

Essays on Insurance Management: Performance Analyses of Riester Pension Schemes and Strategic Claims Management

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St. Gallen, May 19, 2014

The President:

Prof. Dr. Thomas Bieger

To my dear parents/ Meinen lieben Eltern
Martina & Hans-Joachim

To my beloved girlfriend/ Meiner geliebten Freundin
Friederike

Outline

| | | |
|------------|--------------------------------------------------------------------------------------------------------|------------|
| I | A Performance Analysis of Riester Pension Schemes | 1 |
| II | Performances of Riester Products from Customers' Perspectives | 41 |
| III | Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey | 85 |
| IV | Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark | 127 |
| | Curriculum Vitae | 180 |

Contents

| | |
|----------------------------------------------------------------------------------|------------|
| Contents | ii |
| List of Figures | vi |
| List of Tables | vii |
| Introduction | x |
| Einführung | xv |
| | |
| I A Performance Analysis of Riester Pension Schemes | 1 |
| 1 Introduction | 2 |
| 2 Model framework and products | 6 |
| 2.1 Riester fund product | 9 |
| 2.2 Riester life insurance contract | 13 |
| 2.3 Fund product | 18 |
| 3 Reference setting and analysis of different providers | 20 |
| 3.1 Model parametrization | 22 |
| 3.2 Terminal account values and costs across products and providers | 24 |
| 4 Comparison of performance measures | 30 |
| 5 Summary and conclusion | 32 |
| A Analysis of fund-shifting effects in the Riester fund product | 34 |
| References | 36 |
| | |
| II Performances of Riester Products from Customers' Perspectives | 41 |
| A Introduction | 42 |
| B Prior research | 43 |
| C Model framework with governmental aids | 45 |
| C.1 Model with transfer payments | 46 |
| C.2 Model with tax account | 51 |

| | | |
|------------|---------------------------------------------------------------------------------------------|------------|
| D | Riester and non-Riester products | 54 |
| D.1 | Riester life insurance product | 54 |
| D.1.1 | Cost structure of the Riester life insurance product | 55 |
| D.1.2 | Underlying of the Riester life insurance product | 55 |
| D.1.3 | Customer account of the Riester life insurance product | 56 |
| D.2 | Riester fund product | 57 |
| D.2.1 | Cost structure of the Riester fund product | 57 |
| D.2.2 | Underlying of the Riester fund product | 58 |
| D.2.3 | Customer account of the Riester fund product | 59 |
| D.3 | Non-Riester ETF product | 59 |
| D.3.1 | Cost structure of the non-Riester ETF product | 60 |
| D.3.2 | Underlying of the non-Riester ETF product | 60 |
| D.3.3 | Customer account of the non-Riester ETF product | 61 |
| E | Investor and product parametrization | 61 |
| E.1 | Parametrization of Riester model investors | 62 |
| E.1.1 | Parametrization of Riester and non-Riester products | 64 |
| F | Numerical results | 66 |
| F.1 | Analysis of funding rates | 67 |
| F.2 | Product performance according to Performance Ratios | 69 |
| F.3 | Product performances under internal rates of return (IRR) | 75 |
| G | Conclusion | 78 |
| | References | 82 |
| III | Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey | 85 |
| A | Introduction | 87 |
| B | Three main competing goals in strategic claims management | 89 |
| C | Description of current strategic topics and survey setup | 93 |
| D | Data basis and results | 102 |
| D.1 | Data collection: methodology and data basis | 104 |
| D.2 | The current and future importance of the topics | 105 |
| D.3 | Differences between small and large insurers | 113 |

| | |
|---------------------------------------------------------------------------------------------------------------|----------------|
| D.4 Differences between German and Swiss insurers | 116 |
| E Conclusion | 118 |
| References | 120 |
| IV Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark | 127 |
| A Introduction | 129 |
| B A standard claims management model and literature review | 131 |
| B.1 Core process stages | 132 |
| B.2 Claim complexities | 136 |
| B.3 Back office levels | 137 |
| C Workflows in claims management | 139 |
| C.1 Notification of claim | 139 |
| C.2 Registration of claim | 141 |
| C.3 Claim coverage audit | 141 |
| C.4 Settlement of claim | 143 |
| C.5 Closing of claim | 144 |
| D Methodology and description of questionnaire | 144 |
| D.1 Methodology and survey participants | 144 |
| D.2 Description of the questionnaire | 146 |
| D.2.1 Company data | 147 |
| D.2.2 Process quantities and times | 147 |
| D.2.3 General topics | 151 |
| E Results and discussion | 154 |
| E.1 Industry benchmark: descriptive statistics of the survey results | 154 |
| E.1.1 Characteristics of the data panel | 155 |
| E.1.2 Process quantities and times | 158 |
| E.1.3 Organization setup | 161 |
| E.1.4 Human resources | 162 |
| E.1.5 Process strategies | 164 |
| E.2 Discussion of results and management implications . . . | 167 |
| E.2.1 Segmentation of claims | 168 |

| | | |
|----------|-------------------------------------------------------------------------------|----------------|
| E.2.2 | Influence of auditor engagement on claims cycle times | 170 |
| E.2.3 | Influence of claim adjustment allowances on the occurrence of fraud | 172 |
| E.2.4 | Influence of cycle times on the occurrence of fraud | 173 |
| E.2.5 | Cycle times and lump sum adjustment | 174 |
| F | Conclusion | 176 |
| | References | 178 |
| | Curriculum Vitae | 180 |

List of Figures

A Performance Analysis of Riester Pension Schemes

- | | | |
|---|---------------------------------------------------------------------------------|----|
| 1 | Illustration of contract parameters and cash flows | 8 |
| 2 | Illustration of policyholder account values and product guarantees | 29 |

Performances of Riester Products from Customers' Perspectives

- | | | |
|---|---------------------------------------------------------------------------|----|
| 3 | Model framework for the development of policyholder accounts | 47 |
| 4 | Illustration of policyholder account developments | 48 |
| 5 | Model framework of the customer tax account | 53 |

Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey

- | | | |
|---|----------------------------------------------------------------------------------------------------------------------|-----|
| 6 | Triangular representation of the competing strategic goals in insurance claims management. | 90 |
| 7 | Illustration of survey responses in bar charts | 106 |
| 8 | Illustration of the participants' rating of the current and future impact of the 13 topics in quadrants | 108 |
| 9 | Detailed illustration of the participants' rating differ- ences for the 13 topics | 109 |

Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark

- | | | |
|----|---------------------------------------------------------------------------------------------|-----|
| 10 | Outline of the standard claims management process model with its core elements | 133 |
| 11 | The standard claims management process model with detailed work flows | 140 |
| 12 | Illustration of the measurement of process times and quantities | 148 |
| 13 | Illustration of claims cases distributions | 169 |
| 14 | Claims cycle times and insurance fraud | 174 |

List of Tables

A Performance Analysis of Riester Pension Schemes

| | | |
|----|-----------------------------------------------------------------------------------------------------------------------|----|
| 1 | Categories and calculation of costs in the Riester fund product (A). | 11 |
| 2 | Value of the policy holder account for the Riester fund product in case (1) | 12 |
| 3 | Value of the policy holder account for the Riester fund product in case (2) | 13 |
| 4 | Value of the policy holder account for the Riester fund product in case (3) | 14 |
| 5 | Categories and calculation of costs in the Riester life insurance product (B). | 15 |
| 6 | Value of the policy holder account for the Riester life insurance product in case (1) | 16 |
| 7 | Value of the policy holder account for the Riester life insurance product in case (2) | 17 |
| 8 | Value of the policy holder account for the Riester life insurance product in case (3) | 17 |
| 9 | Categories and calculation of costs in the fund product (C). | 19 |
| 10 | Value of the policy holder account for the fund product in case (1) | 20 |
| 11 | Value of the policy holder account for the fund product in case (2) | 21 |
| 12 | Parametrization of performances and costs for the Riester and non-Riester products | 38 |
| 13 | Results for terminal values of policyholder accounts and cost ratios | 39 |
| 14 | Descriptive statistics of policyholder account values at maturity | 39 |
| 15 | Descriptive statistics of policyholder account values and performance measures for all investment scenarios | 40 |
| 16 | Terminal account values for different fund-shifts | 40 |

Performances of Riester Products from Customers' Perspectives

| | | |
|----|------------------------------------------------------------------|----|
| 17 | Governmental children and individual transfer payments | 49 |
|----|------------------------------------------------------------------|----|

| | | |
|----|----------------------------------------------------------------------------------------|----|
| 18 | Definition of costs in the Riester life insurance product (RL) | 55 |
| 19 | Policyholder account calculation for the Riester life insurance product (RL) | 57 |
| 20 | Definition of costs in the Riester fund product (RF) . . . | 58 |
| 21 | Policyholder account calculation for the Riester fund product (RF) | 59 |
| 22 | Definition of costs in the ETF product (ETF) | 60 |
| 23 | Policyholder account calculation for the ETF product (ETF) | 61 |
| 24 | Composition of the Microcensus sample | 64 |
| 25 | Cost and performance parameters for Riester and non-Riester products | 65 |
| 26 | Funding rates for the Microcensus sample | 69 |
| 27 | Results for performance ratio one | 71 |
| 28 | Results for performance ratio two | 73 |
| 29 | Results for performance ratio three | 74 |
| 30 | Results for IRR one | 76 |
| 31 | Results for IRR two | 77 |
| 32 | Results for IRR three | 78 |
| 33 | Summary of Riester investment prerequisites | 81 |
| 34 | Details to German income tax calculation | 81 |
| 35 | Detailed results for performance ratios one, two and three | 82 |

Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey

| | | |
|----|---------------------------------------------------------------------------------------------|-----|
| 36 | Summary of 13 topics in claims management | 103 |
| 37 | Categorization of participating insurers in the survey . . . | 105 |
| 38 | Detailed statistical results for all survey participants . . . | 110 |
| 39 | Summary of results for the three strategic dimensions . . | 111 |
| 40 | Detailed statistical results for small and large insurance companies | 115 |
| 41 | Detailed statistical results for insurance companies from Germany and Switzerland | 117 |

Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark

| | | |
|----|--------------------------------------------------------------|-----|
| 42 | Categorization of participating insurers in the survey . . . | 146 |
|----|--------------------------------------------------------------|-----|

| | | |
|----|---------------------------------------------------------------------------|-----|
| 43 | Excerpt from the questionnaire: Core company data . . . | 148 |
| 44 | Excerpt from the questionnaire: Process quantities and times | 149 |
| 45 | Excerpt from the questionnaire: Organization setup . . . | 152 |
| 46 | Excerpt from the questionnaire: Personnel quantities . . . | 153 |
| 47 | Excerpt from the questionnaire: Process strategies | 155 |
| 48 | Characteristics of the data panel | 156 |
| 49 | Results for process benchmarks of quantities and times . . | 159 |
| 50 | Results for benchmarks of organization setups | 163 |
| 51 | Results for benchmarks of personnel efficiencies | 164 |
| 52 | Results for benchmarks of process strategies | 165 |
| 53 | Analysis of auditor impact on claims cycle times | 170 |
| 54 | Analysis of fraud levels and settlement modes | 172 |
| 55 | Cycle times and lump sum allowances | 175 |

Introduction

The Riester pension scheme is heavily discussed within the insurance industry since its introduction in 2002 in the German market. Consumerists on the one hand side and insurers and their lobby groups on the other hand side discuss the topic with an increasing bias. These discussions result in a continuously diminishing trust of consumers towards Riester products. Argumentations with regard to this, consider high product costs and low returns as the main reasons. Investments in Riester products are governmentally supported with direct transfer payments and tax advantages. The amount of governmental transfer payments depends on the family situation of the investor. Two out of four research works of my dissertation cover the Riester pension scheme. Both works target to analyze the product cost structure and performance with regard to a macroeconomic point of view (without governmental investment incentives) and from customers' perspective (with governmental investment incentives). For this purpose, the works are built on a stochastic model framework, to simulate of customers' product accounts.

The first paper with the title "A Performance Analysis of Riester Pension Schemes" compares two Riester products (Riester life insurance and Riester fund product) and a non-Riester product with regard to product performances and cost structures. Since the work aims to make analysis from a macroeconomic point of view, governmental transfer payments and tax advantages are not included in the model framework. The

numerical product simulations are executed for the saving period of a model investor on basis of the stochastic asset development model. Our model contains all relevant Riester and non-Riester product cost and performance parameters. Input parameters are calibrated along market data for the respective Riester and non-Riester products. The analysis shows that especially cost ratios for Riester products are often on a high level, compared to non-Riester products. Furthermore, Riester fund products are bearing a significantly higher performance volatility than Riester life insurance products.

In the second work, named “Performances of Riester Products from Customers’ Perspectives” the perspective of analysis is shifted to individual investors. Therefore, the paper targets to evaluate potential benefits of a Riester investment from customers’ perspectives. For this purpose, the model includes the German population according to the Microcensus of 2009 and considers all investors that are eligible to Riester investments. Simulations are based on the model from the first work, which is extended by the pension period to calculate tax effects and effects from governmental transfer payments. Various key performance measures are introduced to compare the results with regard to different investors and product types. We come to the result that governmental transfer payments and not the Riester product performance decide, whether a Riester investment is beneficial for an investor.

The second part of my dissertation discusses claims management of insurance companies in Germany and Switzerland. The relevance of claims management for insurance companies has significantly increased over the recent past due to a soaring competition among property and liability insurers. This competition results in a tremendous pressure to reduce overall operating costs. Since claims costs account for around 65% of all operating costs in insurance companies, the claims management units are naturally one of the starting points for cost reductions. Although it is indisputable that the topic is highly relevant, there is only little academic research that covers claims management. In this context, empirical work is most difficult to find. Both papers of my dissertation are thus aiming to identify success factors in insurance companies' claims management on basis of extensive qualitative and quantitative empirical data.

The first work with regard to claims management is called "Evolution of Strategic Levers in Insurance Claims Management: an Industry Survey". It discusses goals and success factors, based on a standard claims management model framework. This claims triangular framework has often been utilized for such purpose, both from practitioners and academics. The three core elements of the framework are claims administration costs, customer satisfaction and claims volume. Due to diverse interests of customers and insurers, target conflicts can arise along the three dimensions. Causes and interdependencies of these conflicts are

discussed in the paper. The second part of the work compares empirical assessments of 21 insurers companies from Germany and Switzerland with regard to current and future relevance of topics in insurers' claims management. This study compares current and future relevance of key topics and points out differences between small and large insurers and companies from Germany and Switzerland. We see that German and Swiss as well as small and large insurers come to different assessments towards relevant topics.

In the second paper, "Efficiency in Claims Management of Non-Life Insurers: Standardized Process Landscape and Benchmarks" a standardized claims management process model for property and liability insurers is developed. On basis of this model, an extensive benchmarking among 11 property and liability insurers from Germany and Switzerland is conducted. The work targets to make generally admitted conclusions with regard to working patterns in claims management. For this purpose, the benchmarking focuses on claims' process cycle times, claims quantities and claims volumes as well as comprehensive topics like personnel quantities, regulation allowances and organizational design. To the best of our knowledge, this study is the first of this kind for the German and Swiss insurance industry. In addition to the descriptive benchmarking, statistical methods are applied to identify success factors in claims management.

Einführung

Das Riester Pensionsmodell gehört seit seiner Einführung in Deutschland im Jahr 2002 zu den sehr kontrovers diskutierten Produkten in der Versicherungsindustrie. Hierbei interagieren insbesondere Verbraucherschützer und Kunden auf der einen Seite sowie Versicherer und deren Interessenverbände auf der anderen Seite mit zunehmender Vehemenz. Diese Diskussionen haben dazu geführt, dass Riester-Produkte in der breiten Öffentlichkeit der deutschen Bevölkerung mittlerweile als wenig attraktiv wahrgenommen werden. Als Argumente hierfür werden überwiegend hohe Produktkosten sowie niedrige Renditen in den jeweiligen Produkten angeführt. Generell werden Investitionen in Riesterprodukte in grossem Umfang durch direkte staatliche Zulagen sowie Steuervorteile unterstützt. Diese staatlichen Subventionierungen hängen insbesondere von der familiären Situation des Investors ab. In meiner Dissertation befassen sich zwei der vier Veröffentlichungen mit dem Riester Pensionsmodell. Hierbei werden sowohl Kosten- als auch Renditebetrachtungen zum einen auf Produktebene (ohne Einbezug von staatlichen Förderungen) und zum anderen aus Kundensicht (unter Einbezug von staatlichen Förderungen) analysiert. In beiden Arbeiten wird hierfür ein stochastischer Modellrahmen zur Simulation von Kundenkonten verwendet.

In der ersten Arbeit mit dem Titel “A Performance Analysis of Riester Pension Schemes” werden zwei Varianten von Riesterprodukten (Rie-

ster Lebensversicherung und Riester Fondsprodukt) mit einem Nicht-Riesterprodukt hinsichtlich Kosten und Renditen verglichen. Ziel der Arbeit ist es, die Vorteile von Riesterprodukten aus makroökonomischer Sicht zu beurteilen, d.h. ohne Berücksichtigung von individuellen staatlichen Zulagen sowie Steuervorteilen für Investoren. Hierzu wird die Ansparphase eines exemplarischen Investors mit einem stochastischen Modell simuliert, welches alle relevanten Kosten- und Renditeparameter enthält. Zur konkreten Berechnung von Kostenquoten und Renditen wird das Modell mit Marktzahlen von Anbietern aus Deutschland kalibriert. Im Ergebnis zeigt sich, dass Riesterprodukte teilweise sehr hohe Kostenquoten haben, was insbesondere im Vergleich zum Nicht-Riesterprodukt deutlich wird. Darüber hinaus wird ersichtlich, dass Riester Fondsprodukte eine massiv höhere Volatilität als klassische Riester Lebensversicherungsprodukte haben.

In der zweiten Arbeit “Performances of Riester Products from Customers’ Perspectives” wird die Betrachtungsebene auf die von individuellen Investoren verlagert. Ziel ist es, die Vorteilhaftigkeit von Riesterprodukten aus direkter Investorensicht zu beurteilen. Es werden Investorengruppen auf Basis des Deutschen Mikrozensus von 2009 gebildet, wodurch die gesamte deutsche Bevölkerung als potenzielle Riesterinvestoren im Modell betrachtet wird. Hierzu wird das Modell aus der ersten Arbeit um die Rentenphase erweitert und individuelle staatliche Zulagen sowie Steuervorteile für Investoren werden berücksichtigt. Zur Ergebnisanaly-

se werden unterschiedliche Performance-Kennziffern definiert. Es zeigt sich hierbei, dass die staatlichen Zulagen der wesentliche Treiber für die Vorteilhaftigkeit von Riesterprodukten aus Investorensicht sind.

Der zweite Themenblock meiner Dissertation befasst sich mit dem Schadenmanagement von Versicherungsunternehmen in Deutschland und der Schweiz. Die Bedeutung des Schadenmanagements hat in den vergangenen Jahren einen deutlichen Zuwachs erfahren, da Schadenversicherer aufgrund der sich verschärfenden Wettbewerbssituation unter enormen Kostensenkungsdruck geraten. Der Schadenbereich von Versicherern bildet hierbei natürlicherweise einen wesentlichen Ansatzpunkt, da Schadenkosten etwa 65% aller Ausgaben von Schadenversicherern ausmachen. Trotz der hohen Relevanz des Themenfeldes für die Unternehmen gibt es aktuell nur einen sehr begrenzten Umfang an wissenschaftlichen Arbeiten zum Schadenmanagement. Insbesondere Ausführungen auf Grundlage von empirischen Untersuchungen sind kaum vertreten. Die beiden abschliessenden Arbeiten meiner Dissertation haben daher das Ziel, auf Grundlage einer umfangreichen qualitativen und quantitativen Umfrage unter Versicherern den Status-Quo sowie Ausblicke im Schadenmanagement zu diskutieren.

Die erste Arbeit zum Schadenmanagement “Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey” diskutiert Ziele und Erfolgsfaktoren im Schadenmanagement anhand eines

Standardmodells. Das Modell setzt auf dem schon häufig in der Praxis und Literatur verwendeten Schadendreieck mit den Dimensionen Verwaltungskosten, Kundenzufriedenheit und Schadenaufwand auf. Aufgrund unterschiedlicher Interessen von Kunden und Versicherern kommt es häufig zu Zielkonflikten innerhalb dieses Konstrukts. Deren Ursachen und Wechselwirkungen werden in der Arbeit diskutiert. Im zweiten Teil der Arbeit werden 21 Versicherer aus Deutschland und der Schweiz zu relevanten Themen entlang der Dimensionen Verwaltungskosten, Kundenzufriedenheit und Schadenaufwand im Hinblick auf deren aktueller und zukünftiger Bedeutung befragt. Diese Befragung erlaubt neben dem konsolidierten Vergleich von aktueller und zukünftiger Bedeutung der Themen auch die Erörterung von Unterschieden zwischen kleinen und grossen Versicherern sowie Unternehmen aus Deutschland und der Schweiz. Im Ergebnis identifizieren wir Themengebiete mit zunehmender Bedeutung im Schadenmanagement. Darüber hinaus stellen wir fest, dass kleine und grosse sowie deutsche und schweizer Versicherer unterschiedliche Themenschwerpunkte im Schadenbereich sehen.

In der zweiten Arbeit zum Schadenmanagement mit dem Titel “Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark” wird ein Standard Prozessmodell für Schadenversicherer entwickelt und auf dessen Grundlage ein umfangreiches Benchmarking unter 11 Schadenversicherern aus Deutschland und der Schweiz durchgeführt. Ziel der Arbeit ist es, Aussagen über die Ar-

beitsweisen von Versicherern im Hinblick auf die zentralen Schadenprozesse abzuleiten. Im Rahmen des Benchmarkings werden hierfür neben Prozesszeiten, Schadenmengen und -höhen auch übergeordnete Themen wie zum Beispiel Personalmengen, Regulierungsvollmachten und Organisationseinheiten betrachtet. Nach unseren Informationen ist dies das erste Benchmarking dieser Art, welches für den deutschsprachigen Versicherungsmarkt durchgeführt wird. Neben dem Benchmarking werden in der Arbeit durch statistische Methoden zentrale Zusammenhänge untersucht, die zu einem erfolgreichen Schadenmanagement führen.

Part I

A Performance Analysis of Riester Pension Schemes

Abstract

The offering of the German Riester pension scheme has great implications on the development of the pension system in Germany. Since their introduction in 2002, Riester pension products have been strongly subsidized by the government. Recent political and public discussions hover around the question whether the Riester pension scheme is the right system to be subsidized. The major points of criticism include high product costs, a lack of transparency of the out payments and customer lock-in-effects. In order to contribute to the quality assessment of the Riester pension schemes, we compare the performance of Riester life insurance contracts and Riester fund contracts with an alternative non-Riester fund investment. Evaluating the development of the policyholder account for the saving periods of the respective products through numerical simulations, we compare the distributions of the policyholder account terminal values. The special focus of our analysis lies on the product performance and the cost structure. The resulting payoff distributions are assessed through financial performance measures. Our findings add quantitative arguments to the discussion whether the German Government supports the right product category within the Riester pension scheme.¹

¹N. Mahlow, H. Schmeiser, and J. Wagner. A Performance Analysis of Riester Pension Schemes. *Working Papers on Risk Management and Insurance*, 2013. This paper has been presented at the Jahrestagung des Deutschen Vereins für Versicherungswissenschaft in March 2013 and at the Annual Meeting of the American Risk and Insurance Association in August 2013.

1 Introduction

The Riester pension scheme was introduced in Germany in 2002. It is subsidized by the German Government by providing tax benefits and direct investment grants to investors of Riester products. The scheme allows to invest in several product categories, while Riester life insurance products and Riester fund products dominate the market. In 2011, life insurance contracts had a market share of 72% followed by Riester fund products with a market share of 19% and other products (including, for example, bank savings plans) with a combined market share of about 9%. The intention of the German Government through the Riester pension scheme was to introduce a system that raises the savings propensity of individuals. However, over the past years intense discussions were held around the question whether the products that are offered within the Riester pension scheme are adequately constructed. Discussions mainly involved the insurance and fund industry on the one side and consumerists on the other. Low performance, high costs, lack of transparency and inflexibility of the products are the core points of criticism in the news press. The rising relative importance of the topic is illustrated by its presence in news articles. In 2010, word counts for Riester in the German news press revealed about 2 700 hits, whereas in 2011 word counts have risen to 3 600.

The target of this paper is to contribute to the discussion whether Riester products are competitive to other investments. We therefore compare the two most important Riester products with a substitute non-Riester product. Our analysis compares the performance and cost structures of the considered products with focus on the saving period. Thus, we do not consider lock-in effects for the pension period, which is a binding contract with the provider chosen during the saving period defining the conditions for the annuities at retirement.² In the following, we will focus on the value of the final policyholder account before the beginning of the pension period. In our model, tax benefits and govern-

²In fact, currently no relevant number of experience cases concerning the pension period are available. Furthermore, if lock-in effects that are adverse for the customers arise, regulatory measures like allowing to switch to other providers should be installed. Thus, we do not include such effects in our analysis.

mental investment grants are not included since the evaluation of the performance of Riester products is in our focus, and this is independent from governmental investment incentives (tax relief and subsidization). Thus, after taxes and investment grants, Riester products, which in our analysis may not be competitive to substitute products, may turn out to be beneficial to individual investors. However, in such cases, customers and providers are both subsidized.

In the following, we summarize the public discussions and the academic contributions on the topic of Riester pension schemes found in the literature. Several scholars and interest groups have made contributions to this theme over the time period from the inception of the Riester pension scheme in 2002 until today. These publications can be separated into two main categories. Publications in the first category concentrate on the question whether the Riester pension scheme is beneficial to individual investors. Publications in the second category look at the Riester pension scheme from a macroeconomic perspective.

Kleinlein (2011) and Hagen, Kleinlein, Geyer, and Wagner (2011) analyze if the Riester pension scheme is beneficial to the individual investor or not. Herefore, Kleinlein uses different concepts to evaluate Riester insurance products including annuity factors and internal rate of returns for the saving as well as the pension period. He also compares his results for the years 2002 and 2011 to point out the effects of changes in the Riester pension scheme that were executed within this time period. Kleinlein concludes that changes made to the Riester scheme from 2001 to 2011 had a negative impact on the product performance for individual investors. The question whether the Riester pension scheme has an impact on the individual investors propensity to save is answered in the paper from Corneo, Keese, and Schröder (2007). The authors find that there is no positive correlation between the governmental Riester surplus quote and the individuals propensity to save. Hence the authors state that the Riester scheme fails in one of its primary targets, namely, to motivate individuals, especially with low incomes, to make contributions to their pension plans with Riester products. Furthermore, Feigl, Jarozsek, Leinert, Tiffe, and Westerheide (2010) look at the transparency of Riester products. Besides a theoretical approach to this question the

authors conduct a study among 238 experts from the financial industry. Theoretical results as well as results from the expert survey indicate that Riester products are widely seen as too intransparent for individual investors. Oehler and Kohlert (2009) look at the threats that could result from the Riester pension scheme in the future. They see the biggest weakness as being the intransparency of Riester products. The authors suggest to introduce more extensive product rules for cost limits and performance comparability mechanisms. Kling, Russ, and Schmeiser (2006) look at governmentally subsidized insurance products (with money-back guarantees) and analyze the value that paid-up options within these products have for individual investors. Riester products also fall in this category of products and contain both characteristics. Paid-up options allow investors to stop premium payments at any time during the saving period while not canceling the contract. The authors find evidence, that the paid-up option significantly increases the value of the money-back guarantee.

In their study, Coppola and Reil-Held (2009) look at the acceptance of Riester products among the German population for the time period from 2003 to 2008. They find indicators that for medium to high income households the Riester market is nearly saturated in 2008. For low income households the opposite is true. For these households, the authors still find a high level of dynamics towards investing in Riester products. By looking at the factors that determine if an individual investor buys a Riester product, Lamping and Tepe (2009) go a step further. The authors see that the primary determinants are age and income which reflect the pure ability to invest in Riester products. Besides this, they quantify the influence of an individual investor's perception of the publicly financed pension system and risk of becoming unemployed on the decision of buying Riester products. In his study, Schröder (2011) summarizes the research on Riester products that had been done so far. He looks at the establishment of Riester products, windfall gains and the distribution of returns that result from Riester products.

In their most recent analysis of the Riester Pension scheme, Börsch-Supan, Coppola, and Reil-Held (2012) focus on the development dynamics of the Riester scheme and the acceptance within the population.

Their study is based on publicly available data and comes to the results that especially after the simplification of the Riester scheme, a significant increase in investor acceptance has been found. Besides this, another main finding is that only around 25% of low-income households have Riester contracts while these households can benefit most from governmental transfer payments. In earlier research, Börsch-Supan and Gasche (2010) look at the introduction of the Riester pension scheme from a macroeconomic point of view. They find that the Riester pension scheme is a good extension of the German pension scheme. The authors do not, however, evaluate the performance of Riester products. Moreover, Börsch-Supan and Gasche evaluate the contribution of the Riester pension scheme to the shift towards a more privately financed pension system in Germany. Schmähl, Himmelreicher, and Viebrock (2004) are investigating how the development of the German pension system with its publicly and privately funded pension systems can be improved. Among other findings the authors come to the conclusion that it is necessary to support lower income households in order to achieve a higher propensity to save and invest in privately funded pension products. The study also points out that the high level of lack of transparency of pension products discourages people from investments. Gründl, Nietert, and Schmeiser (2004) add to the discussion that for Riester fund products, product issuers may not be able to fulfill the governmentally required point-to-point investment guarantee. The authors come to see the core issue in that the German regulatory authorities do not make statements on how the increased equity-level has to be financed.

Our paper provides information to the question of whether the German Government supports the right product category within the Riester pension scheme. Our analysis makes contributions on how and to what extent the cost structure, profit participation and individual investment horizons have an impact on the product performance in terms of the terminal payoff to the policyholders. We consider Riester and non-Riester savings products and use market values for the cost structures and the underlying funds. For each of the products, and using a weighting of cases of continuing investment as well as surrender and mortality, we numerically simulate the terminal payoff distribution from the policyholder

account. Thereby, the cumulated value of product costs until maturity is considered in detail. Different approaches are used to assess the considered products. To start with, descriptive statistics help to derive the payoff distribution. Then, performance measures are used to evaluate the policyholder account financially.

The remainder of this paper is organized as follows: In Section 2 our paper starts with an introduction of the different products and the model framework which are described in detail. Section 3 sets the parametrization of the model and the market values characterizing the different products (Sect. 3.1). Then an analysis of the average payoff and costs is given for all products in the case of continuing investment in the products until maturity (Sect. 3.2). In Section 4 we introduce the weighted payoff distribution using surrender and mortality probabilities and assess the results using financial performance measures. Section 5 summarizes the main findings and provides the conclusion.

2 Model framework and products

In the following section, we introduce the general model framework used for the comparative product analysis. Three different products are compared to each other in the model. We consider (A) Riester fund products, see Section 2.1, (B) Riester life insurance products, see Section 2.2, and (C) non-Riester fund products, see Section 2.3. In each product the cost structure, the underlying investment and its historical performance is taken into account to model the evolution of the value of the policyholder account. Thus, our model setup builds upon the three core elements which are the costs, the underlying investment and the value of the policyholder account. Before introducing the model, we set several basic assumptions which apply throughout the model: firstly, investors do not use the paid-up option, which means that premium payments are constantly fulfilled throughout the saving period. Secondly, all guarantees that are granted from product issuers to individual investors can be fulfilled at all times. Thus, the model assumes that there is no default risk for the seller associated with the investment in Riester products. Finally, our model framework only considers the saving period and the

terminal values of the policyholder account at the time of conversion of the accumulated savings into pension payments. This gives accurate results for the practice when no lock-in at a chosen provider for the pension period occurs or when all market players offer fair annuities.

Figure 4 illustrates the model parameters and cash flows which apply during the saving period of a contract from inception in $t = 0$ until maturity in T . For each time period, two points in time are relevant for the model simulation. The beginning of each period is marked by $(+)$ and the end of each period is marked with $(-)$. Thus the t^{th} period, for $t = 1, \dots, T$, starts with $(t - 1)^+$ and ends with t^- . Referring to Figure 1, we introduce time periods from 1 to maturity T . Maturity is defined as the point in time where the contract is transferred into the payout period. Times before that refer to the saving period. Although, in the case of the non-Riester fund products, the concept of maturity is of lower importance since, in practice, contracts can be paid out at any time, we use the term *cancellation before maturity* to be consistent with the terminology in the Riester products. Taking costs and the respective underlying into account, the development of the policyholder account starts at the beginning of period 1, in $t = 0^+$. At this time, the investor makes the initial annual premium payment P , which is from then on paid annually at a fixed amount. In each of the following time periods, cost deductions and endowments are considered. These endowments depend on the type of product. In Figure 4, the case of the non-Riester product (C) is illustrated using the annual return of the investment (A_t/A_{t-1}) as endowment. The corresponding endowment for each product is defined in detail in the following sections (see Tables 2, 6, 10). The final value of the policyholder account in T is represented by P_T .

In the following, we introduce our consideration of costs and of the underlying investment. In our model, costs are considered at the beginning of each time period after the payment of the annual premium. The sum of costs in each time period t is denoted by $\sum K_{t-1}$, $t = 1, \dots, T$, where the sum runs over all cost categories for the respective product. The considered types of costs, depending on the product and case, include issuance, administration, acquisition, depot, surrender and mortality costs (see for example Table 1 illustrating the cost categories in the

| Time | 0 + | Period 1 | - 1 + | Period t | - t + | Period T | - T |
|------------------------------------|-------------|---------------------------------|-------------|-----------------------------------------|-------------|-----------------------------------------|-------|
| Initial policy account | 0 | | | | | | |
| Premium payments | $+P$ | | $+P$ | | $+P$ | | |
| Sum of costs deducted | $-\sum K_0$ | | $-\sum K_1$ | | $-\sum K_t$ | | |
| Policy account beginning of period | P_{0+} | | P_{1+} | | P_{t+} | | |
| Endowment (e.g., fund product) | | $+P_{0+} \cdot \frac{A_1}{A_0}$ | | $+P_{(t-1)+} \cdot \frac{A_t}{A_{t-1}}$ | | $+P_{(T-1)+} \cdot \frac{A_T}{A_{T-1}}$ | |
| Policy account end of period | | P_{1-} | | P_{t-} | | P_{T-} | |
| Final account (end of contract) | | | | | | | P_T |

Figure 1: Illustration of the contract parameters (premiums, costs, endowments and policyholder account values) and the cash flows during the saving period along the contract timeline from inception in $t = 0$ until maturity T .

different cases for product A). In each category, costs are calculated as a relative value depending on the premium payments or the policyholder account or as an absolute (fixed) value along current industry practice. For example, issuance costs are mainly charged for the distribution of the product by the issuer. The larger part, typically 80% to 95%, of these costs are credited to the distributor of the product. Issuance costs are considered differently for all three products and range from annual charges to upfront costs which are allocated to the policyholder account over a specific time period (see, e.g., product B). Administration costs are charged for the management of the policyholder account which includes the asset management and the administration of the contract (for the insurance product A or B). Acquisition costs incur whenever annual premiums are paid (products A and B). Costs that fall in one of the prior categories are charged as relative amounts on the policyholder account or on annual premium payments. As the fourth cost category, depot fees are typically yearly charged in fund products (products A and C) as a fixed absolute value. Surrender and mortality costs incur only in the year when the contract is canceled or stopped prematurely. After the time of contract surrender or mortality, no further costs apply. The order in which costs are considered in the model and which cost basis is used for the individual cost category is described in the following sec-

tions. Tables 1, 5 and 9 inform on the cost categories and the calculation of the costs in the three products considered.

In our model framework, the underlying investment and the development of the assets is the only source of stochasticity in each product. The endowment from asset returns to the policyholder account is done at the end of each period. Annual endowments for the three products are derived from the development of the investment. For the development of the underlying investment, the model parametrization uses market values, which we introduce in Section 3, see Table 12. The products differ in their underlying investment and the time and way the annual endowments are defined. Depending on the product, the guarantees that apply are different. The Riester fund product (A) contains an option which guarantees a return (before costs) of 0% at maturity (point-to-point guarantee) that corresponds to a nominal capital conservation guarantee. Product (B) guarantees a minimum return of r^g (before costs) on an annual basis (cliquet-style guarantee). In excess to this guarantee, investors are entitled to non-fixed profit participations. That guarantee and endowment mechanism is comparable to the one in traditional endowment contracts (i.e., participating life insurance policies). In the non-Riester fund product (C), the annual endowments, expressed through returns that can be positive or negative, depend on the actual performance of the underlying asset.

In the following, we detail the introduced products with special regard to the costs structure and the underlying investment. Furthermore, we define three cases for the contract evolution in each product. In the first case (1) the investor is assumed to hold the contract until maturity. In the second and third cases we consider an investor who cancels the policy early (case 2) or dies before contract maturity (case 3).

2.1 Riester fund product

We consider a Riester fund contract (product A) with annual payments P , which are invested in selected funds. An interest rate of 0% on the premiums paid (money-back guarantee) before the costs are charged is guaranteed to the individual investor. Differing from the yearly interest

rate guarantee in the Riester insurance product (see Section 2.2), this guarantee does only apply for contracts held until maturity T . Contracts terminated before are paid out to the value of the policyholder account less cancellation costs. During the saving period, most issuers of Riester fund products gradually reduce the investor's exposure to volatile investments and shift to more secure investments.

Cost structure

Specific costs arise during contract duration or at termination depending on the different contract development cases (1) to (3). In the continuing investment case (1), issuance, acquisition, depot and administration costs are charged. These costs are deducted from the policyholder account on an annual basis. Issuance $K_t^{(A1),\text{iss}}$ and acquisition $K_t^{(A1),\text{acq}}$ costs are calculated as a percentage $k_t^{(A1),\text{iss}}$, $k_t^{(A1),\text{acq}}$ of the annual premium payments P . Depot fees $K_t^{(A1),\text{dep}}$ are deducted in absolute values (independent of the amount of premium P). After the deduction of issuance, acquisition and depot fees from the policyholder account, administration costs $K_t^{(A1),\text{adm}}$ are calculated on the basis of the remaining value of the policyholder account $P_{t-}^{(A1)} + P - K_t^{(A1),\text{iss}} - K_t^{(A1),\text{acq}} - K_t^{(A1),\text{dep}}$. In the surrender (2) and mortality (3) cases further costs apply. These costs incur only at the time $t = t^*$ or $t = t^{**}$ in which the contract is canceled. These costs are typically deducted from the policyholder account as absolute values. The different cost categories for the Riester fund product are summarized in Table 1.

Underlying investment

The evolution of the policyholder account strongly depends on the performance of the fund in which the premium payments are invested. The calculation of the annual endowments to the policyholder account is linked to the development of the underlying investment. The underlying assets typically represent a fund composed of different stocks. Let $A_0^{(A)}$ denote the initial value of the underlying assets. We assume the asset development process to follow a geometric Brownian motion (GBM). Thus,

| Case | Category | Cost calculation | Times |
|------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1 | issuance | $K_t^{(A1),iss} = k_t^{(A1),iss} \cdot P$ | $t = 0, 1, \dots, T - 1$ |
| | acquis. | $K_t^{(A1),acq} = k_t^{(A1),acq} \cdot P$ | $t = 0, 1, \dots, T - 1$ |
| | depot | $K_t^{(A1),dep} = k_t^{(A1),dep}$ | $t = 0, 1, \dots, T - 1$ |
| | admin. | $K_t^{(A1),adm} = \begin{cases} k_t^{(A1),adm} \cdot (P - K_t^{(A1),iss} - K_t^{(A1),acq} - K_t^{(A1),dep}) & t = 0 \\ k_t^{(A1),adm} \cdot (P_t^- + P - K_t^{(A1),iss} - K_t^{(A1),acq} - K_t^{(A1),dep}) & t = 1, \dots, T - 1 \end{cases}$ | $t = 0$ $t = 1, \dots, T - 1$ |
| 2 | surrender | $K_t^{(A2,t^*),sur} = \begin{cases} k_t^{(A2),sur} & t = t^* \\ 0 & t \neq t^* \end{cases}$ | $t = t^*$ $t \neq t^*$ |
| 3 | mortality | $K_t^{(A3,t^{**}),mor} = \begin{cases} k_t^{(A3),mor} & t = t^{**} \\ 0 & t \neq t^{**} \end{cases}$ | $t = t^{**}$ $t \neq t^{**}$ |

Table 1: Categories and calculation of costs in the Riester fund product (A).

the development of the underlying assets $A_t^{(A)}$ for $t = 1, \dots, T$ is given by

$$A_t^{(A)} = A_{t-1}^{(A)} \cdot \exp[\mu_{\text{GBM}} - \sigma_{\text{GBM}}^2/2 + \sigma_{\text{GBM}}(W_t^{\mathbb{P}} - W_{t-1}^{\mathbb{P}})], \quad (1)$$

where μ_{GBM} and σ_{GBM} represent a given deterministic drift and volatility for the underlying asset and $W_t^{\mathbb{P}}$ denotes a standard Brownian motion. The yearly returns $A_t^{(A)}/A_{t-1}^{(A)}$, $t = 1, \dots, T$, will be used to define the endowments to the policyholder account. Towards the end of the saving period, Riester fund products offer the possibility to shift the investment from one fund to another in order to typically reduce the risk expose. Thus the underlying assets may be changed which will translate in our framework in a different value of the underlying's performance $(\mu_{\text{GBM}}, \sigma_{\text{GBM}})$.

Value of the policyholder account

In the following, the development of the policyholder account $P_t^{(A)}$ for the Riester fund product is described for the time periods from inception $t = 0$ until $t = T$ (see Figure 4 for the definition of the periods). The development of the account value is described for case (1) in which the investor invests in the product until maturity, denoted by $P_t^{(A1)}$, and for cases (2) and (3) in which the investor surrenders the contract in $t = t^*$

or dies before maturity in $t = t^{**}$. The policyholder account is specified by $P_t^{(A2,t^*)}$ and $P_t^{(A3,t^{**})}$ in the last two cases.

Case (1): Contract held until maturity. At the beginning of each time period from $t = 1, \dots, T$ the investor pays the annual premiums P , which are then credited to the policyholder account. For each period, cumulated costs from all categories $\sum K_t^{(A1)}$ are deducted at the beginning of the period from $0^+, \dots, (T-1)^+$ (recall that, e.g., 0^+ denotes the beginning of period 1, see Figure 4). At the end of each period, in times $1^-, \dots, T^-$ the annual asset endowments are credited to the policyholder account. The annual asset endowments are derived from the return of the underlying asset $A_t^{(A)}/A_{t-1}^{(A)}$ from one time period to the next. The model simulates the development of the policyholder account for time periods 1 until T and the Riester fund product guarantees a 0% annual return (before costs) that applies at the end of the investment period $t = T$ (see the “max”-operator in the formula of $P_T^{(A1)}$ in Table 2). As introduced above, the guarantee is a point-to-point option. Thus the option is only exercisable if the investor holds the contract until maturity. Table 2 summarizes the development of the policyholder account.

| Times | Value of policyholder account $P_t^{(A1)}$ |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| $t = 0$ | $P_{0^+}^{(A1)} = P - \sum K_0^{(A1)}$ |
| $t = 1, \dots, T-1$ | $P_{t^-}^{(A1)} = P_{(t-1)^+}^{(A1)} \cdot A_t^{(A)}/A_{t-1}^{(A)}$ $P_{t^+}^{(A1)} = P_{t^-}^{(A1)} + P - \sum K_t^{(A1)}$ |
| $t = T$ | $P_T^{(A1)} = P_{T^-}^{(A1)} = \max \left(P_{(T-1)^+}^{(A1)} \cdot A_T^{(A)}/A_{(T-1)}^{(A)} ; T \cdot P - \sum K_t^{(A1)} \right)$ |

Table 2: Value of the policyholder account $P_t^{(A1)}$ for the Riester fund product (A) in case (1) for times $t = 0, \dots, T$.

Case (2): Contract canceled before maturity. The second case simulates the development of the policyholder account in the case when the investor cancels the contract before maturity at time $t = t^*$. The calculation of the value of the policyholder account is identical to the one in case (1) until t^* . In time $t = (t^*)^-$ the policyholder account is credited with the endowment from the underlying asset $A_{t^*}^{(A)}/A_{t^*-1}^{(A)}$ for the last

time. At the moment of cancellation $t = (t^*)^+$ surrender fees $K_{t^*}^{(A2,t^*),\text{sur}}$ are to be paid. We assume that after cancellation of the contract the investor allocates the full value of his account in assets at a risk free rate r^f for the remaining time until T . Endowments are credited to the policyholder account at the end of each of the remaining periods. Table 3 summarizes the development of the policyholder account for the times t^* until T .

| Times | Value of policyholder account $P_t^{(A2,t^*)}$ |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $t = t^*$ | $P_{(t^*)-}^{(A2,t^*)} = P_{(t^*-1)+}^{(A2,t^*)} \cdot A_{t^*}^{(A)} / A_{t^*-1}^{(A)}$ $P_{(t^*)+}^{(A2,t^*)} = P_{(t^*)-}^{(A2,t^*)} - K_{t^*}^{(A2,t^*),\text{sur}}$ |
| $t = t^* + 1, \dots, T$ | $P_t^{(A2,t^*)} = P_{(t-1)}^{(A2,t^*)} \cdot (1 + r^f)$ |

Table 3: Value of the policyholder account $P_t^{(A2,t^*)}$ for the Riester fund product (A) in case (2) for times $t = t^*, \dots, T$. For previous times $t < t^*$, the account values are given by case (1), see Table 2.

Case (3): Death before contract maturity. In the case where the investor dies in $t = t^{**} < T$ before the maturity of the contract, the Riester fund product policy is terminated prematurely. The calculation mechanisms for case (3) are identical to the previous case (2) where the contract is canceled by the investor. Transaction costs that are charged in case the policyholder dies before maturity $K_{t^{**}}^{(A3,t^{**}),\text{mor}}$ differ from the surrender costs $K_{t^*}^{(A2,t^*),\text{sur}}$ in case (2) regarding the absolute amount that incurs. Furthermore, similarly to case (2) we assume that after contract cancellation, the account value is invested risk free until time T . Table 4 summarizes the development of the policyholder account for the times $t = t^{**}$ until $t = T$.

2.2 Riester life insurance contract

Riester life insurance contracts (product B) differ significantly from Riester fund products in one aspect, namely that the insurance company guarantees a fixed yearly minimum interest rate r^g on the account value

| Times | Value of policyholder account $P_t^{(A3,t^{**})}$ |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $t = t^{**}$ | $P_{(t^{**})-}^{(A3,t^{**})} = P_{(t^{**}-1)+}^{(A3,t^{**})} \cdot A_{t^{**}}^{(A)} / A_{t^{**}-1}^{(A)}$ $P_{(t^{**})+}^{(A3)} = P_{(t^{**})-}^{(A3,t^{**})} - K_{t^{**}}^{(A3,t^{**}),\text{mor}}$ |
| $t = t^{**} + 1, \dots, T$ | $P_t^{(A3,t^{**})} = P_{(t-1)}^{(A3,t^{**})} \cdot (1 + r^f)$ |

Table 4: Value of the policyholder account $P_t^{(A3,t^{**})}$ for the Riester fund product (A) in case (3) for times $t = t^{**}, \dots, T$. For previous times $t < t^{**}$, the account values are given by case (1), see Table 2.

(see below) to the investor at the time of contracting and valid for the whole contract duration. The current maximum value of the minimum guaranteed interest rate allowed by the German government is 1.75%. This rate is the one offered by most life insurers in the market to their customers. In the following, we detail the cost structure, the endowment mechanism used in our model and the subsequent calculation of the policyholder account values.

Cost structure

The costs for the Riester life insurance product are defined for the continuing investment case (1), the surrender case (2) and the mortality case (3). In case (1), issuance costs $K_t^{(B1),\text{iss}}$, acquisition costs $K_t^{(B1),\text{acq}}$ and administration costs $K_t^{(B1),\text{adm}}$ are relevant. The amount of issuance costs that the policyholder has to pay over the contract period is calculated as a percentage $k_t^{(B1),\text{iss}}$ of the cumulated premiums $P \cdot T$ that the policyholder pays into the contract within the saving period (if surrender or death do not take place). The total sum of issuance costs is evenly allocated to the first five years of the saving period (times $t = 0, 1, \dots, 4$). Acquisition costs are calculated as a percentage $k_t^{(B1),\text{acq}}$ of the annual premium payments P and are due in every year of the saving period. Administration costs are calculated as a percentage-value $k_t^{(B1),\text{adm}}$ of the policyholder account in the saving period. To calculate administration costs, issuance and acquisition costs are first deducted from the policyholder account and then administration costs are

calculated on the basis of the remaining value of the policyholder account $P_{t-} + P - K_t^{(B1),\text{iss}} - K_t^{(B1),\text{acq}}$. For cases (2) and (3), surrender $K_t^{(B2,t^*),\text{sur}}$ and mortality costs $K_t^{(B3,t^{**}),\text{mor}}$ are deducted as absolute values. Surrender and mortality costs only apply at the time $t = t^*$ or $t = t^{**}$ when the contract is canceled. Table 5 summarizes the costs for the Riester life insurance contract.

| Case | Category | Cost calculation | | Times |
|------|-------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 1 | Issuance | $K_t^{(B1),\text{iss}}$ | $= \begin{cases} k_t^{(B1),\text{iss}} \cdot 1/5 \cdot P \cdot T \\ 0 \end{cases}$ | $t = 0, 1, \dots, 4$ $t = 5, \dots, T - 1$ |
| | Acquisition | $K_t^{(B1),\text{acq}}$ | $= k_t^{(B1),\text{acq}} \cdot P$ | $t = 0, 1, \dots, T - 1$ |
| | Admin. | $K_t^{(B1),\text{adm}}$ | $= \begin{cases} k_t^{(B1),\text{adm}} \cdot (P - K_t^{(B1),\text{iss}} - K_t^{(B1),\text{acq}}) \\ k_t^{(B1),\text{adm}} \cdot (P_{t-} + P - K_t^{(B1),\text{iss}} - K_t^{(B1),\text{acq}}) \end{cases}$ | $t = 0$ $t = 1, \dots, T - 1$ |
| 2 | Surrender | $K_t^{(B2,t^*),\text{sur}}$ | $= \begin{cases} k_t^{(B2),\text{sur}} \\ 0 \end{cases}$ | $t = t^*$ $t \neq t^*$ |
| 3 | Mortality | $K_t^{(B3,t^{**}),\text{mor}}$ | $= \begin{cases} k_t^{(B3),\text{mor}} \\ 0 \end{cases}$ | $t = t^{**}$ $t \neq t^{**}$ |

Table 5: Categories and calculation of costs in the Riester life insurance product (B).

Underlying investment

The underlying investment of the Riester life insurance product differs from the Riester fund product in that the relevant performance is related to the overall investment of the insurer. Additionally for the calculation of the endowment, a minimum return guarantee r^g applies in every period. In practice, insurance companies derive profits from interest profits, mortality profits and administration profits that are distributed to customers. We assume the surplus profit distribution r_t^p in times $t = 1, \dots, T$ is given by:

$$r_t^p = \mathcal{N}[\mu(r^p), \sigma(r^p)], \quad (2)$$

where \mathcal{N} stands for the normal distribution with mean $\mu(r^p)$ and standard deviation $\sigma(r^p)$. In our application, we will make use of historical values of the surplus distribution, see Table 12, to calibrate the mean value and the volatility. Our model uses the maximum of r_t^p and the

guarantee r^g denoted by $\max(r^g; r_t^p)$ for the development of the policyholder account. Thus $P_t^{(B)}$ earns an interest rate which is the greater of the guaranteed interest rate r^g and the surplus return r_t^p . The annual surplus participation becomes part of the guarantee (so-called cliquet-style guarantee). In case (1), the policyholder account $P_t^{(B1)}$ writes out as $P_{t-}^{(B1)} = P_{(t-1)}^{(B1)} \cdot (1 + \max(r^g; r_t^p))$ for times $t = 1, \dots, T$ (see the following description and Table 6).

Value of the policyholder account

The development of the policyholder account $P_t^{(B)}$ for the insurance product is detailed in the following. The account value reflects the accumulated premiums that the investor has paid into the contract, reduced by the costs that have incurred and increased by the yearly endowment. Three cases corresponding to different scenarios for the contract development are again considered.

Case (1): Contract held until maturity. The model mechanism of the development for the policyholder account of the Riester life insurance product in case (1) is similar to the one for the Riester fund product (A) (compare with Table 2). The core difference with product (A) is the yearly endowment mechanism which is detailed in Table 6 below. The guaranteed interest rate applies on a yearly basis in product (B) for all times $t = 1, \dots, T$, whereas in product (A) a money-back guarantee (before costs) is granted in time T .

| Times | Value of policyholder account $P_t^{(B1)}$ |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------|
| $t = 0$ | $P_{0+}^{(B1)} = P - \sum K_0^{(B1)}$ |
| $t = 1, \dots, T - 1$ | $P_{t-}^{(B1)} = P_{(t-1)}^{(B1)} \cdot (1 + \max(r^g; r_t^p))$ $P_{t+}^{(B1)} = P_{t-}^{(B1)} + P - \sum K_t^{(B1)}$ |
| $t = T$ | $P_T^{(B1)} = P_{T-}^{(B1)} = P_{T-1}^{(B1)} \cdot (1 + \max(r^g; r_T^p)) - \sum K_T^{(B1)}$ |

Table 6: Value of the policyholder account $P_t^{(B1)}$ for the Riester life insurance product (B) in case (1) for times $t = 0, \dots, T$.

Case (2): Contract canceled before maturity. The cancellation case (2) for product (B) simulates the development of the policyholder account

$P_t^{(B2,t^*)}$ of the Riester life insurance contract if the investor cancels the contract in $t = t^*$ before maturity. The model mechanism is identical to the second case in product (A), see Table 3. After the last endowment, cancellation fees $K_{t^*}^{(B2,t^*),\text{sur}}$ apply. The model assumes that, after the cancellation of the contract, the investor reinvests the full amount at a risk free rate r^f until time T . Table 7 summarizes the development of the policyholder account for times t^* through T .

| Times | Value of policyholder account $P_t^{(B2,t^*)}$ |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $t = t^*$ | $P_{(t^*)-}^{(B2,t^*)} = P_{(t^*-1)}^{(B2,t^*)} \cdot (1 + \max(r^g; r_t^p))$ $P_{(t^*)+}^{(B2,t^*)} = P_{(t^*)-}^{(B2,t^*)} - K_{t^*}^{(B2,t^*),\text{sur}}$ |
| $t = t^* + 1, \dots, T$ | $P_t^{(B2,t^*)} = P_{(t-1)}^{(B2,t^*)} \cdot (1 + r^f)$ |

Table 7: Value of the policyholder account $P_t^{(B2,t^*)}$ for the Riester life insurance product (B) in case (2) for times $t = t^*, \dots, T$. For previous times $t < t^*$, the account values are given by case (1), see Table 6.

Case (3): Death before contract maturity. In the last case the investor dies in t^{**} before maturity of the contract and the model assumes that as a consequence the contract is terminated. The model mechanisms for case (3) in the Riester life insurance contract are identical to case (3) in the Riester fund product (see Table 4). Table 8 summarizes the development of the policyholder account for times t^{**} to T .

| Times | Value of policyholder account $P_t^{(B3,t^{**})}$ |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $t = t^{**}$ | $P_{(t^{**})-}^{(B3,t^{**})} = P_{(t^{**}-1)}^{(B3,t^{**})} \cdot (1 + \max(r^g; r_t^p))$ $P_{(t^{**})+}^{(B3,t^{**})} = P_{(t^{**})-}^{(B3,t^{**})} - K_{t^{**}}^{(B3,t^{**}),\text{mor}}$ |
| $t = t^{**} + 1, \dots, T$ | $P_t^{(B3,t^{**})} = P_{(t-1)}^{(B3,t^{**})} \cdot (1 + r^f)$ |

Table 8: Value of the policyholder account $P_t^{(B3,t^{**})}$ for the Riester life insurance product (B) in case (3) for times $t = t^{**}, \dots, T$. For previous times $t < t^{**}$, the account values are given by case (1), see Table 6.

2.3 Fund product

Product (C) is a classical (non-Riester) fund product. In our model, and to allow a comparison with the Riester products (A) and (B), we assume the investor to purchase the fund product (C) in the same pattern. That means that investments are done on an annual basis with constant payments P at the beginning of each time period. Yearly investments until maturity ($t = T$) are supposed in case (1). In case (2) the investor cancels the contract before maturity ($t = t^* < T$). This case is identical to the case where the investor dies before time T and the contract is terminated early. The total fund value of the account at the time of disinvestment ($t = t^*$) is invested at a risk-free rate r^f . The cost structure, the underlying investment and the development of the policyholder account are described in the following.

Cost structure

Costs for the fund product are defined for cases (1) and (2). We assume that there are three relevant cost categories, namely issuance costs, administration costs and depot fees. In the case where the contract is held to maturity (case 1), issuance costs, administration costs and depot fees apply. All costs are considered on an annual basis. Issuance costs $K_t^{(C1),\text{iss}}$ incur whenever the investor pays P to his account. They are calculated as a percentage $k_t^{(C1),\text{iss}}$ of the annual payment P . Depot costs $K_t^{(C1),\text{dep}}$ are deducted as absolute values. Administration costs $K_t^{(C1),\text{adm}}$ are calculated as a percentage $k_t^{(C1),\text{adm}}$ of the value of the policyholder account in each period of relevance. Looking at their application in times, issuance and depot costs are first deducted from the policyholder account in each period and then administration costs are calculated on the basis of the remaining value of the policyholder account. In the case of early contract termination (case 2), the investment contract is canceled and no other costs apply. The relevant costs for product (C) are summarized in the Table 9.

| Case | Category | Cost calculation | | Times |
|------|----------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1 | Issuance | $K_t^{(C1),iss}$ | $= k_t^{(C1),iss} \cdot P$ | $t = 0, 1, \dots, T - 1$ |
| | Depot | $K_t^{(C1),dep}$ | $= k_t^{(C1),dep}$ | $t = 0, 1, \dots, T - 1$ |
| | Admin. | $K_t^{(C1),adm}$ | $= \begin{cases} k_t^{(C1),adm} \cdot (P - K_t^{(C1),iss} - K_t^{(C1),dep}) & t = 0 \\ k_t^{(C1),adm} \cdot (P_{t-} + P - K_t^{(C1),iss} - K_t^{(C1),dep}) & t = 1, \dots, T - 1 \end{cases}$ | $t = 0$ $t = 1, \dots, T - 1$ |

Table 9: Categories and calculation of costs in the fund product (C).

Underlying investment

Similarly to the development of the policyholder account in the Riester fund product (A), the investor's account value in the classical fund product (C) depends on the performance of the assets underlying the investment. We assume that the fund investment follows a geometric Brownian motion with initial assets value of given by $A_0^{(C)}$. The development in time from $t = 1$ to $t = T$ of the assets $A_t^{(C)}$ is modeled through the following equation:

$$A_t^{(C)} = A_{t-1}^{(C)} \cdot \exp[\mu_{\text{GBM}} - \sigma_{\text{GBM}}^2/2 + \sigma_{\text{GBM}}(W_t^{\mathbb{P}} - W_{t-1}^{\mathbb{P}})], \quad (3)$$

where μ_{GBM} and σ_{GBM} are the deterministic drift and volatility of the asset class. $W_t^{\mathbb{P}}$ stands for the standard geometric Brownian motion. The ratio $A_t^{(C)}/A_{t-1}^{(C)}$, $t = 1, \dots, T$, is used for the calculation of the investment account value.

Value of the policyholder account

In the following, the development of the policyholder account for the fund product is described from time inception ($t = 0$) to maturity ($t = T$). The calculation of the account value is detailed for case (1) in which the investor invests in the product until maturity and for case (2) in which the contract is canceled before maturity. Because no particular mortality options and costs are included in the fund product, the mortality case is identical to case (2).

Case (1): Contract held until maturity. The account value follows the calculation mechanism for the Riester fund product in all years $t < T$ (see Table 2). The amount of the costs $\sum K_t^{(C1)}$ that are deducted differs.

The fund product offers no capital conservation guarantee nor another minimum interest rate guarantee. Thus the calculation of $P_T^{(C1)}$ differs from $P_T^{(A1)}$. Table 10 summarizes the development of the policyholder account in case (1) for times $0, \dots, T$.

| Times | Value of policyholder account $P_t^{(C1)}$ |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------|
| $t = 0$ | $P_{0+}^{(C1)} = P - \sum K_0^{(C1)}$ |
| $t = 1, \dots, T - 1$ | $P_{t-}^{(C1)} = P_{(t-1)+}^{(C1)} \cdot A_t^{(C)} / A_{t-1}^{(C)}$ $P_{t+}^{(C1)} = P_{t-}^{(C1)} + P - \sum K_t^{(C1)}$ |
| $t = T$ | $P_T^{(C1)} = P_{T-}^{(C1)} = P_{(T-1)+}^{(C1)} \cdot A_T^{(C)} / A_{(T-1)}^{(C)}$ |

Table 10: Value of the policyholder account $P_t^{(C1)}$ for the fund product (C) in case (1) for times $t = 0, \dots, T$.

Case (2): Contract canceled before maturity. In this scenario the contract does not run until maturity. If $t = t^*$ is the point in time when the investor cancels the contract, the policyholder account develops as given in case (1) for all time periods prior to that moment. After contract termination, the investor reinvests the full amount of the policyholder account at t^* at a risk free rate for the rest of the saving period until T . At $t^{*(-)}$ the policyholder account is credited with the endowment from the underlying asset $A_{t^*}^{(C)} / A_{t^*-1}^{(C)}$ for the last time. At the time of cancellation t^* and in the consecutive periods, no costs are deducted. For the remaining time periods of the saving period, the investor receives a risk free rate of r^f . Endowments are credited to the policyholder account at the end of each of the remaining time periods. Table 10 summarizes the development of the policyholder account for the non-Riester fund product for times $0, \dots, T$.

3 Reference setting and analysis of different providers

In the following, we use the model framework introduced in Section 2 to calculate the resulting values of the policyholder account in various

| Times | Value of policyholder account $P_t^{(C2,t^*)}$ |
|---------------------------|-----------------------------------------------------------------------------------------------------------------|
| $t = t^*$ | $P_{(t^*)+}^{(C2,t^*)} = P_{(t^*)-}^{(C2,t^*)} = P_{(t^*-1)+}^{(C2,t^*)} \cdot A_{t^*}^{(C)} / A_{t^*-1}^{(C)}$ |
| $t = (t^* + 1), \dots, T$ | $P_t^{(C2,t^*)} = P_{(t-1)}^{(C2,t^*)} \cdot (1 + r^t)$ |

Table 11: Value of the policyholder account $P_t^{(C2,t^*)}$ for the fund product (C) in case (2) for times $t = t^*, \dots, T$. For previous times $t < t^*$, the account values are given by case (1), see Table 10.

cases on the basis of a parametrization given by the market. First the main parameters for the different products in the model are introduced (see Section 3.1). We start with presenting an overview of the costs and performance of Riester and non-Riester products for three selected providers (labeled from 1 to 3) in Table 12. Each of these providers has a significant market share in the German Riester market so that results are capable towards practical implications. In order to make the cost structure comparable, both products (A) and (C) are assumed to invest in the same underlying.

In a first comparative study in Section 3.2, we assume that the investor holds the contract until maturity (case 1) and comparisons are first based on the average payout values and incurred costs to the policyholder. Thus the upside-potential and downside-risk of the individual products is not considered. Having considered the impact of the costs and market performance of the three providers (Table 13), we consider one reference provider (provider 2) in each category for further analysis. We consider the distribution of the values of the policyholder account at maturity and illustrate product-specific risks in Figure 2 and Table 14. In the separate Section 4, we introduce the product valuation considering all three investment cases of our model (continuing investment until maturity, surrender, death). We study the overall performance and use the Sharpe and Sortino ratios for financial performance measures.

To evaluate the model and assess the value of the policyholder account in the different products and cases, a Monte Carlo simulation is utilized. Numerical results are obtained in each case by simulating $N = 1\,000\,000$ Monte Carlo realizations. In the studied situations, we set

the duration of the investor's saving period to $T = 25$ years and assume yearly premium payments of $P = \text{€}1\,200$. In our calculations, we fix the risk free rate of return $r^{(f)} = 2\%$.

3.1 Model parametrization

For the numerical simulations, we use market values for Riester and non-Riester products from the largest providers in the German market. A summary of all parametrization variables can be found at the end of this section in Table 12.

For the Riester fund product (A) market values for costs and the performance of the underlying are available from the providers. We consider the three largest issuers of Riester fund products which are Union Investment (called provider 1 in the sequel), DWS (provider 3) and Deka Investment (provider 2). In 2011, the three providers had a cumulated market share of about 98% measured in terms of the total number of contracts sold. For the value of the fund performance for the different products we consider the average annual fund return μ and volatility σ over the ten year time period from 2002, the year of introduction of Riester pension schemes, to 2011.³ Riester fund products offer the option to shift investments between funds during the duration of the policy. Usually the level of risk is reduced towards the end of the contract period. In our model, we assume that the investor or the product issuer can switch between two given underlying funds with different performance and cost structures. We label the relevant parameters (performance and costs) before the fund switch with “before” and parameters for times after the fund switch with “after” in the model. Model parameters for the Riester fund product contain funds that are stock-dominated for time periods before the fund-switch and funds that are bond-dominated for time periods after the fund-switch. We will refer to the case where no fund-shift is performed by (A¹) and to the case with fund-shift by (A²). In the following, we assume that the fund-shift in (A²) is done 7 years

³The ISIN numbers for the underlying funds of the three providers are as follows: provider 1 (Union Investment) = DE0008491051 and DE0008491069; provider 2 (Deka) = DE0005424519 and DE0009771824; provider 3 (DWS) = LU0350005186 and LU0011254512.

before the end of the saving period (that is in time $t = T - 7$).⁴ Finally, we consider the structure and the amount of costs as disclosed by the three product issuers (without any discounts). The values of the cost parameters $k_t^{(A)}$ as well as the fund performance (μ, σ) before and after the shifting option are summarized in the upper part of Table 12. The performance of the underlying fund and the costs for the Riester fund product differ by a significant amount from each other. For example, issuance costs $k_t^{(A), \text{iss}}$ range from 0.0% to 4.5%, acquisition costs $k_t^{(A), \text{acq}}$ from 0.0% to 0.5% and administration costs $k_t^{(A), \text{adm}}$ from 0.7% to 1.4% respectively. The cost parameters for provider two are lower than the the comparable costs for providers one and three.

The market values from 34 product issuers of Riester insurance products provide the basis for the calculation of the parameter values used in the Riester life insurance product (B). Market shares in this Riester product category are distributed among more issuers than it is the case in the market of Riester fund products. Furthermore, only few companies disclose numbers of outstanding Riester contracts which makes the deduction of market shares difficult. Thus, we define three reference providers whose configurations in terms of average surplus return correspond to the lower 10%-quantile, the median and the upper 90%-quantile product issuer. We retrieve historical surplus return values for Riester life insurance products from Map-Report (Poweleit, 2012) and information on the cost structure from Morgen & Morgen (2012), an independent German product rating company. In order to characterize the policyholder surplus distribution, we calculate the mean value $\mu(r^P)$ and volatility $\sigma(r^P)$ for the different companies over a period of 8 years (where available) from 2004 to 2011 and choose the three reference issuers based on their average surplus along the above defined quantiles. The resulting average surplus returns are $\mu(r^P) = 4.0\%$, 4.3% and 4.5% which correspond to Nürnberger (called provider 1 in the following), Provinzial NordWest (provider 2) and WWK (provider 3). For these three providers, we consider the historical surplus return volatility $\sigma(r^P)$ and the corresponding cost structure from 2011. The full config-

⁴The effects of different switching times on the terminal value of the policyholder account for the Riester fund product are described in detail in Appendix A.

uration is reported in Table 12. Looking at the cost parameters shows significant cost differences. Note that from all players, the highest market costs can reach issuance costs of 9.5%, acquisition costs of 15.3% and administration costs of 6.0%.

For the (non-Riester) fund product (C) we will assume the same performance for the underlying fund as for provider 2 for the Riester fund product (A). Differing from the Riester fund product, the model of the fund product (C) does not consider a shift in funds over time. In fact, a fund-shift would lead to very high amounts of issuance costs since these would in practice apply to the total value of the policyholder account at that point in time.⁵ Our model calculation takes into account two cases for the non-Riester fund product which differ from each other regarding the cost structure. In case (C¹) the product uses the costs from provider 2 of product (A). We assume the same fund as in product (A) to be purchased from an online broker (maxxblue, the online sales platform of Deutsche Bank), what leads to a cost structure which is on a comparable level to the one of the Riester fund product (A). In a second case (C²) we combine exchange traded funds (ETFs) to the same risk and performance profile as the underlying fund from product (A), as purchased in case (C¹). Purchasing a combination of ETFs leads to significantly lower costs than in case (C¹), see Table 12. The fund product in case (C¹) has issuance costs of $k_t^{(C^1),\text{iss}} = 3.5\%$ and administration costs of $k_t^{(C^1),\text{adm}} = 1.0\%$. Using an ETF-based cost structure in case (C²) leads to issuance costs of $k_t^{(C^2),\text{iss}} = 1.0\%$ and administration costs of $k_t^{(C^2),\text{iss}} = 0.3\%$. We assume in both cases depot fees of zero.

3.2 Terminal account values and costs across products and providers

The performance of the underlying investment, the guarantees included in the product and the costs structure are the most important elements that drive the terminal value of the policyholder account. In this section,

⁵Note that the Riester fund product issuer charges no additional issuance fees whenever parts of the policyholder account are switched from one fund to another at the issuer.

we consider the mean terminal values $E[P_T]$ obtained and the accumulated costs until T that incur in the different products issued by the selected providers (see Table 12) in the case of a continued investment (case 1) into the product until maturity (no surrender or death occurs). Furthermore, we analyze the distribution of P_T in each product for the offering of provider 2. A detailed performance analysis of the distribution of the terminal account values P_T using the combinations of the cases (1), surrender (case 2) and mortality (case 3) is presented in the following Section 4.

Mean terminal values and accumulated costs (case 1)

During the term of $T = 25$ years a total nominal premium volume of $T \cdot P = \text{€}30\,000$ is invested in the contract in case (1). This nominal value corresponds to an accumulated investment in T of $\text{€}39\,205$ (when compounding the premium payments at the risk free rate of return of $r^{(f)} = 2\%$).⁶ Comparing the average terminal values of the policyholder account $E[P_T]$ in the different products (A), (B) and (C) at the three reference providers (1–3) yields important differences. In Table 13, we report the expected values of the policy accounts $E[P_T]$ in T (net of costs).

For Riester fund products (A), terminal values $E[P_T]$ range from around $\text{€}36\,000$ to $\text{€}112\,000$. Provider 3 within the Riester fund products is almost two times as successful as provider one which is mostly due to underlying fund's performance. Even provider 2 reaches only an average final policyholder account value $E[P_T]$ of around $\text{€}36\,000$ (product A²), which is on the same level as provider 1. The fund-shift performed in product (A²) leads to lower mean values in comparison to the cases (A¹) where no shift in less risky funds has been done. However, this comes at the price of a higher volatility in the terminal value what we discuss in the following sections (see, e.g., Figure 2). Riester life insurance contracts (B) have average terminal values that range from around $\text{€}32\,000$ to $\text{€}43\,000$ which is significantly below the mean terminal values for Riester fund products, especially when comparing provider 3.

⁶This corresponds to the premium payments P in $t = 0, \dots, T - 1$ compounded at the risk free rate of return of $r^{(f)}$ until T , i.e., $P \cdot \sum_{t=0}^{T-1} (1 + r^{(f)})^{(T-t)}$.

Average terminal values for the provider 2 of Riester life insurance products (B) are with $E[P_T]$ around €32 000 on a significantly lower level than provider 2 of Riester fund products (products A¹ and A²). Terminal values for non-Riester products differ in cases (C¹) to (C²) due to the different cost structures. Contrary to product (A²) there is no fund-shift in the non-Riester product because of potential issuing costs, so the fund products (C¹) and (C²) best compare to product (A¹). In case (C¹) the average policyholder account value at maturity $E[P_T]$ is around €41 000 whereas it rounds up to €47 000 in case (C²). This difference is due to the lower cost structure assumed in product (C²) where we assume the underlying is not bought as issued by a Riester provider but modeled from ETFs (see the discussion on costs below). In conclusion, Riester life insurance providers have mean terminal policyholder account values that are in all but one case below results from non-Riester and Riester fund product providers. Only in the fund product (C²) based on an ETF cost structure, the Riester life insurance product on average leads to a lower terminal policyholder account value.

In the following, we discuss the average total costs incurred in the different products at the three reference providers over the duration T of the saving period. We consider the total costs paid in each year over all categories in the different products and accumulate them over the contract duration to time T . That is, we compound the payments in each time t with the risk free interest rate $r^{(f)}$ in order to get a valuation of the costs at maturity T . Since costs depend on the development of the value of the policyholder account P_t (in each realization), we consider the average value of the total accumulated costs paid which we denote with $E_T[\sum K]$. The corresponding numerical results are reported in Table 13.

Spreads in the cost structure for different providers of Riester fund products are higher than the spreads for Riester life insurance providers (see Table 12). Annual issuance costs for Riester fund products range from 3.2% to 4.5% (for the first fund, i.e., before fund-shift), acquisition costs from 0.4% to 0.5% (for the first fund) and administration costs from 1.2% to 1.4% (for the first fund). Riester life insurance products on the other hand have cost parameter ranges of 3.5% to 4.2% in issuance costs, 4.3% to 5.5% in acquisition costs and 1.0% to 3.0% in administration

costs. The development of costs over the saving period however shows that in all cases there are “turning points”, before which a higher amount of cumulated costs is allocated to the Riester life insurance contracts. This is mainly due to the allocation of issuance costs of Riester life insurance contracts (B) over the first five years of the contract period (see the typical calculation of costs reported in Table 5). The distribution of these costs is regulated by the German Government which says that insurance companies have to allocate issuance costs at least over the first five years of contract periods.⁷ The allocation of costs during the saving period for Riester fund products (A) is not regulated by the German Government.

Looking at accumulated costs $E_T[\sum K]$ in T shows the impact of the different cost structures as described above in absolute values. Costs for the Riester fund products with and without fund-shifts (cases A¹ and A²) are on a comparable level for providers 1 and 2 and are significantly higher for provider 3 (recall that provider 3 has the highest fund performance in terms of the expected return). Compared to this, absolute costs for the Riester life insurance product (B) are differing to a greater extent between the different providers 1, 2 and 3. Most significant is the amount of accumulated costs for provider 2. Costs in the non-Riester fund products (C¹) and (C²) are significantly lower than the cumulated costs for the Riester products in all but one case, namely the provider 3’s product (A¹), if put in relation to the terminal policyholder account value $E[P_T]$ in T . The cost ratios CR , calculated as the accumulated costs $E_T[\sum K]$ over the average terminal value $E[P_T]$ and reported in Table 13, for the non-Riester fund products are consequently the lowest for case (C²) with 4.8% where an ETF-cost-structure is applied. The second lowest cost structure is reached by the Riester fund product (A¹) for provider 3 with 14.9%. Cost ratios for Riester fund products (A) range from 14.9% to 20.5% and are therefore always below the cost ratios of Riester life insurance products (B), which range from 22.0% to 54.2%.

⁷Note that before 2011, insurance companies were required to distribute these costs at least over the first ten years of the saving period.

As a result of the cost and performance analysis, four findings have the greatest importance. First, cost ratios for the Riester fund products (A) are always lower than the respective cost ratios for Riester life insurance products (B). This holds true for Riester fund products with and without fund-shifts, that is the cases (A¹) and (A²). Secondly, Riester life insurance products (B) have a significant spread in costs depending on which provider is chosen, and no direct link between product performance and level of accumulated product costs can be observed for the three different providers. Thirdly, cost structures of Riester fund products (A) are in a way corresponding to the individual product performance that the product issuer offers. This means that product issuers with a lower product performance have also lower accumulated costs (see, e.g. provider 1 in case A¹), whereas product issuers with a higher product performance (see, e.g., provider 3 in case A¹) have consequently higher accumulated costs. Our observations are in line with findings (see, e.g., Kleinlein, 2011 and Schröder, 2011) from earlier analysis of Riester products which showed, that cost and performance structures of Riester products are varying significantly between different product issuers. Finally, our results show that, considering the product pay-offs from provider 2, the expected values of the policyholder account in products (A²) and (B) are below the risk-free investment which yields €39 205.⁸ Thus these product-provider combinations show a low performance at high costs in comparison to a risk-free investment.

Distribution of terminal account values (case 1, provider 2)

In the following, we focus on each product on the offering of provider 2 and suppose continued investment until maturity T (case 1). The aim is to present an analysis of the volatility of the terminal policy account values P_T and to depict the volume of the guarantees included in the products. We take again the performance configuration and cost structure introduced in Table 12. Results for the terminal value of the policyholder account are illustrated in Figure 2 while the corresponding numerical values are reported in Table 14.

⁸This figure corresponds to the value of the accumulated premiums compounded at the risk free rate of return. Therein no costs are considered.

Figure 2 shows the results for the terminal values of the policyholder account in each product category. Solid vertical lines in each box represent the median value (50%-quantile of P_T), while the dark-shaded boxes represent 80% of the P_T -cases from the lower 10%- to the upper 90%-quantile. The dotted vertical line represents the mean value $E[P_T]$ in each product. In the Riester products (A) and (B) guarantees apply. Their volume is indicated with a clearer-shaded box. The exact amounts are reported in Table 14.

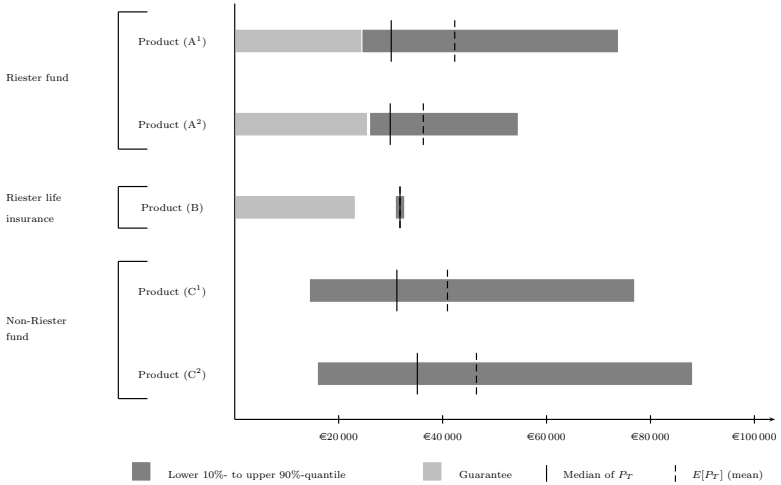


Figure 2: Illustration of the distribution of the values of the policyholder account P_T at maturity (mean and median values and 10%- to 90%-quantiles) and product guarantees for provider 2 in case (1) of continued investment until time T . The parametrization for the performance and cost structure is taken from Table 12. The numerical values corresponding to the figures used in the illustration are reported in Table 14.

The Riester fund contract and the non-Riester fund contract have terminal policyholder account values P_T with the largest spread compared to the Riester life insurance contract. For the Riester fund product (A) the lower 10% and upper 90%-quantile ranges from around €24 000 to around €74 000, whereas the non-Riester fund product (C) ranges (in the same measure) from around €14 000 to around €88 000. The Riester life

insurance product (B) at the same time results in quantile values ranging from around €31 000 to €32 000. Comparing median values of P_T , the non-Riester fund product (C²) outperforms the other products. When looking at the minimum values of P_T the central feature of the minimum return guarantees provided in the Riester products (A) and (B) can be seen. The Riester fund product (A) has a point-to-point 0% return guarantee on the premiums paid (from contract inception to contract maturity) whereas the Riester life insurance contract holds a yearly 1.75% minimum return guarantee (before costs).

4 Comparison of performance measures

In this section, we introduce performance measures to assess the different products. In our assessment we include the surrender and mortality cases (case 2 and case 3). Surrender and mortality rates are considered as probability-weighted rates which means that expected values of terminal policyholder accounts for each product are calculated with compound probabilities for continuing investment (case 1), customer surrender (case 2) and customer/investor mortality (case 3). For surrender and mortality rates, market values are utilized. The surrender rate is taken as the four-year average life insurance surrender rate in the German life insurance market from 2008 to 2011 as published by the German Insurance Association (GDV). This yields a value of 3.74% which is evenly distributed over the contract duration. The yearly mortality rates are taken from the DAV mortality tables of 2008. The cumulated probability of mortality for a 40-year-old investor (at contract inception) dying during the saving period (T years), i.e., aged between 40 and 65 years is 11.27%.

Table 15 reports the expected terminal values of policyholder accounts for an investor with an average probability to continue investment, surrender the contract or die before contract maturity. In the following, we analyze in more details the different payoff distributions introducing preference-dependent performance measures.

For the performance measurement, we use the Sharpe and Sortino ratios as introduced in similar frameworks where the assessment of life

insurance contract payoffs is concerned, see, e.g. Gatzert and Schmeiser (2009) and Faust, Schmeiser, and Zemp (2012). The Sharpe ratio expresses the relation between the excess return of an investment (here: expected terminal policyholder account values $E[P_T]$) over an alternative (riskless) investment and the additional amount of risk which is linked to this investment (here: standard deviation of expected terminal policyholder account values $\sigma[P_T]$), see Sharpe (1966). The ratio is defined as follows:

$$\text{Sharpe ratio} = \frac{E[P_T] - Y_T}{\sigma[P_T]}, \quad (4)$$

where Y_T denotes the sum of annual premium payments invested at a risk free rate r^f every year. The annual premiums P paid and the saving period duration T are the same in all products. Thus, compounding the premium payments with the interest rate r^f , while taking surrender and mortality probabilities into account, leads to $Y_T = \text{€}37\,374$ in our numerical examples. This value can be compared with the $\text{€}39\,205$ obtained previously when no surrender and mortality is considered. The average total nominal premium volume reduces from $T \cdot P = \text{€}30\,000$ to $\text{€}28\,343$ when surrender and mortality cases are taken into account.

The Sortino ratio (we will make use of the formula following Gatzert and Schmeiser, 2009) is an extension of the Sharpe ratio and is stricter in its measurement method. The Sortino ratio only calculates for the downside-deviation, hence omitting the positive effect that an upside development of the underlying investment might have. We use the following definition of the Sortino ration in our calculations:

$$\text{Sortino ratio} = \frac{E[\max(P_T - Y_T, 0)]}{\sqrt{E[\max(Y_T - P_T, 0)^2]}}. \quad (5)$$

Table 15 summarizes the information on the terminal policyholder accounts distribution (quantiles, mean and standard deviation) for the different products from provider 2 and reports the Sharpe and Sortino ratios in the different cases.

According to the Sortino and Sharpe ratio performance measures, the non-Riester fund product with the ETF cost-structure (C^2) is val-

ued higher than the other products (Riester fund products A^1 , A^2 , Riester life insurance product B and the non-Riester product with a classic cost structure (C^1). Considering the Sharpe ratio, the non-Riester fund product with the ETF cost-structure (C^2) shows a significantly better performance than the other Riester and non-Riester products from our analysis. The second and third best products are the Riester fund product without a fund-shift (A^1) and the non Riester fund product with the classic cost structure (C^1). For products (A^2) and (B) negative values for the Sharpe ratios are obtained since the expected payoff from the insurance product is lower than the one that is obtained from a risk free investment.

Looking at the Sortino ratio, the non-Riester fund with an ETF cost-structure (C^2) is again ranked highest. The Riester life insurance product shows an inferior performance because of the high product costs and low performances at the same time in comparison with the other product categories (Riester and non-Riester fund products). The non-Riester fund product with a classic cost-structure (C^1) reaches the second-highest performance, which is slightly better than for the performance of the Riester fund product (A^1).

In conclusion, these results show the superiority of the non-Riester fund product with the ETF cost-structure (C^2) as well as the ETF product with a classic cost structure (C^1) and the Riester fund products without a fund-shift (A^1) over the Riester life insurance product (B). The Riester life insurance product (B) is not chosen because of the high product costs and the non-Riester fund product (C^2) because of the performance upside-potential in combination with a low cost structure. The Riester fund product (A^1) without a fund-shift is again superior to the Riester life insurance product (B) because of the performance upside-potential.

5 Summary and conclusion

The analyses in our paper compare the performance and the cost structures of Riester fund and Riester life insurance product with a non-Riester fund product. Costs and product performance are compared

between the different product categories as well as for different product issuers within each product category. For numerical results, the parametrization of the model is based on market values of Riester fund and Riester life insurance products. Both Riester products include guarantees on the savings, namely a point-to-point guarantee for Riester fund products and a cliquet-style guarantee for Riester life insurance products, whereas the full investment is at risk in the non-Riester fund. Since customers consider their own risk profile when making product purchase decisions, we use in our study of the payoffs financial performance measures and customer utility functions.

Our results show that Riester life insurance products (B) typically lead to lower expected values of the terminal policyholder payoff than the other Riester (A) and non-Riester fund products (C). However, in the life insurance product (B), the final account values are subject to a much smaller standard deviation (see Tables 14 and 15).

Numerical results show important findings for different product issuers within each product category. For example, cost and performance structures differ significantly between the different product providers. This finding is most relevant for Riester fund products (A). The different providers within this product category offer products with a wide range of average annual returns. High differences in the terminal policyholder account values are particularly significant when considering providers with higher average returns (e.g., provider 3). In this case, the expected payouts from Riester fund products (A) outperform the ones from the Riester life insurance product (B) by around 52% when comparing with case (A¹) and by around 160% for case (A²). Riester fund products (A) have a much higher volatility than Riester life insurance products (B) for each of the three product providers considered. The corresponding upside- and downside-potential of Riester fund products transfers the products into riskier investments than Riester life insurance products. Numerical results show that a fund-shift within Riester fund products reduces overall volatility (compare cases A¹ and A²). Nevertheless, product providers do not offer investors to actively influence the composition of their fund portfolio. Over all cases (provider 2), the upper 90%-quantile payoff value (upside potential) in the Riester

fund product (A^2) is 82% over the median payoff, whereas the lower 10%-quantile (downside risk) is only about 15% below the median (see Table 15). The lower volatility of Riester life insurance products (B) is expressed by the fact that the value of the upper 90%-quantile of the payoff distribution is less than 1% higher than the distribution's median and the lower 10%-quantile value is less than 1% lower than the median. However it has to be noted that in the products (A^2) and (B), due to the high costs, the expected value of the policyholder payoff is smaller than the outcome of a risk free investment of the premiums.

The performance measures Sharpe and Sortino ratios, ranking the non-Riester fund product with ETF cost-structure (C^2) significantly better than the other products. The Riester fund product without fund-shift (A^1) and the non-Riester fund product with the Riester product cost-structure (C^1) rank second and third. These findings are in line with the observations regarding product volatility and performance upside potential.

Aggregating the results from the different analysis, a major result must be underlined. In all products the performance of the underlying is moderate. However and most importantly the costs play a crucial role in the calculation of the value of policyholder account. In several of the cases that we studied, expected costs are much higher than 20% of the expected value of the policyholder account. This finding along with the performance measures adds robust information on what Riester pension scheme the German Government should support.

Appendix

A Analysis of fund-shifting effects in the Riester fund product

The use of the option to shift the investment from one fund to another in the Riester fund products has an impact on the value of the policyholder account at maturity. In Table 13, we report the mean terminal values of the policyholder account $E[P_T^{(A)}]$ for the case where no fund-

shift has been performed (A^1) and the case (A^2) where the funds have been shifted at time $T - 7$, that is, 7 years before contract maturity T . Issuers usually shift funds towards the end of contract periods to allocate the policyholder accounts to less risky funds. The consequences on the distribution of $P_T^{(A)}$ is illustrated in Figure 2 and in Table 14.

The switching patterns differ between providers and the products they offer. In our model, the funds are either not shifted or completely shifted in $t = T - 7$. In Table 16 report results from a sensitivity analysis where different times for the (complete) shift are analyzed. We provide the resulting figures for the mean terminal policyholder account value $E[P_T^{(A)}]$ in the case where shifting is performed at times $t = T - 5, T - 7, T - 10$. The parametrization for the performance and cost structure is taken from Table 12.

Fund shifts in Riester fund products have different impacts on the mean terminal values, depending on the individual product performance and fund switching times. Fund switches have the largest impact on mean terminal values for provider 3 of Riester fund products. Average terminal policyholder account values with fund switches (five, seven and ten years) result in percentage values of 47% (€52 213 with fund switch ten years before contract maturity) to 67% (€75 463 with fund switch five years before contract maturity) in comparison to 100% (€111 812 terminal policyholder account value) without fund switches for provider 3. For providers 1 and 2, differences in the mean terminal policyholder account values are less important than for provider 3. Looking at providers 1 and 2 simultaneously, fund switches ten years before maturity lead to percentage values of 77% (€33 335) and 81% (€34 281) in comparison to 100% without fund switches. Fund switches five years before maturity result in percentage values of 87% (€37 729) and 89% (€37 814).

The main driver for these differences considering provider 3 on the one hand and providers 1 and 2 on the other hand are different performance parameters of the respective funds. Product funds of provider 3 have the largest spread of 7.00% in return performance ($\mu = 8.7\%$ for the fund before the switch and $\mu = 1.7\%$ for the fund after the switch) comparing pre- and after-switch product performance. Provider 1 has a spread of 0.50% and provider 2 of 0.30%. Additionally, the reduced

volatility in all cases (reduction of σ of about 20%) has to be considered when analyzing the reduced riskiness of the investment.

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| | | Provider 1 | | Provider 2 | | Provider 3 | |
|------------|----------------|-------------------|-------|------------|--------|------------|-------|
| Fund shift | | before | after | before | after | before | after |
| (A) | Fund | μ | 0.8% | 0.3% | 1.1% | 0.8% | 8.7% |
| | performance | σ | 24.5% | 3.0% | 22.1% | 1.0% | 18.6% |
| | | | | | | | 0.8% |
| | | $k_t^{(A),iss}$ | 4.5% | 2.7% | 3.2% | 0.0% | 4.1% |
| | | $k_t^{(A),acq}$ | 0.5% | 0.3% | 0.4% | 0.0% | 0.5% |
| | | $k_t^{(A),adm}$ | 1.2% | 0.7% | 1.2% | 0.7% | 1.4% |
| | | $k_t^{(A),dep}$ | €12.5 | €12.5 | €10.0 | €10.0 | €15.4 |
| | | $k_t^{(A),sur}$ | €25.0 | €25.0 | €50.0 | €50.0 | €0.0 |
| | | | | | | | |
| | | | | | | | |
| (B) | Surplus return | $\mu(r^P)$ | 4.0% | | 4.3% | | 4.5% |
| | | $\sigma(r^P)$ | 0.0% | | 0.2% | | 0.3% |
| | | $k_t^{(B),iss}$ | 3.5% | | 4.2% | | 4.0% |
| | | $k_t^{(B),acq}$ | 4.3% | | 4.5% | | 5.5% |
| | | $k_t^{(B),adm}$ | 1.8% | | 3.0% | | 1.0% |
| | | $k_t^{(B),sur}$ | €50.0 | | €100.0 | | €50.0 |
| | | $k_t^{(B),mor}$ | €0.0 | | €0.0 | | €0.0 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| (C) | Fund | μ | | | 1.1% | | |
| | performance | σ | | | 22.1% | | |
| | | | | | | | |
| | | $k_t^{(C^1),iss}$ | | | 3.5% | | |
| | | $k_t^{(C^1),adm}$ | | | 1.0% | | |
| | | $k_t^{(C^1),dep}$ | | | €0 | | |
| | | | | | | | |
| | | $k_t^{(C^2),iss}$ | | | 1.0% | | |
| | | $k_t^{(C^2),adm}$ | | | 0.3% | | |
| | | $k_t^{(C^2),dep}$ | | | €0 | | |

Table 12: Parametrization of the performance and costs used in the model for the Riester fund product (A), the Riester life insurance contract (B) and the fund product (C) from three reference providers.

The reference providers in product (A) correspond to the three largest Riester fund issuers as of 2011, namely Union Investment (provider 1), Deka Investment (provider 2) and DWS (provider 3). In product (A), the account can be shifted from one fund to another during the saving period. The two values reported for the fund performance for each provider are marked in the table with “before” and “after” the fund-shift. In product (B) the reference providers are chosen as to reflect the lower 10%-quantile (provider 1, Nürnberger), the median (provider 2, Provinzial NordWest) and the upper 90%-quantile (provider 3, WWK) of the average (2004-2011) surplus return in the market. The volatility correspond to the standard deviation of the surplus return and the costs reflect costs as of 2011. For product (C) the provider 2’s performance of product (A) is used for reference. In the case of product (C^1), the cost structure corresponds to reflect the price if the underlying fund from product (A) is purchased outside a Riester product. In case (C^2), the costs of purchasing ETFs that reflect the same performance as in product (A) are considered.

| Products | Provider 1 | | | Provider 2 | | | Provider 3 | | |
|-------------------|------------|---------------|-------|------------|---------------|-------|------------|---------------|-------|
| | $E[P_T]$ | $E_T[\sum K]$ | CR | $E[P_T]$ | $E_T[\sum K]$ | CR | $E[P_T]$ | $E_T[\sum K]$ | CR |
| (A ¹) | 43 562 | 8 902 | 20.4% | 42 338 | 8 237 | 19.5% | 111 811 | 16 681 | 14.9% |
| (A ²) | 35 801 | 7 334 | 20.5% | 36 284 | 6 578 | 18.1% | 65 115 | 12 078 | 18.5% |
| (B) | 36 482 | 12 218 | 33.5% | 31 802 | 17 230 | 54.2% | 42 799 | 9 407 | 22.0% |
| (C ¹) | | | | 40 933 | 6 936 | 16.9% | | | |
| (C ²) | | | | 46 508 | 2 213 | 4.8% | | | |

Table 13: Results for the mean terminal values in € of the policyholder account $E[P_T]$, the accumulated costs $E_T[\sum K]$ in T in € for the saving period until maturity and cost ratio $CR = E_T[\sum K] / E[P_T]$ for the different products across the three reference providers in case (1) of continued investment until time T . The parametrization for the performance and cost structure is taken from Table 12.

| Products | (A ¹) | (A ²) | (B) | (C ¹) | (C ²) |
|------------------------------|-------------------|-------------------|--------|-------------------|-------------------|
| Upper 90%-quantile | 73 966 | 54 693 | 32 037 | 77 098 | 88 240 |
| Upper 75%-quantile | 47 649 | 40 244 | 31 925 | 49 460 | 56 195 |
| Median (50%-quantile) | 30 112 | 29 919 | 31 801 | 31 203 | 35 139 |
| Lower 25%-quantile | 25 276 | 26 329 | 31 678 | 20 340 | 22 698 |
| Lower 10%-quantile | 24 350 | 25 825 | 31 567 | 14 234 | 15 764 |
| Mean $E[P_T]$ | 42 338 | 36 284 | 31 802 | 40 933 | 46 508 |
| Std. deviation $\sigma[P_T]$ | 31 348 | 16 280 | 169 | 34 887 | 40 568 |
| Guarantee | 25 676 | 25 676 | 23 336 | n.a. | n.a. |

Table 14: Descriptive statistics on the distribution of the values in € of the policyholder account P_T at maturity for the different products from provider 2 in the case (1) of continued investment until time T . The parametrization for the performance and cost structure is taken from Table 12. Abbreviation: n.a. = not applicable.

| Products | (A ¹) | (A ²) | (B) | (C ¹) | (C ²) |
|------------------------------|-------------------|-------------------|--------|-------------------|-------------------|
| Upper 90%-quantile | 68 923 | 52 438 | 30 459 | 71 806 | 82 035 |
| Upper 75%-quantile | 45 043 | 38 608 | 30 357 | 46 745 | 52 978 |
| Median (50%-quantile) | 29 019 | 28 703 | 30 245 | 30 048 | 33 740 |
| Lower 25%-quantile | 23 709 | 24 550 | 30 132 | 20 061 | 22 315 |
| Lower 10%-quantile | 23 544 | 24 385 | 30 031 | 14 415 | 15 905 |
| Mean $E[P_T]$ | 39 901 | 34 593 | 30 245 | 38 832 | 43 995 |
| Std. deviation $\sigma[P_T]$ | 28 481 | 15 686 | 167 | 31 619 | 36 732 |
| Sharpe ratio | 0.09 | -0.18 | -42.70 | 0.05 | 0.18 |
| Sortino ratio | 93.50 | 55.05 | 0 | 101.66 | 135.62 |

Table 15: Descriptive statistics and performance measures on the distribution of the values in € of the policyholder account P_T at maturity for the different products from provider 2 when considering a weighted combination of cases of continuing investment (1), surrender (2) and mortality (3). The parametrization for the performance and cost structure is taken from Table 12. In the calculation of the performance ratios, the alternative is evaluated using a risk-free investment of $r^f = 2\%$.

| Product | Case | Provider 1 | Provider 2 | Provider 3 |
|-------------------|----------------------------|------------|------------|------------|
| (A ¹) | No fund-shift | 43 561 | 42 337 | 111 812 |
| (A ²) | Fund-shift in $t = T - 5$ | 37 729 | 37 814 | 75 463 |
| (A ²) | Fund-shift in $t = T - 7$ | 35 801 | 36 278 | 65 155 |
| (A ²) | Fund-shift in $t = T - 10$ | 33 335 | 34 281 | 52 213 |

Table 16: Mean terminal values of the policyholder account $E[P_T^{(A)}]$ in € for the Riester fund product (A) with a fund-shift at five, seven and ten years before contract maturity T .

Part II

Performances of Riester Products from Customers' Perspectives

Abstract

This paper contributes to the question if selected products from the German Riester pension scheme provide adequate performances to investors. Ten years after the introduction of the Riester scheme in Germany, theorists as well as practitioners are still debating intensively on this question. Special focus in our model framework lies on the impact of governmental transfer payments and tax effects on the product performance. The model introduces performance measures, which separate the effect of governmental transfer payments and of tax effects on overall product performance. Product calculations are based on Riester life insurance and Riester fund products due to their dominant role in the market for Riester products in Germany. For product performance comparisons, a non-Riester ETF product is introduced as a substitute investment. Parameters are chosen along market data from the largest product issuers, which allows us to derive results with practical relevance. The parametrization of sample investors is done along data from the 2009 German Microcensus. Using Microcensus data allows to cluster the German population and derive Riester performance expectations for these groups.⁹

⁹N. Mahlow. Performances of Riester Products from Customers' Perspectives. *Working Papers on Risk Management and Insurance*, 2013.

A Introduction

To establish a new building block of the privately financed pension system, the Riester pension scheme was introduced in Germany in 2002. The German government introduced investment incentives by granting transfer payments and tax benefits. Several changes and adaptations were made to the system over the time period of the past ten years in respect to product regulation, investment grants and others. Recent developments show tendencies that the Riester pension scheme does not fulfill the high expectations, which were linked to this product category. As of mid 2012, around 20% of all Riester investors made use of the *paid up option*, which causes them no longer to be entitled to governmental transfer payments. Furthermore, numbers for new contracts sold are declining significantly. Both facts show the shrinking acceptance for the Riester pension scheme. This paper looks at the Riester pension scheme from a customer point of view by assessing Riester product performances for life insurance and fund contracts. These product categories have the largest market shares in Germany. In order to evaluate Riester product performance, we focus on the effects that governmental transfer payments and potential tax benefits can have. For the parametrization of the Riester product categories, we use market values of average product providers for performance and cost structures. In order to introduce a non-Riester comparative investment, an ETF product is included in the performance analysis. The non-Riester product allows for simultaneous performance simulations on which a potential investor can base the decision between a Riester or non-Riester investment. Our model uses multiple Monte-Carlo-Simulations to stochastically simulate the development of assets and costs for each product (assets are the only primary source of stochasticity within the model). The methodology for the simulation of policyholder accounts is also applied in our previous research, where we used the model to assess Riester product performances irrespective of transfer payments and tax effects (see Mahlow, Schmeiser, and Wagner, 2013). To build a representative sample of Riester investors, data from

the 2009 German Microcensus¹⁰ are utilized. This data allows to identify sample investors (with individual characteristics of age, income and number of children), that cover large parts of the German population who are entitled to Riester investments.

The paper extends existing research on the Riester pension scheme in two aspects: First, we use a representative sample of potential Riester investors. This allows us to derive conclusions from individual as well as macroeconomic points of view. Former research mainly used limited sets of investors without linkages to the total German population. Second, a stochastic model for the simulation of policyholder accounts is applied, which considers market product costs and performances simultaneously. Earlier models did often not include market values for costs and performances but only estimates.

The paper is structured as follows: Section B gives an overview on prior research in the field of the Riester pension scheme. In Section C, the model framework with governmental transfer payments and tax benefits is introduced. Section D describes the Riester and non-Riester products and their integration into the model framework. Section E introduces the model parametrization regarding Riester and non-Riester products and the investor sample. The numerical analysis in Section F concludes the paper.

B Prior research

As introduced in our prior research paper on the Riester pension scheme, there have been ample discussions around the Riester scheme in the academic and practitioner literature in recent years. The following section herefore aims to summarize the most important discussion streams. Due to the proximity to our previous research, large parts of the forthcoming discussions and sources can be found in Mahlow et al. (2013).

Kleinlein (2011) and Hagen, Kleinlein, Geyer, and Wagner (2011) make contributions to the question if the Riester pension scheme is beneficial

¹⁰The Microcensus is a survey among the German population which is annually executed by the German Federal Statistical Office (see also www.destatis.de). Data for 2009 is the latest available Microcensus data for scientific use.

to the individual investor or not. Kleinlein (2011) uses different concepts to evaluate the Riester insurance products (for example annuity factors and internal rate of returns for the savings and the pension period). He compares his results for the years 2001 and 2011 to point out the effects of changes in the Riester pension scheme that were introduced in this time period. The model assumptions are: First, all contracts are held until maturity. Second, 12.5% of the annual premiums during the saving period are deducted as costs and 1.5% of the annual pension payments during the pension period. Third, customer benefits from profit participations are constant during the saving and pension period. Kleinlein (2011) comes to the result that the changes that were made to the Riester pension scheme from 2001 to 2011 had a greatly negative impact on the product performance for investors.

The question if the Riester pension scheme increases the propensity to save of Riester investors is answered by Corneo, Keese, and Schröder (2007). The authors find that there is no positive correlation between the governmental Riester surplus quote and investors' propensity to save. Accordingly, they state that the Riester pension scheme fails in one of its primary targets to motivate individuals especially with low incomes to make contributions to their pension plans through Riester products. Feigl, Jarozsek, Leinert, Tiffe, and Westerheide (2010) look at the customer transparency of Riester products by conducting a study among 238 experts from the financial services industry. Theoretical considerations and results from the expert survey indicate that Riester products are widely seen as too intransparent for individual investors. Oehler and Kohlert (2009) look at customer threats that might arise from the Riester pension scheme in the future. They also see the biggest threat in the high level of intransparency of Riester products. The authors suggest to introduce governmentally regulated product disclosure rules for costs and performances. Focusing on the acceptance of Riester products in the German population, Coppola and Reil-Held (2009) look at saturation ratios of Riester products for the time period of 2003 to 2008. They find indicators that for medium to high income households the Riester market is nearly saturated in 2008. For low income households the opposite is true. These households are still underinvested in Riester products,

compared to households with higher incomes. By looking at the factors that determine if an individual investor purchases a Riester product, Lamping and Tepe (2009) extend the focus. The authors conclude that the primary determinants for Riester investments are investor age and investor income, which reflects the pure economic ability to invest in Riester products. Furthermore, they consider the individually perceived ruin probability of the governmentally financed pension system and the risk of becoming unemployed as pivotal decision parameters for Riester investments. Schröder (2011) conducts a meta-study, which summarizes research on Riester products that had been done so far. He looks at the establishment of Riester products, windfall gains and the distribution of returns that result from the Riester products.

Börsch-Supan and Gasche (2010) in their paper look at the introduction of the Riester pension scheme from a macroeconomic point of view. They find that the Riester pension scheme is a good extension of the German pension scheme. The authors do however not evaluate the performance of Riester products. Börsch-Supan and Gasche (2010) evaluate the contribution of the Riester pension scheme to the shift towards a more privately financed pension system in Germany. Schmähl, Himmelreicher, and Viebrok (2004) are looking at how the development of the German pension system with its publicly and its privately funded pension systems can be improved. Among other findings, the authors come to the conclusion that it is necessary to support lower income households in order to achieve a higher propensity to save and invest in privately funded pension products. Second, the study points out that the high level of intransparency of pension products discourages people from investments.

C Model framework with governmental aids

This section introduces our model framework which is applied for numerical simulations in the remainder of this paper. In Section C.1, the model evolution for the saving and the pension with governmental transfer payments is developed. In a next step (see Section C.2), the model is extended through the integration of investors' tax accounts. Combining governmental transfer payments and tax considerations into our model

then allows numerical simulations from the perspective of individual investors.

C.1 Model with transfer payments

Our model simulates different Riester products and a non-Riester ETF product with focus on the effects of governmental transfer payments and tax effects for individual investors. It develops customer accounts $C^{(RL,RF,ETF)}$ for Riester life insurance, Riester fund and non-Riester ETF products. Governmental aids (transfer payments and tax benefits) are simulated separately from each other in the model to differentiate between the two effects in the concluding analysis. Figures 3 and 4 outline the model with governmental transfer payments and Figure 5 extends the framework by adding the simulation of investors' tax accounts. Governmental transfer payments and potential tax advantages only apply to the Riester life insurance (RL) and Riester fund product (RF). Investors are not entitled to these benefits when investing in non-Riester ETF products (ETF).

The development of policyholder accounts is simulated for the saving and the pension period for times $t = I, \dots, x^{**}$, which leads to terminal policyholder account values of C_{x^*} at an investor age of $x^* = 65$ and an account value of 0 at an investor age of $x^{**} = 85$. The model separates terminal values of policyholder accounts into the *premium payments part*, which comes from investors' own premium payments and the *transfer payments part*, which develops from governmental transfer payments. By assumption, investors do not cancel the contract at any time prior to $t = x^* = 65$ or during the pension period from $t = x^* + 1, \dots, x^{**}$. The development of the policyholder accounts with Riester products and the non-Riester product as illustrated in figure 3 is introduced in detail in Section D.

In the following, the model framework is described in respect to premium payments, product costs and the asset development for times $t = I, \dots, x^{**}$.

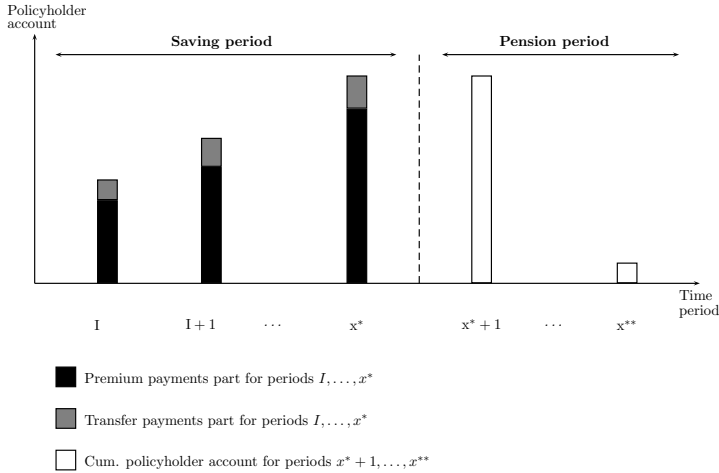


Figure 3: Model framework for the development of policyholder accounts for time periods from I, \dots, x^* for the saving period and for time periods from $x^* + 1, \dots, x^{**}$ for the pension period. The development of the policyholder account for the saving period is split in the premium payments part from premium payments of the investor P_t^O and in the transfer payments part from governmental transfer payments P_t^T . For the pension period, the cumulated policyholder account is illustrated.

Premium and transfer payments Premium payments $P_t^{(O,T)}$ are made to the policyholder account at the beginning of each period (+) I, \dots, x^* . During the pension period from $t = x^* + 1, \dots, x^{**}$, the investors make no premium payments. Annual premium payments are composed of own premium payments $P_t^{(O)}$ and transfer payments that the investor receives from the government $P_t^{(T)}$ if the respective investor falls into the category of *Riester entitled investors*¹¹. The development of policyholder accounts for Riester life insurance C^{RL} and Riester fund products C^{RF} is thus divided in the part that arises from own premium payments (*premium payments part*) and the part of the policyholder ac-

¹¹The appendix to this paper summarizes conditions that must be met by investors to be entitled to governmental transfer payments.

| | Saving period | | | | | | Pension period | | |
|----------------------------|----------------|---------------------------------|----------------|---------------------------------------|----------------|-----------------------------------------------|----------------|-----------------------------------|-------|
| Time | 0 + | Period I | - I + | Period t | - t + | Period x* | - x*+ | Period x** | - x** |
| Initial policy account | 0 | | | | | | | | |
| Premium/ transfer payments | $+P_0^{(O,T)}$ | | $+P_I^{(O,T)}$ | | $+P_t^{(O,T)}$ | | | | |
| Sum of costs deducted | $-\sum K_0$ | | $-\sum K_I$ | | $-\sum K_t$ | | | | |
| Acc. begin period | C_{0+} | | C_{I+} | | C_{t+} | | C_{x^*+} | | |
| Endowments | | $+C_{0+} \cdot \frac{A_I}{A_0}$ | | $+C_{(t)+} \cdot \frac{A_t}{A_{t-1}}$ | | $+C_{(x^*)+} \cdot \frac{A_{x^*}}{A_{x^*-1}}$ | | $+C_{(x^{**}-1)+} \cdot r^{pen.}$ | |
| Pension payouts | | | | | | | | $PE_{x^{**}}$ | |
| Acc. end of period | | C_{I-} | | C_{t-} | | C_{x^*-} | | $C_{x^{**}-}$ | |
| Final account | | | | | | C_{x^*} | | | 0 |

Figure 4: Illustration of the policyholder account development for time periods from I, \dots, x^* for the saving period and for time periods from $x^* + 1, \dots, x^{**}$ for the pension period. Illustration of the calculation mechanism within each time period for the central model parameters premium and transfer payments ($P_t^{O,T}$), product costs ($\sum K_t$), endowments ($C_t \cdot \frac{A_t}{A_{t-1}}$) and pension payouts (PE_t).

count that develops from transfer payments (*transfer payments part*) as illustrated in Figure 3.

To receive the full amount of governmental transfer payments, investors have to pay a combined amount of own premium payments and governmental transfer payments which equals at least 4% of the investor's annual taxable income. If the investor pays 4% into the contract, the effective annual payment, that the investor has to contribute as own premium payments $P_t^{(O)}$ is calculated by deducting the governmental premium payments $P_t^{(T)}$ from the minimum annual contract contributions (4% of the annual investor income). There is a maximum annual premium payment $P_t^{(O,T)}$ of €2 100, which equals an annual income of around €52 500. For incomes above €52 500, the cumulated annual premium payments remain at €2 100 per year and the investor still receives the full amount of governmental transfer payments. For annual combined premium payments $P_t^{(O,T)}$ below 4% of the annual income, investors receive proportionate governmental transfer payments. Governmental

transfer payments consist of individual grants ($P_t^{\text{T}^1}$) and children transfer payments ($P_t^{\text{T}^C}$). Table 17 summarizes these two categories. Transfer payments for children are paid to investors (parents), who are entitled to governmental child benefits¹². Consequently, the time period for which children transfer payments are granted is determined by the time period for which governmental child benefits arise. The maximum amount of children transfer payments is not limited for Riester investments. The level of individual transfer payments that an investor receives depends on the amount of own premium payments $P_t^{(O)}$.

If an investor does not fall into the group of *Riester entitled investors*, the person is still allowed to purchase Riester products but without receiving governmental transfer payments. Regardless, if the investor receives direct investment grants, tax benefits under conditions apply to all individual investors. If a Riester entitled investor, marries a non-Riester entitled investor, the latter becomes an *indirectly entitled Riester investor* and is thus entitled to all governmental transfer payments.

| | Minimum payment | Maximum payment |
|-------------------------------------------------|-----------------|-----------------|
| Children transfer payments $P_t^{\text{T}^C}$ | €0 | €300 |
| Individual transfer payments $P_t^{\text{T}^1}$ | €0 | €154 |

Table 17: Governmental children and individual transfer payments are reported for minimum and maximum annual payments. Children transfer payments can be received, depending on the age of the child, to a maximum child-age of 25 years. Individual transfer payments can be received for all investor ages.

Costs Costs in the model (see Figure 4) apply for all periods I, \dots, x^* of the saving period. Costs are always deducted at the beginning of each period (+) after the annual premium payment $P_t^{(O,T)}$ is made. For time periods $x^* + 1, \dots, x^{**}$ of the pension period, no costs apply because a constant return r^{pen} as net of all costs is utilized.

¹²In Germany, families receive different amounts of child benefits from the government, depending on the number of own children. Every family is entitled to child benefits for ages from 0 to 25 years of the respective child.

For each period, the sum of all product costs $\sum K_t$ is considered and deducted from the current value of the policyholder account. This leads to the policyholder account at the beginning of the period C_t+ . The composition and calculation of individual costs for the Riester life insurance, Riester fund and non-Riester ETF product are introduced in Sections D.1.1, D.2.1 and D.3.1. Cost categories that are summed under $\sum K_t$ contain Issuance, Acquisition and Administration costs for the Riester life insurance product (see Table 18), Issuance, Acquisition, Depot and Administration costs for the Riester fund product (see Table 20) and Issuance and Administration costs for the non-Riester ETF product (see Table 22). Cost categories differ in their impact on the products cost ratios and their calculation mechanisms.

Endowments Account endowments are credited to the policyholder account at the end $(-)$ of each time period I, \dots, x^{**} for the saving and the pension period. Endowments for the saving period (time periods I, \dots, x^*) are derived from the underlying product asset developments for Riester life insurance, Riester fund and non-Riester ETF products. Endowments for period t are calculated by comparing the asset value of period t with the asset value of period $t - 1$. Absolute endowments on basis of the current policyholder account value in period t are thus reflected by $C_{(t-1)+} \cdot \frac{A_t}{A_{t-1}}$. The calculation of the underlying assets for Riester life insurance contracts is introduced in Section D.1.2, for Riester fund products in Section D.2.2 and the non-Riester ETF product in Section D.3.2. Endowments for the pension period (time periods $x^* + 1, \dots, x^{**}$) are also credited to the policyholder account at the end of each period $(-)$. The calculation of annual endowments for the pension period differs from the endowment mechanism for the saving period in that a constant interest rate $r^{pen.} = 4\%$ is assumed. This interest rate is utilized as net of all costs. Thus, the model contains no cost elements for the pension period. Furthermore, there is no source of stochasticity in the model for time periods $x^* + 1, \dots, x^{**}$.

C.2 Model with tax account

Next, the model with transfer payments from Section C.1 is extended by adding the investor tax account. Tax effects on the one hand result from a deferred taxation of reduced investor taxable income by Riester and non-Riester investments (P_t^O) for the saving period (time periods I, \dots, x^*). On the other hand, effects arise from the amount of the investor's taxable income for the pension period (time periods $x^* + 1, \dots, x^{**}$). Taking the investor's tax account into consideration can lead to either positive or negative tax effects on the individual income tax level. Positive tax effects occur, if the tax rate of the investor for the pension period is below the tax rate of the saving period. Negative tax effects result vice versa, if the investor tax rate during the saving period is lower than during the pension period. Investors are allowed to deduct a maximum of €2100 for Riester and non-Riester investments from annual taxable income, which applies for time periods I, \dots, x^* in the saving period. The annual amount that lowers the taxable annual income is reflected by the investor's own premium payments P_t^O . Annual children and individual transfer payments P_t^T do not reduce the investor's annual taxable income.

Investors' tax accounts are simulated for the framework in Figure 5 and the corresponding numerical calculations are conducted in accordance with Equation 6. The tax model is applied to the same time periods as the model with transfer payments from Section C.1. Herein, time periods from I, \dots, x^* reflect the saving period and time periods from $x^* + 1, \dots, x^{**}$ the pension period. The model framework is built on the four elements *Tax without investment*, *Tax with investment*, *Tax account* and the *Cumulated tax account*. All of these elements apply to periods I through x^{**} .

Taxes without investment are calculated on basis of the annual investor income $I_t = I_{(t,WR)}$ and individual tax rates for the scenario without a Riester or non-Riester investment $tax_{t,WR}$. This calculation mechanism applies to all time periods I, \dots, x^{**} . The investor tax rate $tax_{t,WR}$ is determined by the individual investor income $I_{(t,WR)}$ of the time period and is calculated on basis of the German income tax

law¹³. Investor incomes $I_{(t,WR)}$ during the saving period (time periods I, \dots, x^{**}) are exogenously set and remain constant until $t = x^*$. In the scenario without Riester or non-Riester investments, incomes for the pension period are determined by pension payouts from the governmental pension plan. To simulate payouts, annual contributions to the governmental pension system of $S_{gov} = 9.8\%$ on basis of the individual income $I_{(t,WR)}$ are made during the saving period. By assumption, the governmental pension system has an annual return of $r_{gov} = 4.0\%$. This rate of return is applied for the development of the governmental pension account for each investor for time periods I, \dots, x^* . For time periods $x^* + 1, \dots, x^{**}$, investors receive annual governmental pension payouts on basis of terminal governmental account values in $t = x^*$. This terminal governmental account is then evenly distributed over the pension period from $x^* + 1, \dots, x^{**}$.

Taxes with investment are calculated on basis of the annual investor income I_t reduced by own premium payments P_t^O , which leads to a taxable income of $I_{(t,R)}$. The calculation applies to all time periods I, \dots, x^{**} of the saving and the pension period. The investor's tax rate $tax_{t,R}$ as a result of the annual taxable investor income $I_{(t,R)}$ consequently differs from the tax rate without a Riester investment. During the saving period, the tax rate with Riester or non-Riester investment $tax_{t,R}$ is always below the tax rate without Riester or non-Riester investments $tax_{t,WR}$. For the pension period, tax rates with Riester or non-Riester investment can be either above or below the corresponding tax rate if the investor would not have made an investment. Incomes for the pension period with investments are calculated by adding the annual Riester or non-Riester pension payouts PE_t (see Figure 4) to the payouts from the governmental pension system.

The *Tax account* reflects the difference in income taxes payable for each time period I, \dots, x^{**} of the saving and the pension period between the scenarios if an investor purchases a Riester or non-Riester product and if the investor pays taxes without an investment. The tax account adopts positive values if the income taxes payable in the investment

¹³Tax rates according to the German income tax system are reported in the Appendix.

scenario are lower than in a scenario without a Riester or non-Riester investment. The value of the tax account for each period is represented by $[(I_{(t,R)} \cdot tax_{(t,R)}) - (I_{(t,WR)} \cdot tax_{(t,WR)})]$.

The *Cumulated tax account* shows the cumulated value of the investor's tax account in t , which corresponds to the sum of tax accounts for time periods from I, \dots, t .

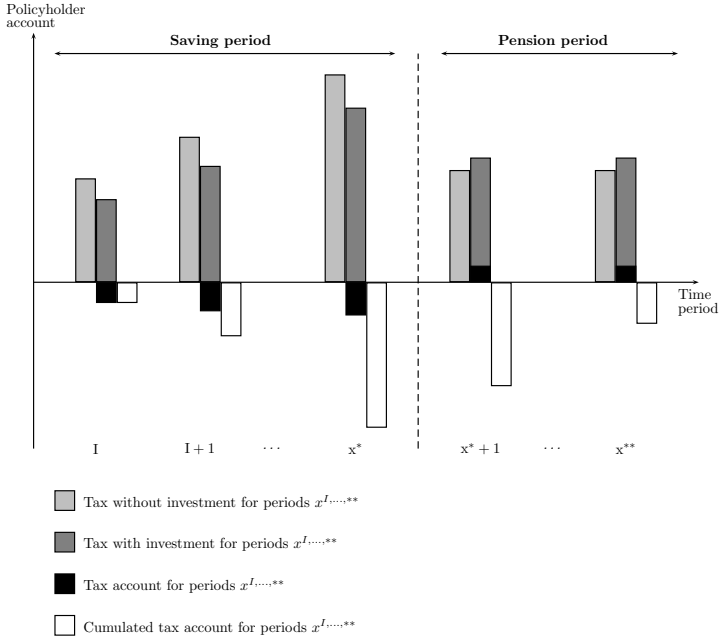


Figure 5: Model framework of the customer tax account for the saving period (time periods I, \dots, x^*) and the pension period (time periods $x^* + 1, \dots, x^{**}$). The tax account for time periods I, \dots, x^{**} (black boxes) is calculated as the difference of taxes payable with and without a Riester or non-Riester investment. The cumulated tax account for periods I, \dots, x^{**} reports tax benefits or taxes payable for each time period. The terminal cumulated tax account in time period x^{**} can thus be either positive or negative.

Equation 6 calculates the compounded tax effect that arises from a Riester or non-Riester investment in period x^* . In the first part of the

equation, an alternative investment rate of $r_{(alt)} = 4.0\%$ is applied for the saving period from I, \dots, x^* . In the second part of the equation, a risk-free interest rate of $r_{rf} = 1.5\%$ is utilized. Period x^* as the reference point is introduced for calculations of product performance ratios in Section F.2.

$$TAX_{x^*} = \sum [[(I_{(t,R)} \cdot tax_{(t,R)}) - (I_{(t,WR)} \cdot tax_{(t,WR)})] \cdot (1 + r_{(alt)})^{x^* - t}] + \sum [[(I_{(t,R)} \cdot tax_{(t,R)}) - (I_{(t,WR)} \cdot tax_{(t,WR)})] \cdot (1 + r_{(rf)})^{-(x^* - t)}] \quad (6)$$

D Riester and non-Riester products

The two most important Riester products (in percentage market share¹⁴) in the German market are utilized in our model. These are Riester life insurance and Riester fund products. Furthermore, a non-Riester ETF product is introduced. The following section introduces the detailed cost structures (Sections D.1.1, D.2.1 and D.3.1) and the development of the product underlyings (Sections D.1.2, D.2.2 and D.3.2) as well as policyholder account development mechanisms (Sections D.1.3, D.2.3 and D.3.3) for the three product categories. These model parameters complete the model with transfer payments, which was introduced in Section C.1 (see also Figure 3 and 4). The product framework (with regard to costs, asset developments and policyholder accounts) has been developed in our previous research paper on the Riester pension scheme (see Mahlow et al., 2013). Formulations and descriptions in the forthcoming section are thus often identical to our earlier work.

D.1 Riester life insurance product

Riester life insurance contracts guarantee a fixed minimum annual interest rate of $r^{(g)} = 1.75\%$ ¹⁵. This option can be interpreted as a cliquet-style-option because of the annual guarantee (before costs). Riester life

¹⁴Riester life insurance products had a market share of around 72% and Riester fund products of around 19% in 2011.

¹⁵As of September 2013, $r^{(g)} = 1.75\%$ is the maximum annual interest rate that the German government allows insurance companies to grant their customers.

insurance contracts grant death benefit options to the customer for the case of mortality during the pay out period of the insurance contract. This allows to transfer the pension payments to the investor's spouse or children. The remainder of this section introduces the cost structure, the underlying and the policyholder account of the Riester life insurance product.

D.1.1 Cost structure of the Riester life insurance product

Costs for the Riester life insurance product are applied as summarized in Table 18. Issuance costs ($K_t^{(\text{RL}),\text{iss}}$), acquisition costs ($K_t^{(\text{RL}),\text{acq}}$) and administration costs ($K_t^{(\text{RL}),\text{adm}}$) are the relevant cost categories. The amount of issuance costs that the policyholder has to pay over the contractual time period is calculated as a percentage ($k_t^{(\text{RL}),\text{iss}}$) of the cumulated premiums that the policyholder pays for the saving period. The total sum of issuance costs is allocated to the first five years of the saving period. Acquisition costs are calculated as a percentage ($k_t^{(\text{RL}),\text{acq}}$) of the annual premium payments and are due in every year of the saving period. Administration costs are calculated as a percentage value ($k_t^{(\text{RL}),\text{adm}}$) of the policyholder account for the saving period. To calculate administration costs, issuance and acquisition costs are first deducted from the policyholder account and then administration costs are calculated on basis of the remainder ($C_{t-}^{\text{RL}} + P_t^{\text{O,T}} - K_t^{(\text{RL}),\text{iss}} - K_t^{(\text{RL}),\text{acq}}$).

| Category | Cost calculation $K_t^{(\text{RL})}$ | Times |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Issuance | $K_t^{(\text{RL}),\text{iss}} \begin{cases} k_t^{(\text{RL}),\text{iss}} \cdot 1/5 \cdot P_t^{\text{O,T}} \cdot (x^* - x^I) \\ 0 \end{cases}$ | $t = I - 1, \dots, I + 4$ $t = I + 5, \dots, x^* - 1$ |
| Acq. | $K_t^{(\text{RL}),\text{acq}} = k_t^{(\text{RL}),\text{acq}} \cdot P_t^{\text{O,T}}$ | $t = I - 1, \dots, x^* - 1$ |
| Admin. | $K_t^{(\text{RL}),\text{adm}} \begin{cases} k_t^{(\text{RL}),\text{adm}} \cdot (C_t^{(\text{RL})} - K_t^{(\text{RL}),\text{iss}} - K_t^{(\text{RL}),\text{acq}}) \\ k_t^{(\text{RL}),\text{adm}} \cdot (C_{t-}^{(\text{RL})} + P_t^{\text{O,T}} - K_t^{(\text{RL}),\text{iss}} - K_t^{(\text{RL}),\text{acq}}) \end{cases}$ | $t = I - 1$ $t = I, \dots, x^* - 1$ |

Table 18: Categories and calculation of costs in the Riester life insurance product (RL).

D.1.2 Underlying of the Riester life insurance product

The underlying investment performance of the Riester life insurance product is related to the overall investment of the insurer. Addition-

ally for the calculation of the endowment, a minimum return guarantee $r^{(g)}$ applies in every period. In practice, insurance companies derive profits from interest profits, mortality profits and administration profits that are distributed to customers. We assume the surplus profit distribution $r_t^{(p)}$ in times $t = I, \dots, x^*$ is given by:

$$r_t^{(p)} = \mathcal{N} \left[\mu(r^{(p)}), \sigma(r^{(p)}) \right], \quad (7)$$

where \mathcal{N} stands for the normal distribution with mean $\mu(r^{(p)})$ and standard deviation $\sigma(r^{(p)})$. In our application we use historical values of the surplus distribution, see Table 25, to calibrate the mean value and the volatility. The model uses the maximum of $r_t^{(p)}$ and the guarantee $r^{(g)}$ denoted by $\max(r^{(g)}; r_t^{(p)})$ for the development of the policyholder account. Thus $C_t^{(RL)}$ earns an interest rate which is the greater of the guaranteed interest rate $r^{(g)}$ and the surplus return $r_t^{(p)}$.

D.1.3 Customer account of the Riester life insurance product

Table 19 illustrates the development of the policyholder account of the Riester life insurance product C_t^{RL} for times $I - 1, \dots, x^{**}$ (time periods I, \dots, x^{**}). At the beginning of each time period (+) I, \dots, x^* , the annual total premium $P_t^{O,T}$ is given by the investor's own premium payments P_t^O and the sum of governmental transfer payments P_t^T received. Cumulated product costs $\sum K_t^{RL}$ are also deducted at the beginning of each time period I, \dots, x^* after premium payments are made to the contract. At the end (−) of each time period from I, \dots, x^{**} , product endowments are made. For time periods from I, \dots, x^* , the underlying asset develops according to the formulation in Section D.1.2. For time periods from $x^* + 1, \dots, x^{**}$, a constant annual return of $r^{pen} = 4.0\%$ (after costs) is utilized. Pension payouts PE_t are made at the end of each time period from $x^* + 1, \dots, x^{**}$.

| Times | Value of customer account $C_t^{(\text{RL})}$ |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $t = I - 1$ | $C_{0+}^{(\text{RL})} = P_t^{\text{O,T}} - \sum K_0^{(\text{RL})}$ |
| $t = I, \dots, x^* - 1$ | $C_{t-}^{(\text{RL})} = C_{(t-1)}^{(\text{RL})} \cdot (1 + \max(r^{(\text{g})}; r_t^{(\text{p})}))$ $C_{t+}^{(\text{RL})} = C_{t-}^{(\text{RL})} + P_t^{\text{O,T}} - \sum K_t^{(\text{RL})}$ |
| $t = x^*$ | $C_{x^*}^{(\text{RL})} = C_{x^*-}^{(\text{RL})} = C_{x^*-1}^{(\text{RL})} \cdot (1 + \max(r^{(\text{g})}; r_t^{(\text{p})})) - \sum K_{x^*}^{(\text{RL})}$ |
| $t = x^* + 1, \dots, x^{**}$ | $C_t^{(\text{RL})} = C_{(t-1)}^{(\text{RL})} \cdot r^{\text{pen}} - PE_t$ |

Table 19: Value of the policyholder account for the Riester life insurance product (RL) for times $t = I - 1, \dots, x^{**}$.

D.2 Riester fund product

Riester fund products offer a guaranteed interest rate of 0.0% (preservation guarantee of premiums) to the investor. Different from the Riester insurance product, this guarantee is only valid for contracts that are held until maturity in x^* . If a contract is terminated before that time $t < x^*$, the investor receives the current value of the policyholder account C_t^{RF} (which can have any value). During the saving period, most issuers of Riester fund products gradually reduce the investors' exposure to volatile investments (e.g., stock market) and shift to more secure investments (e.g. government bonds). The issuer of the Riester fund product guarantees pension payments until the investor's age of $x^{**} = 85$. For times $t > x^{**} = 85$, the issuer guarantees for the pension payments through a life insurance contract, which is bought in $t = x^{**}$. Riester fund products offer a death benefit option to the investor. This option allows the investor to transfer the own pension payouts for times $t = I, \dots, x^{**}$ to a heiress. All options that apply during the pension period are not relevant in our model.

D.2.1 Cost structure of the Riester fund product

For the Riester fund product, issuance, acquisition, depot and administration costs are relevant. All costs are deducted from the policyholder account on an annual basis and apply for time periods I, \dots, x^* . Is-

suance $K_t^{(\text{RF}),\text{iss}}$ and acquisition $K_t^{(\text{RF}),\text{acq}}$ costs are calculated as a percentage ($k_t^{(\text{RF}),\text{iss}}$, $k_t^{(\text{RF}),\text{acq}}$) of the annual premium payments P , depot fees $K_t^{(\text{RF}),\text{dep}}$ are deducted in absolute values (currency units). After the deduction of issuance, acquisition and depot fees from the policyholder account, administration costs $K_t^{(\text{RF}),\text{adm}}$ are calculated on basis of the current value of the policyholder account ($C_t^{\text{RF}} + P_t^{O,T} - K_t^{(\text{RF}),\text{iss}} - K_t^{(\text{RF}),\text{acq}} - K_t^{(\text{RF}),\text{dep}}$). Costs are summarized in Table 20:

| Category | Cost calculation $K_t^{(\text{RF})}$ | Times |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Issuance | $K_t^{(\text{RF}),\text{iss}} = k_t^{(\text{RF}),\text{iss}} \cdot P_t^{O,T}$ | $t = I - 1, \dots, x^* - 1$ |
| Acquis. | $K_t^{(\text{RF}),\text{acq}} = k_t^{(\text{RF}),\text{acq}} \cdot P_t^{O,T}$ | $t = I - 1, \dots, x^* - 1$ |
| Depot | $K_t^{(\text{RF}),\text{dep}} = k_t^{(\text{RF}),\text{dep}}$ | $t = I - 1, \dots, x^* - 1$ |
| Admin. | $K_t^{(\text{RF}),\text{adm}} = \begin{cases} k_t^{(\text{RF}),\text{adm}} \cdot (C_t^{(\text{RF})} - K_t^{(\text{RF}),\text{iss}} - K_t^{(\text{RF}),\text{acq}} - K_t^{(\text{RF}),\text{dep}}) \\ k_t^{(\text{RF}),\text{adm}} \cdot (C_t^{\text{RF}} + P_t^{O,T} - K_t^{(\text{RF}),\text{iss}} - K_t^{(\text{RF}),\text{acq}} - K_t^{(\text{RF}),\text{dep}}) \end{cases}$ | $t = I - 1$ $t = I, \dots, x^* - 1$ |

Table 20: Categories and calculation of costs in the Riester fund product (RF).

D.2.2 Underlying of the Riester fund product

The evolution of the policyholder account strongly depends on the performance of the fund, where the premiums are invested. The calculation of annual endowments for the policyholder account is linked to the development of the underlying investment. The underlying assets typically represent a fund composed of different stocks. Let $A_0^{(\text{RF})}$ denote the initial value of the underlying assets. We assume the asset development process to follow a Geometric Brownian Motion (GBM). Thus, the development of the underlying assets $A_t^{(\text{RF})}$ for $t = I, \dots, x^*$ is given by

$$A_t^{(\text{RF})} = A_{t-1}^{(\text{RF})} \cdot \exp[\mu_{t,\text{GBM}} - \sigma_{t,\text{GBM}}^2/2 + \sigma_{t,\text{GBM}}(W_t^{\mathbb{P}} - W_{t-1}^{\mathbb{P}})], \quad (8)$$

where μ_{GBM} and σ_{GBM} represent a given deterministic drift and volatility for the underlying asset and $W_t^{\mathbb{P}}$ denotes a standard Brownian Motion. The yearly returns $A_t^{(\text{RF})}/A_{t-1}^{(\text{RF})}$, $t = 1, \dots, x^*$, are used to define the endowments to the policyholder account. Towards the end of the saving period, Riester fund products offer the possibility to shift the investment from one fund to another in order to reduce the risk exposure. Thus, the underlying assets may be changed, which will translate in our framework in a different value of the underlying's performance $(\mu_{\text{GBM}}, \sigma_{\text{GBM}})$.

D.2.3 Customer account of the Riester fund product

The development of the Riester fund product policyholder account $C_t^{(\text{RF})}$ for time periods $t = I, \dots, x^{**}$ is reported in this paragraph. The development is identical to the mechanism of the policyholder account development for the Riester life insurance product $C_t^{(\text{RL})}$ as introduced in Section D.1.3. Differences apply through the consideration of the underlying asset development $A_t^{(\text{RF})}$ and the product guarantee. The 0.0% point-to-point guarantee (before costs) is considered in time $t = x^*$ by choosing the maximum of the terminal policyholder account that arises if the underlying product asset $A_t^{(\text{RF})}$ is applied to the policyholder account development and if the sum of all premium payments $\sum P_t^{\text{O,T}}$ for time periods I, \dots, x^* (after costs) as the policyholder account value is used. Table 23 summarizes the development of the policyholder account $C_t^{(\text{RF})}$ for times $t = I - 1, \dots, x^{**}$:

| Times | Value of customer account $C_t^{(\text{RF})}$ |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $t = I - 1$ | $C_{0+}^{(\text{RF})} = P_t^{\text{O,T}} - \sum K_0^{(\text{RF})}$ |
| $t = I, \dots, x^* - 1$ | $C_{t-}^{(\text{RF})} = C_{(t-1)+}^{(\text{RF})} \cdot A_t^{(\text{RF})} / A_{t-1}^{(\text{RF})}$ $C_{t+}^{(\text{RF})} = C_{t-}^{(\text{RF})} + P_t^{\text{O,T}} - \sum K_t^{(\text{RF})}$ |
| $t = x^*$ | $C_{x^*}^{(\text{RF})} = C_{x^*-}^{(\text{RF})} = \max C_{(x^*-1)+}^{(\text{RF})} \cdot A_{x^*}^{(\text{RF})} / A_{(x^*-1)}^{(\text{RF})}; x^* \cdot P_t^{\text{O,T}} - \sum K_t^{(\text{RF})}$ |
| $t = x^* + 1, \dots, x^{**}$ | $C_t^{(\text{RF})} = C_{(t-1)}^{(\text{RF})} \cdot r^{\text{pen}} - PE_t$ |

Table 21: Calculation of policyholder account for product (RF).

D.3 Non-Riester ETF product

The non-Riester ETF product (ETF) is introduced as the investment alternative to the Riester life insurance and Riester fund product. Considering the central model mechanisms, the non-Riester product is most similar to the Riester fund product. The biggest difference is the missing investment guarantee for investors. Thus, the investor always receives the current value of the policyholder account C_t^{ETF} (which can have any value) for time periods I, \dots, x^* if the product is sold. There are no other options that the non-Riester product grants to potential investors.

D.3.1 Cost structure of the non-Riester ETF product

For the non-Riester ETF product, issuance and administration costs are relevant. All costs are deducted from the policyholder account on an annual basis and apply through time periods I, \dots, x^* . Issuance costs $K_t^{(\text{ETF}),\text{iss}}$ are calculated as a percentage ($k_t^{(\text{ETF}),\text{iss}}$) on basis of the annual premium payments $P_t^{\text{O,T}}$. After the deduction of issuance costs from the policyholder account, administration costs $K_t^{(\text{ETF}),\text{adm}}$ are calculated on the basis of the current value of the policyholder account $P_{t-}^{\text{ETF}} + P_t^{\text{O,T}} - K_t^{(\text{ETF}),\text{iss}}$. Costs are summarized in Table 22:

| Category | Cost calculation $K_t^{(\text{ETF})}$ | | Times |
|----------|---------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------|
| Issuance | $K_t^{(\text{ETF}),\text{iss}}$ | $= k_t^{(\text{ETF}),\text{iss}} \cdot P_t^{\text{O,T}}$ | $t = I - 1, \dots, x^* - 1$ |
| Admin. | $K_t^{(\text{ETF}),\text{adm}}$ | $k_t^{(\text{ETF}),\text{adm}} \cdot (C^{(\text{ETF})} - K_t^{(\text{ETF}),\text{iss}})$ | $t = I - 1$ |
| | | $k_t^{(\text{ETF}),\text{adm}} \cdot (C_{t-}^{\text{ETF}} + P_t^{\text{O,T}} - K_t^{(\text{ETF}),\text{iss}})$ | $t = I, \dots, x^* - 1$ |

Table 22: Categories and calculation of costs in the non-Riester ETF product (ETF).

D.3.2 Underlying of the non-Riester ETF product

The development mechanism for the non-Riester ETF underlying is the same as for the Riester fund product. Thus, the annual endowments to the policyholder account are linked to the development of the underlying investment. Let $A_0^{(\text{ETF})}$ denote the initial value of the underlying assets. By assumption, the asset development process again follows a Geometric Brownian Motion (GBM). Thus, the development of the underlying assets $A_t^{(\text{ETF})}$ for time periods $t = I, \dots, x^*$ is given by

$$A_t^{(\text{ETF})} = A_{t-1}^{(\text{ETF})} \cdot \exp[\mu_{t,\text{GBM}} - \sigma_{t,\text{GBM}}^2/2 + \sigma_{t,\text{GBM}}(W_t^{\mathbb{P}} - W_{t-1}^{\mathbb{P}})], \quad (9)$$

where μ_{GBM} and σ_{GBM} represent a given deterministic drift and volatility for the underlying asset and $W_t^{\mathbb{P}}$ denotes a standard Brownian Motion. Annual returns $A_t^{(\text{ETF})}/A_{t-1}^{(\text{ETF})}$, $t = 1, \dots, x^*$ are used to define the endowments to the policyholder account.

D.3.3 Customer account of the non-Riester ETF product

The development of the non-Riester ETF product policyholder account $C_t^{(\text{ETF})}$ for time periods $t = I, \dots, x^{**}$ is reported in Table 23 of this paragraph. The development is identical to the development of the Riester fund product if no investment guarantee (point-to-point guarantee) is applied.

| Times | Value of customer account $C_t^{(\text{ETF})}$ |
|------------------------------|-------------------------------------------------------------------------------------------------------|
| $t = I - 1$ | $C_{0+}^{(\text{ETF})} = P_t^{\text{O,T}} - \sum K_0^{(\text{ETF})}$ |
| $t = I, \dots, x^*$ | $C_{t-}^{(\text{ETF})} = C_{(t-1)+}^{(\text{ETF})} \cdot A_t^{(\text{ETF})} / A_{t-1}^{(\text{ETF})}$ |
| | $C_{t+}^{(\text{ETF})} = C_{t-}^{(\text{ETF})} + P_t^{\text{O,T}} - \sum K_t^{(\text{ETF})}$ |
| $t = x^* + 1, \dots, x^{**}$ | $C_t^{(\text{ETF})} = C_{(t-1)}^{(\text{ETF})} \cdot r^{pen} - PE_t$ |

Table 23: Calculation of policyholder account for the non-Riester ETF product (ETF).

E Investor and product parametrization

This section introduces Riester model investors and product parameters that are used for numerical calculations in Section F. Riester model investors are parametrized for the *Microcensus sample*, which is introduced in detail in Section E.1. The Microcensus sample is based on data of the German Microcensus from 2009¹⁶. Product parameters for the Riester life insurance and fund product are considered as market values for average product providers.

¹⁶The German Microcensus is a representative sample of the German population with around 370 000 households and around 830 000 individuals. The Microcensus is annually conducted by the German Federal Statistical Office and results are made available for academic use through the SUF - Scientific Use File. Latest data available in the SUF-format as of September 2013 is from the 2009 Microcensus.

E.1 Parametrization of Riester model investors

Next, the *Microcensus sample* of potential Riester investors is introduced in detail. The sample is structured along annual investor income¹⁷, number of children¹⁸ and personal age¹⁹. In addition to the product parameters, these investor attributes are the key parameters that determine the development of Riester investments. This applies for the investment period $x^* - I$ and the amount of own premium payments P_t^O and transfer payments P_t^T ²⁰.

The Microcensus sample provides the central input parameters for the parametrization of Riester investors and consists of data from the 2009 German Microcensus. The Microcensus provides data for the German population on basis of around 370 000 households and provides different attributes (each attribute is referenced with an individual code). To derive the Riester sample, the total Microcensus data sample was divided into the part of the population that is either directly or indirectly entitled to Riester investments and the part of the population that is not entitled to Riester investments (see the Appendix to this paper). In a second step, the sample of Riester entitled investors was clustered along the attributes number of children, personal annual gross income and investor age²¹. For every household, the so called household-reference-person was chosen as the potential Riester investor²². In the following, the deductions of parameters and their clustering are explained. The Microcensus sample includes investors with zero to four children. The 2009 total German Microcensus sample reports zero to fourteen children per household, while households with five to fourteen children account for only 0.26% of all German households. Because of the small quantity, households with

¹⁷Annual investor income is measured in annual gross income before income taxes and after social security taxes.

¹⁸Number of children reflects the number of children that are living in the household of the respective investor and who are entitled to governmental children grants.

¹⁹Personal investor age is measured in years.

²⁰The model assumes, that every investor pays a constant 4% of the annual taxable gross income into the Riester contract (reduced by potential Governmental transfer payments) to receive the full amount of Governmental transfer payments.

²¹Number of children in the household with Microcensus code=*EF669*, annual investor net income=*EF436* and investor age=*EF44*.

²²Microcensus code *EF710* within the 2009 German Microcensus.

five and more children are not included in our numerical calculations. Investor income for the Riester Microcensus sample has to be considered as annual gross income (before income taxes). Since the German Microcensus reports monthly available household and investor net income, we transfer these values into annual gross income (pretax income). To convert net incomes from the Microcensus into gross incomes, we apply results for average income tax rates and social security contributions from the Cologne Institute for Economic Research²³. The German Microcensus reports investor incomes in 24 sections, which range from €0 to \geq €277 700 if transferred into annual gross income. For the Riester Microcensus sample, we use the mean value for each of these 24 income sections and cluster those again in three categories. Category one (low incomes) ranges from €0 to €21 500, category two (medium incomes) from €25 800 to €66 300 and category three (high incomes) from €74 100 to \geq € 277 700. Investor age as the second determinant is considered in the Microcensus sample for ranges from 18 to 60 years. For consolidation purposes, four ages are summarized into *category one=18-30 years*, *category two=31-40 years*, *category three=41-50 years*, *category four=51-60 years*. Although potential Riester investors can be below the age of 18 or above the age of 60, they are not included in the Microcensus sample because of very small investor numbers for these ages. Numerical results in Section F are reported as average values for each age category.

²³For detailed information see www.iwkoeln.de *Distribution of Taxes and Social Security Contributions in Germany* by Dr. Thilo Schäfer.

| 18-30 years | | | | 31-40 years | | | |
|--------------|-------|--------|------|--------------|-------|--------|------|
| <i>Child</i> | Low | Medium | High | <i>Child</i> | Low | Medium | High |
| 0 | 11.3% | 3.4% | 0.0% | 0 | 10.3% | 5.7% | 0.2% |
| 1 | 1.1% | 0.4% | 0.0% | 1 | 1.6% | 1.7% | 0.1% |
| 2 | 0.4% | 0.3% | 0.0% | 2 | 1.2% | 2.1% | 0.2% |
| 3 | 0.1% | 0.0% | 0.0% | 3 | 0.3% | 0.6% | 0.0% |
| 4 | 0.0% | 0.0% | 0.0% | 4 | 0.1% | 0.2% | 0.0% |

| 41-50 years | | | | 51-60 years | | | |
|--------------|-------|--------|------|--------------|-------|--------|------|
| <i>Child</i> | Low | Medium | High | <i>Child</i> | Low | Medium | High |
| 0 | 14.0% | 7.2% | 0.4% | 0 | 13.1% | 7.1% | 0.5% |
| 1 | 2.2% | 2.7% | 0.2% | 1 | 1.1% | 1.7% | 0.2% |
| 2 | 1.3% | 3.3% | 0.4% | 2 | 0.3% | 0.9% | 0.2% |
| 3 | 0.3% | 0.9% | 0.1% | 3 | 0.1% | 0.2% | 0.0% |
| 4 | 0.1% | 0.2% | 0.0% | 4 | 0.0% | 0.1% | 0.0% |

Table 24: Percentage values per category and attribute represent the distribution of potential Riester investors as from the total Microcensus sample. Potential investors are clustered along age, personal income categories and number of children.

E.1.1 Parametrization of Riester and non-Riester products

The Riester life insurance product (RL) and Riester fund product (RF) are parametrized along market data for average product issuers in each category. For the Riester life insurance product, we use market values from Allianz Life, which is the issuer with the largest Riester market share²⁴. Performance parameters (μ and σ) are retrieved from Map-Report (see Poweleit (2012)) and information on the cost structure from Morgen & Morgen (see Morgen & Morgen (2012)). We use the eight year average performance (μ) and standard deviation (σ) from 2004 to 2011 as input parameters for the numerical calculations. For the corresponding values of issuance, acquisition and administration costs, we use data from March 2012.

For the Riester fund product, performance and cost data is utilized from DWS. DWS (subsidiary of Deutsche Bank) is one of the three largest Riester fund product issuers in Germany. Contrary to the market for Riester life insurances, market shares for Riester fund products are

²⁴Allianz Life had a market share of around 14% in 2012.

distributed among three product issuers²⁵. The DWS Riester fund product has a performance, which is above the performance of products from Union Investment and Deka. The corresponding performance parameters for DWS (μ and σ) from 2009 to 2011 are retrieved from Bloomberg and values for issuance, acquisition, administration and depot costs are taken from product information letters. The product performance (μ) and standard deviation (σ) is calculated as the 3-year average on an annual basis. As introduced in Section D.2, Riester fund product providers can switch product funds towards the end of the saving period into less volatile underlying funds. For numerical calculations in Section F the model assumes, that there is no fund switch towards the end of the saving period. Table 25 summarizes the performance and cost values for the chosen Riester life insurance and Riester fund product issuers.

The non-Riester ETF product (ETF) is parametrized according to the fund performance of the Riester fund product (RF) to introduce a comparable product. By assumption, the underlying of the Riester fund product can be acquired through the investment in an ETF product. Thus, the cost structure of the non-Riester ETF product (ETF) is significantly lower and different from the Riester fund product (RF).

| | Performance | | Costs | | | |
|-------|-------------|-----------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------|
| | Return | Std. dev. | Issuance | Acquisition | Administration | Depot |
| | μ | σ | $k_t^{(\text{RL}, \text{RF}), \text{iss}}$ | $k_t^{(\text{RL}, \text{RF}), \text{acq}}$ | $k_t^{(\text{RL}, \text{RF}), \text{adm}}$ | $k_t^{(\text{RF}), \text{dep}}$ |
| (RL) | 4.40% | 0.20% | 4.00% | 4.50% | 0.70% | - |
| (RF) | 8.70% | 18.60% | 4.10% | 0.50% | 1.40% | €15.40 |
| (ETF) | 8.70% | 18.60% | 1.00% | - | 0.30% | - |

Table 25: Parametrization of the performance and costs of the Riester life insurance (RL), Riester fund product (RF) and non-Riester ETF product (ETF). Performance and cost values for the Riester life insurance product are taken from Allianz Life and from DWS for the Riester fund product. The performance of the non-Riester ETF product (μ and σ) is by assumption the same as the performance of the Riester fund product (RF).

²⁵In March 2012, DWS, Union Investment and Deka had a combined market share of around 99% in the category of Riester fund products. From this, DWS had a market share of around 22%.

F Numerical results

Next, the Riester and non-Riester products are evaluated on basis of performance measures. Special focus in the numerical section lies on the measurement of the performance effect of governmental transfer payments (P_t^T) and investor income taxes. Numerical calculations are herefore conducted along the model framework with transfer payments (see Section C.1) and the model framework with tax account (see Section C.2). The section is structured as follows: Before product performance measures and the corresponding numerical results are reported, Section F.1 introduces the concept of funding rates. Funding rates show, to what degree a Riester investor is governmentally supported through transfer payments $\sum P_t^T$ in respect to total contract contributions $\sum P_t^{O,T}$. Funding rates are thus independent from the Riester product category that the investor purchases. Section F.2 introduces performance ratios to consider product return and risk simultaneously. The concept of performance ratios is derived from Sharpe Ratios by considering μ and σ at once. Performance measures are reported for Riester and non-Riester products for the saving and the pension period.

Performance ratio one PR^1 shows the annual product performance after costs on basis of total annual premium payments for times I, \dots, x^* (based on terminal policyholder account values). Effects of governmental transfer payments and investors' tax accounts on product performance are not separated in this measure. Performance ratio two PR^2 extends PR^1 by calculating the product performance on basis of investors' own premium payments P_t^O for times I, \dots, x^* . PR^2 can be taken as the product performance that an investor must receive by another investment (non-Riester product) to be indifferent between those options. Performance ratio three PR^3 defines product performance by including the tax account framework from Section C.2. In order to include tax effects, the tax account value (see Equation 6) is added to the terminal policyholder account value²⁶. Note, that Performance ratio two PR^2 and three PR^3 only apply to the Riester life insurance (RL) and Riester

²⁶Note, that the tax account TAX_{x^*} in $t = x^*$ can be either positive or negative, thus increasing or decreasing the value of the terminal policyholder account value in $t = x^*$.

fund products (RF) because only Riester investmetns are governmentally supported with transfer payments and tax benefits.

In Section F.3, internal rates of return (IRR) for Riester and non-Riester products are introduced. Contrary to performance ratios, the IRR is a performance measure that does not include a risk assessment (product volatility σ is not evaluated). Although internal rates of return are often criticized for lacking measurement of downside risk σ , the measure allows to make assessments for products if volatility is kept constant (between Riester life insurance, Riester fund and non-Riester ETF products). Internal rates of return are calculated in accordance with the calculation method of Performance ratios. Thus, IRR^1 calculates product performance on basis of terminal policyholder accounts in $t = x^*$ and the sum of annual premium payments, IRR^2 considers only own premium payments P_t^O and IRR^3 adds the customer tax account to the terminal policyholder account in $t = x^*$ to extend IRR^2 .

Numerical results that are reported in the remainder of this section are applied to the Microcensus sample from Section E.1. In addition to the model framework and the product and investor parametrization, the following assumptions are set: First, investors do not cancel the contract before maturity at the end of the saving period in $t = x^* = 65$. Thus, investors also remain invested in the respective Riester products until the end of the pension period in $t = x^{**} = 85$. Second, all investors can deduct the maximum amount of €2100 per year for the reduction of income taxes. Third, investors do not use the paid-up-option for the saving period (for time periods I, \dots, x^*). All numerical results are obtained from Monte Carlo simulations with $N=500\,000$ realizations per case.

F.1 Analysis of funding rates

The following section defines the funding rate (FR) and reports the corresponding numerical results for the Microcensus sample. Riester funding rates express, to which extent an investor receives governmental transfer payments (as part of annual premium payments). By assumption, investors pay 4.0% of the annual taxable income as combined premium

payments $P_t^{O,T}$ in the Riester contract (up to a maximum of €2 100 per year). The calculation of funding rates is independent from the development of the policyholder account for Riester life insurance and Riester fund products. Thus, the only determinants for investor funding rates (FR) are investor income, investor age and number of children. The following equation 10 shows the calculation of investor funding rates:

$$\text{Funding Rate (FR)} = \frac{PV_I[\sum_{t=I}^{x^*} P_t^T]}{PV_I[\sum_{t=I}^{x^*} P_t^{O,T}]}, \quad (10)$$

where $PV_I[\sum_{t=I}^{x^*} P_t^T]$ represents the present value (PV) of the sum of governmental transfer payments P_t^T that the investor receives during the saving period for time periods I, \dots, x^* in time $t = I$. Transfer payments are discounted with a risk free interest rate of $r^f = 1.5\%$. $PV_I[\sum_{t=I}^{x^*} P_t^{O,T}]$ calculates the present value (PV) in $t = I$ for all combined premium payments $P_t^{O,T}$ (own premium and governmental premium payments) for all time periods during the saving period I, \dots, x^* .

Looking at investor funding rates, two central findings can be obtained: First, funding rates for investors with children are significantly higher than funding rates for investors without children. Second, the investor income has a large impact on the funding rate, since funding rates are decreasing with increased investor incomes. For incomes of €52 500 and above, funding rates remain on a constant level²⁷.

Linking the results for funding rates from Table 26 to the analysis of Riester investors (see Table 24) allows to add to the discussion, which parts of the German population are funded to which degrees. Considering funding rates for the Microcensus sample reveals that on average almost all investors have funding rates of 10.0% and above. Only investors without children from the high income category have lower funding rates of 7.3% on average. Linking these results to the Microcensus sample shows, that only 1.2% of Riester entitled investors receive an average funding rate of 7.3%. Potential Riester investors from the low

²⁷€ 52 500 is the income level at which an annual combined premium payment $P_t^{O,T}$ of €2 100 is reached if the investor pays 4.0% of the annual income into the contract. The model assumes that an investor pays 4.0% of the annual income up to an income of €52 500 and for incomes at this level and above a constant combined premium payment of $P_t^{O,T} = € 2 100$.

income category with one to four children have a minimum funding rate of 37.0%. This investor group accounts for 8.5% of all Riester investors. The largest group of potential Riester investors (48.7%) has low incomes and zero children and an average funding rate of 29.4%. Investors with medium incomes and one to four children (14.4% of all possible Riester investors) receive a minimum funding rate of 12.5%. Taking investors with high incomes and one to four children (1.5% of all possible Riester investors) into the analysis leads to minimum funding rates of 9.5%. Summarizing the results of funding rates for Microcensus sample shows that the largest parts of investors who are entitled to Riester investments can receive significant governmental support. Only small parts of the population (with significantly above average incomes) have funding rates of 10.0% and below.

| 18-30 years | | | | 31-40 years | | | |
|--------------|-------|--------|------|--------------|-------|--------|-------|
| <i>Child</i> | Low | Medium | High | <i>Child</i> | Low | Medium | High |
| 0 | 29.4% | 9.6% | 7.3% | 0 | 29.4% | 9.6% | 7.3% |
| 1 | n.a. | n.a. | n.a. | 1 | 59.8% | 21.9% | 16.7% |
| 2 | n.a. | n.a. | n.a. | 2 | 76.9% | 35.6% | 27.1% |
| 3 | n.a. | n.a. | n.a. | 3 | 85.0% | 50.1% | 38.5% |
| 4 | n.a. | n.a. | n.a. | 4 | 89.2% | 62.6% | 50.4% |

| 41-50 years | | | | 51-60 years | | | |
|--------------|-------|--------|-------|--------------|-------|--------|-------|
| <i>Child</i> | Low | Medium | High | <i>Child</i> | Low | Medium | High |
| 0 | 29.4% | 9.6% | 7.3% | 0 | 29.4% | 9.6% | 7.3% |
| 1 | 51.9% | 18.5% | 14.1% | 1 | 37.0% | 12.5% | 9.5% |
| 2 | 68.0% | 29.4% | 22.4% | 2 | 49.6% | 18.6% | 14.2% |
| 3 | 78.3% | 42.0% | 32.2% | 3 | 63.4% | 27.8% | 21.2% |
| 4 | 84.6% | 53.8% | 42.8% | 4 | 73.4% | 38.0% | 29.5% |

Table 26: Funding rates for the Microcensus sample

F.2 Product performance according to Performance Ratios

Performance ratios for the performance measurement of Riester life insurance, Riester fund and non-Riester ETF products are applied in this section. The concept of performance ratios is utilized because it allows to consider the effects that different performance volatilities σ have. For the numerical calculations in the remainder of this section, the following equation is applied to derive Performance ratios:

$$\text{Performance ratio 1-3 (PR)} = \frac{E[C_{x^*}^{(RL,RF,ETF)}] - Y_{x^*}}{\sigma[C_{x^*}^{(RL,RF,ETF)}]}, \quad (11)$$

where $E[C_{x^*}^{(RL,RF,ETF)}]$ reflects the expected terminal policyholder account value for Riester life insurance, Riester fund or non-Riester ETF product at the end of the saving period in $t = x^*$ for Performance Ratios PR^1 and PR^2 . For Performance ratio PR^3 , the investor tax account TAX_{x^*} in $t = x^*$ has to be added to the expected terminal policyholder account value $E[C_{x^*}^{(RL,RF,ETF)}]$.

By adding the value of the tax account to the terminal policyholder account value, the terminal policyholder account value $E[C_{x^*}^{(RL,RF,ETF)}]$ is either increased or decreased. Y_{x^*} calculates the alternative risk-free investment if the investor does not invest into the Riester or non-Riester product of the product framework. For PR^1 , the value of the alternative investment in $t = x^*$ is calculated with the combined annual premium payments $P_t^{O,T}$ at an annual risk-free interest rate of $r^f = 1.50\%$ for time periods I, \dots, x^* . For PR^2 and PR^3 , the value of the alternative investment is derived from investors' own annual premium payments P_t^O because the second and third Performance ratio show the effect that governmental transfer payments P_t^T have on the product performances. The last parameter in equation 11 $\sigma[C_{x^*}^{(RL,RF,ETF)}]$ shows the standard deviation of the Riester and non-Riester products and measures the product performance downside-risk.

In the remainder of this section, performance ratios are reported for Riester life insurance, Riester fund and non-Riester ETF products along investor parameters from the Microcensus sample (see Section E.1). Numerical input parameters for the calculation of Sortino ratios ($E[C_{x^*}^{(RL,RF,ETF)}]$, Y_{x^*} , $\sigma[C_{x^*}^{(RL,RF,ETF)}]$) are not reported because of the large amount of numbers. This section discusses Performance ratios for sample investors with medium incomes in detail. Results for Microcensus investors with low and high incomes are reported in the Appendix. If, however performance differences between the three income groups occur, those findings are discussed in the following sections.

Results for PR^1 : For PR^1 , results do not depend on the number of children, because annual premium payments $P_t^{O,T}$ are considered simultaneously. Results for PR^1 along investors of the Microcensus sample lead to the following results (see also Table 27): The Riester life insurance product (RL) is ranked highest according to PR^1 before the Riester fund product (RF) and the non-Riester ETF product (ETF) for all investors with medium incomes. The Riester life insurance products reach average Performance ratios, ranging from 11.2954 to 33.9235 for investor ages from 18 to 60 years. Both the Riester fund product ($PR^1=0.6809$ to 0.8522) and the non-Riester ETF product ($PR^1=0.6919$ to 0.9523) have performances that are significantly below the Riester life insurance product performance. Within this setting, the non-Riester ETF product outperforms the Riester fund product slightly. Performance ratios for the Riester life insurance product (RL) on the one hand and for the fund products on the other hand (RF and ETF) show opposite development trends for increasing investor ages. Product performance decreases for rising investor ages for the Riester life insurance product because of the high amount of issuance costs that are allocated to the first five years after contract inception (see product costs in Table 25). For the Riester and non Riester fund products the opposite is true because product volatility $\sigma[C_{x^*}^{(RL,RF,ETF)}]$ is lower for shorter investment periods.

| 18-30 years (medium income) | | | | 31-40 years (medium income) | | | |
|-----------------------------|-------|------|-------|-----------------------------|-------|------|-------|
| Child | (RL) | (RF) | (ETF) | Child | (RL) | (RF) | (ETF) |
| 0-4 | 33.92 | 0.68 | 0.69 | 0-4 | 32.60 | 0.80 | 0.84 |
| 41-50 years (medium income) | | | | 51-60 years (medium income) | | | |
| Child | (RL) | (RF) | (ETF) | Child | (RL) | (RF) | (ETF) |
| 0-4 | 22.84 | 0.85 | 0.95 | 0-4 | 11.30 | 0.80 | 0.95 |

Table 27: Performance ratio one (PR^1) is reported for Riester life insurance (RL), Riester fund (RF) and the non-Riester ETF product (ETF). Ratios are calculated for Microcensus investors with medium incomes (€ 25 800 to €66 300), zero to four children and different ages (18 to 30, 31 to 40, 41 to 50 and 51 to 60 years). Calculations are performed in accordance with the formulation in Equation 11.

Results for PR^2 : Performance ratio two as the performance measure for results in Table 28 calculates performances on basis of investors' own premium payments P_t^O . Thus, performance rates differ depending on the amount of governmental transfer payments P_t^T that the investor receives. PR^2 for the non-Riester ETF product (ETF) equals PR^1 because investors do not receive governmental transfer payments for investments in this product category. Looking at the effect of governmental transfer payments it is important to note, that children transfer payments make up for the largest amount of transfer payments for investors²⁸. Comparing Riester life insurance product performance for different numbers of children, the product performance rises on average from $PR^2=43.7193$ to $PR^2=73.7067$ for an investor with zero children in comparison to an investor with two children and ages from 31 to 40 years. This reflects a performance improvement of around 69%. This performance improvement at an increasing number of children holds true for all product categories (RL, RF and ETF) and investor age categories. However, this effect is significantly lower for fund products (Riester and non-Riester). This is because the Riester and non-Riester fund products (RF, ETF) have much higher expected return rate performances (see Table 25) and thus the effect of governmental transfer payments is not as significant as for Riester life insurance products (RL). Comparing the performance of the Riester fund product (RF) with the non-Riester ETF product (ETF), two main findings are relevant: First, the non-Riester ETF product (ETF) is superior to the Riester fund product for investors with zero children. The superiority of the non-Riester ETF product is driven by lower product costs than for the Riester product (RF). Second, for investors with two and more children, the Riester fund product (RF) becomes superior to the non-Riester ETF product (ETF). In these scenarios, governmental transfer payments P_t^T outweigh the advantages that the low cost structure of the ETF product (ETF) had over the Riester fund product (RF) for investors with zero children. Concluding the comparison of Riester (RL and RF) and non-Riester products (ETF) the previous analysis points out, that governmental transfer payments make

²⁸For each child, the investor receives annual transfer payments of €300. Own transfer payments account for €154 per year.

the Riester fund product superior to the non-Riester fund product in all cases where investors have one and more children. The Riester life insurance product (RL) however is significantly higher ranked than fund products (RF and ETF) in all settings because of lower performance volatility (σ).

| 18-30 years (medium income) | | | | 31-40 years (medium income) | | | |
|-----------------------------|-------|------|-------|-----------------------------|-------|------|-------|
| <i>Child</i> | (RL) | (RF) | (ETF) | <i>Child</i> | (RL) | (RF) | (ETF) |
| 0 | 40.41 | 0.69 | 0.69 | 0 | 43.72 | 0.82 | 0.84 |
| 1 | n.a. | n.a. | n.a. | 1 | 59.62 | 0.86 | 0.84 |
| 2 | n.a. | n.a. | n.a. | 2 | 73.70 | 0.90 | 0.84 |
| 3 | n.a. | n.a. | n.a. | 3 | 84.91 | 0.93 | 0.84 |
| 4 | n.a. | n.a. | n.a. | 4 | 92.73 | 0.95 | 0.84 |

| 41-50 years (medium income) | | | | 51-60 years (medium income) | | | |
|-----------------------------|--------|------|-------|-----------------------------|--------|------|-------|
| <i>Child</i> | (RL) | (RF) | (ETF) | <i>Child</i> | (RL) | (RF) | (ETF) |
| 0 | 38.67 | 0.92 | 0.95 | 0 | 33.14 | 0.93 | 0.95 |
| 1 | 55.77 | 0.99 | 0.95 | 1 | 43.72 | 0.99 | 0.95 |
| 2 | 76.09 | 1.07 | 0.95 | 2 | 61.77 | 1.10 | 0.95 |
| 3 | 98.73 | 1.16 | 0.95 | 3 | 86.69 | 1.24 | 0.95 |
| 4 | 118.74 | 1.24 | 0.95 | 4 | 112.53 | 1.39 | 0.95 |

Table 28: Performance ratio two (PR^2) is reported for Riester life insurance (RL), Riester fund (RF) and the non-Riester ETF product (ETF). Input parameters for investors and calculations are identical to results for PR^1 (see Table 27).

Results for PR^3 : Looking at PR^3 , the effect of investors' personal income taxes on the product performance is evaluated. Income taxes can either increase or decrease the product performance, depending on the tax account value TAX_{x^*} at the end of time period x^* . The comparison of PR^2 and PR^3 shows the resulting performance differences according to Performance ratios. For Riester life insurance (RL) investors, product performances are increased in all scenarios if tax accounts are taken into consideration. Increasing numbers of children however reduce the performance increase. An investor with zero children and ages from 18-30 years has a performance increase of around 180% ($PR^2=38.6699$ to $PR^3=114.7424$), whereas the same investor with 3 children has a surplus performance of around 110% ($PR^2=98.7323$ to $PR^3=204.7497$). The reason for this lower performance improvement is the higher tax rate during the pension period for investors with children compared to in-

vestors without children. While Riester life insurance show an increased performance for all investors, Riester fund (RF) products have reduced performances for selected investors with ages from 18 to 30 years and 31 to 40 years. Two aspects lead to this development. The first is, that because of the high product performance of Riester fund products (RF), investors with long investment horizons (age categories 18 to 30 years and 31 to 40 years) have significantly higher terminal policyholder account values than investors with shorter investment horizons (age categories 41 to 50 years and 51 to 60 years). This leads to higher pension periods for the first category of investors, thus resulting in negative tax effects for investors with zero to two children (compare values from Tables 29 and 28). Second, for investors with three and four children this effect is not present because of higher amounts of governmental transfer payments $P_t^{\text{T}^C}$, which results in less reduced income taxes during the saving period. Comparing the performance of Riester fund (RF) with non-Riester ETF products (ETF), Riester fund products have a higher performance than non-Riester products in all scenarios where investors are above the age of 41. For investment ages from 31 to 40 years, the tax account has a negative effect on product performance in that it makes the non-Riester ETF product (ETF) superior to the Riester fund product (RF) for investors with one child.

| 18-30 years (medium income) | | | | 31-40 years (medium income) | | | |
|-----------------------------|-------|------|-------|-----------------------------|--------|------|-------|
| Child | (RL) | (RF) | (ETF) | Child | (RL) | (RF) | (ETF) |
| 0 | 64.79 | 0.54 | 0.69 | 0 | 88.12 | 0.77 | 0.84 |
| 1 | n.a. | n.a. | n.a. | 1 | 113.36 | 0.83 | 0.84 |
| 2 | n.a. | n.a. | n.a. | 2 | 135.42 | 0.89 | 0.84 |
| 3 | n.a. | n.a. | n.a. | 3 | 152.71 | 0.93 | 0.84 |
| 4 | n.a. | n.a. | n.a. | 4 | 164.64 | 0.97 | 0.84 |

| 41-50 years (medium income) | | | | 51-60 years (medium income) | | | |
|-----------------------------|--------|------|-------|-----------------------------|--------|------|-------|
| Child | (RL) | (RF) | (ETF) | Child | (RL) | (RF) | (ETF) |
| 0 | 114.74 | 1.15 | 0.95 | 0 | 141.78 | 1.56 | 0.95 |
| 1 | 140.62 | 1.25 | 0.95 | 1 | 157.30 | 1.65 | 0.95 |
| 2 | 171.08 | 1.38 | 0.95 | 2 | 183.55 | 1.80 | 0.95 |
| 3 | 204.75 | 1.51 | 0.95 | 3 | 219.46 | 2.01 | 0.95 |
| 4 | 234.39 | 1.63 | 0.95 | 4 | 256.51 | 2.22 | 0.95 |

Table 29: Performance ratios three (PR^3) is reported for Riester life insurance (RL), Riester fund (RF) and the non-Riester ETF product (ETF). Input parameters for investors and calculations are identical to results for PR^1 and PR^2 (see Tables 27 and 28).

F.3 Product performances under internal rates of return (IRR)

In this section, internal rates of return for Riester life insurance and Riester fund products are reported. It is important to note, that product assessment results can differ between results for internal rates of returns and Performance ratios because of the different considerations of risk. Adding to the discussion of Performance ratios, three types of internal rates of return are defined. Return rate one (IRR^1) evaluates the product performance in respect to terminal policyholder account values $C_t^{\text{RL,RF}}$ and combined premium payments $P_t^{\text{O,T}}$ for time periods I, \dots, x^* . Return rate two (IRR^2) calculates the Riester product performance on basis of the premium payments that the individual investor makes to the contract (P_t^{O}). The effect of governmental transfer payments P_t^{T} can thus be directly derived from IRR^2 . IRR^3 adds the value of the investor tax account TAX_{x^*} to the terminal policyholder account in time period x^* . As discussed in previous sections, the tax account value can be either positive or negative, depending on the level of investor income and amount of governmental transfer payments that the investor receives.

The remaining part of this section describes numerical results for IRR^1 , IRR^2 and IRR^3 for the Riester life insurance (RL) and Riester fund product (RF). The analysis only focuses on Riester products because Section F.2 already discussed the performance differences between Riester and non-Riester products extensively.

| 18-30 years | | | | | | | 31-40 years | | | | | | |
|-------------|------|------|--------|------|------|------|-------------|------|------|--------|------|------|------|
| Child | Low | | Medium | | High | | Child | Low | | Medium | | High | |
| | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) | | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) |
| 0 | 3% | 9% | 3% | 9% | 3% | 9% | 0-4 | 3% | 9% | 3% | 9% | 3% | 9% |

| 41-50 years | | | | | | | 51-60 years | | | | | | |
|-------------|------|------|--------|------|------|------|-------------|------|------|--------|------|------|------|
| Child | Low | | Medium | | High | | Child | Low | | Medium | | High | |
| | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) | | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) |
| 0-4 | 3% | 9% | 3% | 9% | 3% | 9% | 0-4 | 2% | 8% | 2% | 9% | 2% | 9% |

Table 30: Values for IRR^1 reflect product performances without the consideration of governmental transfer payments and income tax effects. Input parameters for investors are used from the Microcensus sample (see Table 24).

Results for IRR^1 : IRR^1 are discussed in the following paragraph and Table 30 for Riester life insurance (RL) and Riester fund products (RF). Return rates do not differ for investors with various numbers of children because governmental transfer payments P_t^T are not considered separately. IRR^1 for Riester life insurance products reaches a maximum value of 3.2% for investors with low incomes and ages from 18 to 30 years. There are no performance differences for low, medium and high income groups along the Microcensus investor sample. However, product performances for the Riester life insurance product (RL) decline with rising investor ages from a maximum of 3.2% to a minimum of 2.2%. Lower performances for investors with shorter investment horizons reflect the allocation of issuance costs to the first five years of the saving period (see also Table 18) for Riester life insurance products (RL). Riester fund products (RF) reach return rates of 8.3% to 9.2% as net of product costs. Performances are lower for older investors because of the high volatility of asset developments for Riester fund products (see product parameters in Table 25).

| 18-30 years | | | | | | | 31-40 years | | | | | | |
|-------------|------|------|--------|------|------|------|-------------|------|------|--------|------|------|------|
| Child | Low | | Medium | | High | | Child | Low | | Medium | | High | |
| | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) | | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) |
| 0 | 5% | 10% | 4% | 10% | 4% | 10% | 0 | 5% | 11% | 4% | 10% | 4% | 10% |
| 1 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 1 | 10% | 16% | 5% | 11% | 4% | 10% |
| 2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 2 | 15% | 21% | 6% | 12% | 5% | 11% |
| 3 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 3 | 17% | 23% | 9% | 15% | 6% | 13% |
| 4 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 4 | 19% | 24% | 12% | 18% | 8% | 14% |

| 41-50 years | | | | | | | 51-60 years | | | | | | |
|-------------|------|------|--------|------|------|------|-------------|------|------|--------|------|------|------|
| Child | Low | | Medium | | High | | Child | Low | | Medium | | High | |
| | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) | | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) |
| 0 | 6% | 12% | 4% | 10% | 3% | 10% | 0 | 8% | 14% | 4% | 10% | 3% | 10% |
| 1 | 12% | 19% | 5% | 11% | 4% | 11% | 1 | 10% | 17% | 4% | 11% | 4% | 10% |
| 2 | 18% | 25% | 7% | 13% | 6% | 12% | 2 | 16% | 24% | 6% | 13% | 5% | 11% |
| 3 | 23% | 30% | 10% | 17% | 7% | 14% | 3 | 24% | 33% | 9% | 16% | 6% | 13% |
| 4 | 26% | 32% | 14% | 22% | 9% | 16% | 4 | 32% | 40% | 13% | 21% | 9% | 16% |

Table 31: Values for IRR^2 reflect product performances with the consideration of governmental transfer payments. Input parameters for investors are used from the Microcensus sample (see Table 24).

Results for IRR^2 : Looking at internal rates two IRR^2 , numerical findings with respect to the effect of governmental transfer payments P_t^T are outlined. For both products (Riester life insurance and Riester fund products), annual performance rates increase with rising numbers of investors' children. Driven by the different product parameters, performances between Riester life and Riester fund products are on significantly different levels. Investors, who invest in Riester life insurance products at ages of 18 to 30 years, with no children and low incomes receive an average annual IRR^2 of 4.6% (represents around 11% of German Riester entitled investors - see Table 24). Considering a Riester life insurance investor with medium incomes for ages from 31 to 40 years, return rates start at 3.6% for zero children and rise up to 11.9% for investors with four children. Investors with low incomes can participate the most from governmental transfer payments in respect to annual product return rates because from a certain income level, investors have to pay only a marginal annual premium of €60 (the remaining part of the combined annual premium payment $P_t^{O,T}$ is contributed through governmental transfer payments P_t^T). For Riester fund products (RF), the same mechanisms as for the Riester life insurance product (RL) holds true: Investors with children and low incomes have the highest IRR^2 .

| 18-30 years | | | | | | | 31-40 years | | | | | | |
|-------------|------|------|--------|------|------|------|-------------|------|------|--------|------|------|------|
| Child | Low | | Medium | | High | | Child | Low | | Medium | | High | |
| | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) | | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) |
| 0 | 5% | 10% | 5% | 9% | 4% | 9% | 0 | 7% | 11% | 5% | 9% | 5% | 9% |
| 1 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 1 | 12% | 17% | 7% | 11% | 6% | 10% |
| 2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 2 | 17% | 21% | 8% | 12% | 7% | 11% |
| 3 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 3 | 19% | 24% | 11% | 15% | 9% | 12% |
| 4 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 4 | 20% | 25% | 14% | 18% | 10% | 14% |

| 41-50 years | | | | | | | 51-60 years | | | | | | |
|-------------|------|------|--------|------|------|------|-------------|------|------|--------|------|------|------|
| Child | Low | | Medium | | High | | Child | Low | | Medium | | High | |
| | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) | | (RL) | (RF) | (RL) | (RF) | (RL) | (RF) |
| 0 | 8% | 13% | 7% | 11% | 6% | 10% | 0 | 11% | 16% | 9% | 14% | 9% | 13% |
| 1 | 15% | 20% | 8% | 13% | 7% | 11% | 1 | 15% | 20% | 10% | 15% | 9% | 13% |
| 2 | 22% | 27% | 11% | 15% | 9% | 13% | 2 | 21% | 27% | 12% | 17% | 11% | 15% |
| 3 | 26% | 31% | 15% | 19% | 11% | 15% | 3 | 30% | 37% | 16% | 21% | 13% | 17% |
| 4 | 29% | 34% | 19% | 24% | 13% | 17% | 4 | 38% | 44% | 21% | 26% | 16% | 20% |

Table 32: Values for IRR^3 reflect product performances with the consideration of governmental transfer payments and personal income tax effects. Input parameters for investors are used from the Microcensus sample (see Table 24).

Results for IRR^3 : Analyzing internal return rates three (IRR^3), tax effect are added to the product performance discussion. Tax effects can either have a negative or a positive influence on the return depending on the income, amount of transfer payments and the initial age of the investor. The largest parts of potential Riester investors (on basis of the Microcensus sample in Table 24) profit from their personal tax situation through an investment in a Riester product. Considering the Riester fund product (RF), 27.1% of all potential German Riester investors have a tax disadvantage from an investment, while the remaining 62.9% gain positive tax results. Positive tax results are again most significant for investors who invest into Riester products at higher ages.

G Conclusion

The paper at hand looks at the Riester pension scheme from a customer point of view by introducing a model framework which allows to add to the discussion of Riester product performances. The model at this stage includes a Riester life insurance (RL), a Riester fund (RF) and a non-

Riester ETF product (ETF) into a reference setting. The framework is new in that it differentiates product performance from a customer point of view into the impact of governmental transfer payments and the impact of investors' income tax setting. Another new aspect of the model is the parametrization of sample investors along data from the 2009 German Microcensus which allows to link product performances to the German population. Product performance is analyzed according to Performance ratios and internal rates of return. Furthermore funding rates for potential Riester investors are reported, which are independent from the Riester product category that the investor invests in.

Considering governmental transfer payments for potential Riester investors, the analysis finds that Riester investors can derive significant benefits. Governmental transfer payments are granted personally to investors and for investors' children. Funding rates show, that children are the primary source for above average funding rates. Investors with four children (by assumption the maximum number of children considered) have funding rates of at least around 30%, investors with three children around 21% and investors with two children of at least 14%. Besides the number of investors' children, personal income is the second determinant of funding rates. Low incomes lead to higher funding rates because the governmentally required amount of own premium payments is going down for lower incomes, up to a minimum of €60 annually, where in combination with four children a funding rate of around 90% is reached (for investment ages of 31 to 40 years). Making assessments towards a Riester investment on basis of funding rates, investors with low to medium incomes and above average number of children have the biggest advantages.

Taking product performance into account, Riester life insurance products on the one hand and Riester as well as non-Riester fund products on the other hand lead to significantly different results. The overall assessment for Performance ratios one PR^1 , two PR^2 and three PR^3 show a strong preference towards the Riester life insurance product. The non-Riester fund product is ranked second best and the Riester fund product has the lowest performance. The Riester life insurance product has the highest performance according to all Performance ratios because of the

low asset development volatility. The absolute superiority of Riester life insurance products does not depend on the level of governmental transfer payments. That means that the Riester life insurance product (RL) has a better performance even without any governmental transfer payments and potential tax benefits compared to the Riester (RF) and non-Riester ETF product (ETF) with governmental transfer payments and potential tax benefits. Comparing the Riester fund (RF) and non-Riester ETF products (ETF), shows that the Riester fund product (RF) becomes superior because of governmental transfer payments (for investors with one and more children). Adding to this, tax considerations can result in lower performances of the Riester fund product (RF) in contrast to the non-Riester ETF product (ETF) for investors with one child. Concluding the analysis it is important to note, that results depend strongly on the given product parameters. Especially for Riester and non-Riester fund products, the high volatility of the underlying assets drives the results.

Neglecting risk (asset development volatility σ) by assessing product performance according to internal rates of return ranks the Riester fund product higher than the Riester life insurance product. Internal rates of return one IRR^1 show that investors at higher ages (41 to 50 years and 51 to 60 years) have significantly lower return rates than younger investors, which comes from the allocation of issuance costs over the first five years after contract inception. Due to the more even allocation of costs over the saving period, this *cost effect* does not occur for the Riester fund product (RF). Product performances according to IRR^2 as well as IRR^3 increase by around 200% for Riester life insurance and Riester fund products comparing an investor with zero children to an investor with four children. This again underlines the impact of governmental transfer payments on product performance from a customer point of view.

Appendix

| Entitlement | Riester investment prerequisites |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1) Directly | <ul style="list-style-type: none"> · Employees and trainees who are obliged to social insurance · Civil servants, lawyers and army workers · People who do civilian service · Insured people during the child education period (first 3 years of the child) · Micro jobbers who neglect the free choice of insurance · Recipients of obligatory insurance from the farmer's pension scheme · Recipients of social transfer payments · Self employed people who participate in the German compulsory pension scheme |
| (2) Indirectly | <ul style="list-style-type: none"> · People whose husbands are directly entitled to governmental aids |
| (3) Not entitled | <ul style="list-style-type: none"> · People who are not participating in the German compulsory pension scheme · Insured people of a obligatory insurance institution · Pensioners and recipients of occupational disability insurance · People with low incomes and without entitlement to employer's pension contribution |

Table 33: Riester prerequisites (see column *Riester investment prerequisites*) define, if the respective potential Riester investor receives governmental subsidiess (transfer payments) or if the investors is not entitled to receive governmental transfer payments. Investors who fall into categories (1) and (2) are entitled to transfer payments, while investors from category (3) do not receive these subsidies.

| Gross Income | Tax calculation | Parameters |
|--------------------------------------|----------------------------------------------|------------------------------------------------|
| $\leq \text{€}8\,004$ | no tax payable | |
| $\text{€}8\,005 - \text{€}13\,469$ | $(912.17 \cdot y + 1\,400) \cdot y$ | $y = [(\text{GrossIncome} - 8\,004)/10\,000]$ |
| $\text{€}13\,470 - \text{€}52\,881$ | $(228.74 \cdot z + 2\,397) \cdot z + 1\,038$ | $z = [(\text{GrossIncome} - 13\,469)/10\,000]$ |
| $\text{€}52\,882 - \text{€}250\,730$ | $0.42 \cdot x - 8\,172$ | $x = \text{Gross Income exceeding €}52\,881$ |
| $\geq \text{€}250\,731$ | $0.45 \cdot x - 15\,694$ | $x = \text{Gross Income exceeding €}250\,730$ |

Table 34: Tax categories 1 through 5 show the income taxes in accordance with the annual taxable incomes. Category 1 with an annual income below €8004 results in a tax amount of €0. For categories 2 to 5, taxes are rising above average.

| | 18-30 years | | | | | | | | | | | | 31-40 years | | | | | | | | | | | |
|----------|-------------|-------|------|------|---------------|------|------|-------|-------------|------|-------|-----|-------------|-------|-----|-----|---------------|-----|-----|-----|-------------|----|-----|-------|
| | Low income | | | | Medium income | | | | High income | | | | Low income | | | | Medium income | | | | High income | | | |
| | Child | RL | RF | ETF | RL | RF | ETF | RL | RF | ETF | Child | RL | RF | ETF | RL | RF | ETF | RL | RF | ETF | RL | RF | ETF | Child |
| 1_{PR} | 0- | 33.9 | 0.7 | 0.7 | 33.9 | 0.7 | 0.7 | 33.9 | 0.7 | 0.7 | 32.6 | 0.8 | 0.9 | 32.6 | 0.8 | 0.9 | 31.6 | 0.8 | 0.9 | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 2_{PR} | 0- | 22.8 | 0.8 | 1.0 | 22.8 | 0.9 | 1.0 | 22.8 | 0.9 | 1.0 | 11.3 | 0.8 | 1.0 | 11.3 | 0.8 | 1.0 | 11.3 | 0.8 | 1.0 | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 3_{PR} | 0 | 53.7 | 0.7 | 0.7 | 40.4 | 0.7 | 0.7 | 38.9 | 0.7 | 0.7 | 66.6 | 0.9 | 0.9 | 43.7 | 0.8 | 0.9 | 41.1 | 0.8 | 0.9 | | | | | |
| | 1 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 104.2 | 1.0 | 0.9 | 59.6 | 0.9 | 0.9 | 53.2 | 0.9 | 0.9 | | | | | |
| | 2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 118.7 | 1.0 | 0.9 | 73.7 | 0.9 | 0.9 | 63.9 | 0.9 | 0.9 | | | | | |
| | 3 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 122.7 | 1.0 | 0.9 | 84.9 | 0.9 | 0.9 | 72.8 | 0.9 | 0.9 | | | | | |
| | 4 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 124.6 | 1.0 | 0.9 | 92.7 | 1.0 | 0.9 | 80.6 | 0.9 | 0.9 | | | | | |
| 4_{PR} | 0 | 71.2 | 1.0 | 1.0 | 38.7 | 0.9 | 1.0 | 34.9 | 0.9 | 1.0 | 78.0 | 1.2 | 1.0 | 33.1 | 0.9 | 1.0 | 28.0 | 0.9 | 1.0 | | | | | |
| | 1 | 111.9 | 1.2 | 1.0 | 55.8 | 1.0 | 1.0 | 47.9 | 1.0 | 1.0 | 103.9 | 1.3 | 1.0 | 43.7 | 1.0 | 1.0 | 36.0 | 1.0 | 1.0 | | | | | |
| | 2 | 135.6 | 1.3 | 1.0 | 76.1 | 1.1 | 1.0 | 63.4 | 1.0 | 1.0 | 133.2 | 1.5 | 1.0 | 61.8 | 1.1 | 1.0 | 49.8 | 1.0 | 1.0 | | | | | |
| | 3 | 147.5 | 1.4 | 1.0 | 98.7 | 1.2 | 1.0 | 81.3 | 1.1 | 1.0 | 158.8 | 1.6 | 1.0 | 86.7 | 1.2 | 1.0 | 69.1 | 1.1 | 1.0 | | | | | |
| | 4 | 154.4 | 1.4 | 1.0 | 118.7 | 1.2 | 1.0 | 100.3 | 1.2 | 1.0 | 174.9 | 1.7 | 1.0 | 112.5 | 1.4 | 1.0 | 91.1 | 1.3 | 1.0 | | | | | |
| 5_{PR} | 0 | 77.5 | 0.6 | 0.7 | 64.8 | 0.5 | 0.7 | 60.0 | 0.5 | 0.7 | 112.2 | 1.0 | 0.9 | 88.1 | 0.8 | 0.9 | 77.8 | 0.7 | 0.9 | | | | | |
| | 1 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 160.1 | 1.1 | 0.9 | 113.4 | 0.8 | 0.9 | 98.3 | 0.7 | 0.9 | | | | | |
| | 2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 178.7 | 1.1 | 0.9 | 135.4 | 0.9 | 0.9 | 116.3 | 0.8 | 0.9 | | | | | |
| | 3 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 182.8 | 1.1 | 0.9 | 152.7 | 0.9 | 0.9 | 131.0 | 0.8 | 0.9 | | | | | |
| | 4 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 184.5 | 1.1 | 0.9 | 164.6 | 1.0 | 0.9 | 143.7 | 0.9 | 0.9 | | | | | |
| 6_{PR} | 0 | 128.2 | 1.3 | 1.0 | 114.7 | 1.2 | 1.0 | 90.6 | 1.0 | 1.0 | 149.0 | 1.6 | 1.0 | 141.8 | 1.6 | 1.0 | 125.5 | 1.4 | 1.0 | | | | | |
| | 1 | 178.4 | 1.5 | 1.0 | 140.6 | 1.3 | 1.0 | 111.6 | 1.0 | 1.0 | 180.1 | 1.8 | 1.0 | 157.3 | 1.7 | 1.0 | 138.0 | 1.5 | 1.0 | | | | | |
| | 2 | 207.4 | 1.6 | 1.0 | 171.1 | 1.4 | 1.0 | 136.2 | 1.1 | 1.0 | 214.8 | 2.0 | 1.0 | 183.6 | 1.8 | 1.0 | 159.2 | 1.6 | 1.0 | | | | | |
| | 3 | 220.4 | 1.7 | 1.0 | 204.8 | 1.5 | 1.0 | 164.4 | 1.3 | 1.0 | 244.5 | 2.1 | 1.0 | 219.5 | 2.0 | 1.0 | 188.6 | 1.7 | 1.0 | | | | | |
| | 4 | 227.5 | 1.7 | 1.0 | 234.4 | 1.6 | 1.0 | 194.3 | 1.4 | 1.0 | 262.5 | 2.2 | 1.0 | 256.5 | 2.2 | 1.0 | 222.0 | 1.9 | 1.0 | | | | | |

Table 35: Performance ratios one, two and three (PR^1 , PR^2 , PR^3) are reported for Riester life insurance (RL), Riester fund (RF) and the non-Riester ETF product (ETF). Ratios are calculated for the total Mi-croensus sample (see Section 24). Calculations are conducted along the formulation in Equation 11.

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Part III

Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey

Abstract

This paper discusses competing goals and the current and future importance of success factors in insurance companies' claims management. Strategic levers in claims management have often been discussed solely from the perspective of managing the volume of claims costs, thus neglecting two other factors: The customer satisfaction and the efficiency of the processes. Our analysis of the goals and levers follows a two-step approach and uses new and ad hoc empirical data. First, we utilize the classic triangular representation of the (conflicting) goals in non-life claims management: the optimization of the internal claims processes (administration costs), maximization of the customer satisfaction and the minimization of claims volumes. This framework is well established in the insurance industry and allows us to structure the discussion of the interdependencies of the different aims, effects on the claims management performance and to introduce a set of underlying goals. Subsequently, we discuss the relevant academic literature in these areas and the latest insights from industry practice. Next, we analyze the current view of the insurance industry. Our results are supported by a qualitative survey among 22 insurance companies carried out in 2013 in Germany and Switzerland. We derive findings on the current and expected future importance of the selected topics. From our study, managerial implica-

tions for improving industry practice can be derived. Our findings are relevant for academics as well as practitioners.²⁹

²⁹N. Mahlow and J. Wagner. Evolution of Strategic Levers in Insurance Claims Management: An Industry Survey. *Working Papers on Risk Management and Insurance*, 2014.

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A Introduction

Claims management “best practice” is currently one of the most important strategic topics for the non-life retail business of insurance companies in Europe. Macroeconomic factors such as the recent financial crisis as well as changing buying patterns of insurance customers put significant pressure on insurers to maintain overall profitability and establish excellent claims management. Considering that on average more than 60% of all expenses of property and liability insurers arise from claims costs, the importance of solid claims management is apparent.³⁰ Historically, claims management at insurance companies has often been treated as a necessary part of operations. The potential competitive advantages, both in terms of customers and operational focus, that can be gained through improved claims management have long been underestimated (see, e.g., Dab, Frost, and Schwarz, 2007). In fact, insurance companies often set as their primary goal the reduction of claims volumes, not realizing that customer satisfaction and processes are complementary topics. To gain a better understanding of the dynamics of claims management and its key topics with a focus on current and future challenges, we define our research target as follows. First, we introduce a framework to structure the three most relevant strategic topics in insurance claims management. Within this framework and 13 selected underlying key topics, we discuss target conflicts. Next, we present survey results from insurance companies in Germany and Switzerland to assess the key topics regarding their current and expected future importance.

We introduce the main competing goals in strategic claims management along the core dimensions of claims volume, claims administration costs and customer satisfaction. Each of these three elements is associated with specific targets which often stand in conflict to each other. This threefold framework, also called “the magical triangle”, has been used by several authors (see, for example, Naujoks and Venohr, 1998 and Schmidt, 2012). The idea behind the claims management triangle is that theoretically there is an optimal level of goal fulfillment for each ele-

³⁰See, for example, the most up-to-date figures from the German and Swiss insurance associations at <http://www.gdv.de> and <http://www.svv.ch>.

ment, which then leads to an optimal aggregate level in the consolidated strategy of claims management. The concept is well accepted by practitioners, but to the best of our knowledge, there have been no academic discussions of the competing goals of insurance company claims management (also see our literature review in Section B). On the basis of the triangular framework we select and discuss 13 topics which are of current relevance for the industry. The selection is based on desk research and telephone interviews with C-level representatives. A survey tool is set up to assess the current and future relevance of the chosen topics. Since the survey topics are structured along the claims management triangular framework, the results allow for a discussion of the connections among the three main goals introduced in this paper.

The survey results are based on responses from C-level executives from 22 non-life insurance companies in Germany and Switzerland representing 42 and 68 percent, respectively, of market share in terms of premium volume. Survey participants were asked to assess the current and future impact of each topic on a scale ranging from very low to very high importance using a five-point Likert scale. The setup of the survey also helps to derive results with a focus on differences in the viewpoints of companies of different sizes (small and large insurers) on the one hand, and in different geographical regions (Germany and Switzerland) on the other hand.

With regard to overall key results, we detect a strong trend of insurance companies trying to gain more influence over the overall claims handling process. This goes along with centralization efforts of insurers. Further, insurers seem to perceive customer demand for increased service levels with regard to claims handling. This will be achieved through technological improvements (e.g., the digitization of customer touch points) hand in hand with the faster adjustment processes. A third core finding reveals that insurance companies are not aiming to further outsource claims handling processes to third party providers. This finding is somewhat surprising because insurers have very high claims administration costs and claims process outsourcing is still on a low level when comparing to other industries. When considering small and large insurance companies separately, differences in their assessments regard-

ing the importance of the topics appear. It becomes apparent that large insurers are working on higher professionalization levels than small insurers. A driver behind this is, among others, that large insurers can make use of economies of scale. As a result, large insurers for example consider alternative compensation methods to be more important than small insurance companies do (alternative compensation methods often require greater vertical integration of repairing process activities outside insurance companies' core value chain). Examining differences between insurers from Germany and Switzerland, we come to more significant differences. Summarizing the results, the analysis show, that German insurers currently consider topics with respect to a reduction of claims administration costs and absolute claims volumes to be more important than Swiss insurance companies do. This includes, for example, the outsourcing of claims processes, the usage of alternative compensation methods and the requirement that customers use contractors.

The remainder of the paper is structured as follows: In Section B, we discuss the claims management triangular framework and the main competing strategic goals. In Section C, we define and discuss the selected topics and describe the setup of a survey to assess their current and future relevance. We present and discuss data basis and the survey results in Section D. We present our conclusions in Section F.

B Three main competing goals in strategic claims management

In this section we introduce a triangular structure to discuss the core goals of insurance company claims management and discuss the competing aspects of these goals from both the insurer and the policyholder perspective. This threefold structure lays the basis for our industry survey, which we describe in Section C. We present the core competing goals of claims management in Figure 6. The three main dimensions in our illustration are (A) the minimization of the claims volume, (B) the minimization of claims administration costs and (C) the maximization of customer satisfaction. Different versions of the triangular representation

of goals have been used by several authors because of its simplistic, yet holistic approach for discussing goals in claims management. Such publications include, for example, the work by Naujoks and Venohr (1998) introducing the so-called “magical triangle” of costs, claims volume and customer service and citing the claims strategy of the insurance company Progressive with the key principles of accurate claims settlement, operating efficiency and customer satisfaction. Further Schmidt (2012) focuses on customer satisfaction, cost efficiency and the service quality of contractor collaboration. Finally, Maas and El Hage (2006) adapt the triangle to include efficiency, customer orientation and innovation. The threefold framework is likewise accepted among practitioners at insurance companies, which eases communication with the participants of our study.

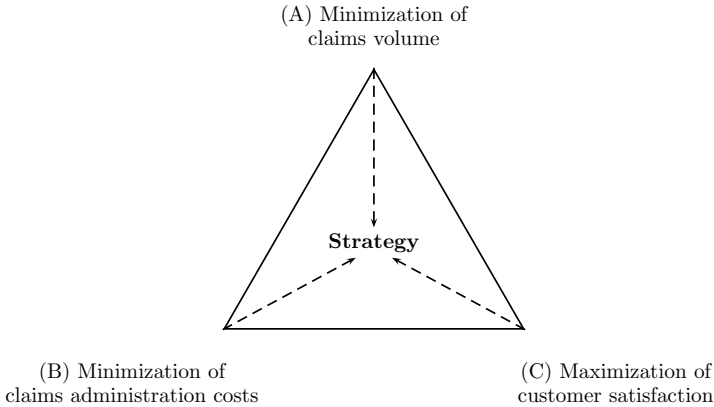


Figure 6: Triangular representation of the competing strategic goals in insurance claims management.

Depending on the non-life (retail) business line the *claims volume*, i.e., the payouts for incurred losses, ranges from 55 to 90 percent of premium income (see, for example, recent reports from the supervisory authorities or the industry associations in Germany and Switzerland, or, e.g., Dab et al., 2007) Thus, it is clear that the strategic focus in the insurance industry is first to optimize the amount of claims payouts. Excellent claims handling, e.g., through the use of contractors or alter-

native compensations and active steering may help minimize the claims volume. In recent years, the levers of fraud detection and goodwill management have received increased management attention. In fact, excess claims payments due to fraudulent claims are estimated to be as high as 18 percent in the U.S. (Insurance Research Council, 2008), and according to the European Insurance and Reinsurance Federation (2013) the amount of detected and undetected fraud represents up to 10 percent of all claim expenditures in Europe. The amount of goodwill claims is not as readily available from insurance companies. Based in expert testimony in a study by Mahlow and Wagner (2014), the amount of claims cases regulated on the basis of goodwill is estimated to be up to 15 percent.

The *administration costs* of an insurance company include all administrative expenses incurred during the claims handling process. These include the labor costs for back-office staff and internal claim auditors, costs for external claim experts, IT investment and operating costs as well as overhead costs of the insurance company and other infrastructure expenses. The claims cost ratio, i.e., the claims administration expenses compared to the insurers' premium income, typically ranges from 5 to 15 percent (see, e.g., Dab et al., 2007) and depends in large part on the efficiency of the insurer being analyzed. Typical drivers for efficiency in claims management include company size, the segmentation of claims and processes (industrialization and specialization) as well as sourcing (e.g. usage of contractors). On the one hand, when considering the basic economic principle of economies of scale, large insurers should be able to lower their administration costs (see, e.g., Cummins and Weiss, 1993). On the other hand, higher levels of complexity and other inefficiencies may limit this advantage (see, e.g., Fenn, Vencappa, Diacon, Klumpes, and OBrien, 2008). An adequate segmentation of claims allows insurance companies, for example to industrialize the handling processes for smaller claims while enabling the company at the same time to assign specialists to more complex cases. Furthermore, the concept of outsourcing selected process stages and the idea of using contractor networks (see, e.g., HUK Coburg, 2009) may help to lower administration costs.

The situation of an insured loss for the customer corresponds to the "moment of truth" for the insurance company in which the insurance

promises are tested. In this case *customer satisfaction* is of paramount importance since a loss event in combination with a bad customer experience with the claims settlement is one of the most important drivers of insurance policy cancellations (see Psychonomics, 2008). Empirical studies by YouGov (2012) underline customers' expectations in the case of a loss: good accessibility when reporting the claim, personal communication during the claims handling process, short response times and fast settlement of the claim, which translates into short cycle times. Transparency regarding the process and the settlement amount is important for policyholders. Finally, customers put their own interest (claims payouts) ahead of the interests of the insured collective. Thus, settlements involving goodwill (i.e., for borderline loss cases not covered by the in-force insurance policy) have a positive impact on how the service is perceived by the customer. This has been analyzed in the consumer goods industry in connection with voluntary compensation for warranties. Andaleeb and Basu (1998) find evidence for a positive correlation between the level of perceived customer service and the amount of warranties granted, while Huysentruyt and Read (2010) identify the emotional well being of the customer as the main reason why companies with higher product warranties were preferred over firms with a lower average level of warranties.

Conflicts within the claims management framework arise because the two stakeholders - the insurance company on the one side and the customer on the other side - have different expectations and goals that need to be reconciled. In addition, the insurers own goals regarding the claims volume and administration costs are competing (see also, e.g., Naujoks and Venohr, 1998). Following, we outline three examples for illustration purposes. First, management may initiate more and more detailed audits that typically help to lower the claims volume (goal A), e.g., by getting better estimates of the actual loss or by detecting more fraudulent filings. However, these audits entail higher administration costs (e.g. human resources) and process expenses (e.g. IT-supported audits), and are therefore in conflict with goal (B). This procedure may also have a negative impact on the cycle times, making the settlement process longer, which is contrary to goal (C). Second, customers typically favor higher

service standards, i.e., fast claims adjustment, personal communication and no waiting times (goal C). However, such initiatives are in opposition to the other two goals. In fact, a quick settlement of claims is almost impossible through audits and therefore hinders fraud detection and claims volume optimization (goal A). And if the company implements such measures, they are only feasible with higher resources and thus at a higher cost (in opposition to goal B). The same holds for personal interaction and short waiting times. Third, goals (A) and (C) are also in opposition to one another in terms of contractor usage (less personal service for customers), alternative compensation (may be perceived negatively by customers) or limitation of goodwill payouts (against policyholder “expectations” in the case of borderline cases and leading to more negative perception of the service).

In the following sections, we detail selected initiatives in three dimensions: Claims volume, administration costs and customer satisfaction. We provide a selection and description of current strategic levers for each aspect (see Section C) and then analyze the current and future importance of these aspects, using the results from an industry survey (see Section D).

C Description of current strategic topics and survey setup

Using the aforementioned threefold structure (see Figure 6), we have identified strategic topics in each of the three dimensions using a two-step process. First, by conducting desk research we have established a long list of relevant levers underlying the three key dimensions (A) claims volume, (B) administration costs and (C) customer satisfaction. Second, on the basis of more than 20 telephone interviews with C-level representatives of different insurance companies in Germany and Switzerland (who are also in charge of the claims management department at their company) we have aggregated our ideas into 13 topics that we describe in detail below. The resulting topics represent the most important issues at present from a practitioner’s perspective. Four topics involve claims vol-

ume (1–4), five concern administration costs (5–9) and the final four deal with customer satisfaction (10–13). Based on these topics, we develop a survey in which we ask relevant industry representatives in Germany and Switzerland about the current impact and the expected future importance of each lever. Below, we briefly introduce the rationale and relevance of each topic. Each topic is related to insurance companies' claims management at different aggregation levels.

(A) Claims volume

- (1) *Usage of alternative compensation methods.* Standardized adjustment patterns can be introduced with the help of alternative compensation methods. They target a reduction of the influence of the individual customer on the claims adjustment process. The so-called “payout” or “standard” claims are most suitable for alternative compensation methods since they show comparably low levels of complexity. Most often, alternative compensation methods are applied when the customer receives payments on a different basis than actual invoices. Such methods can, for example, lead to replacements in kind. From the insurance companies' point of view, such compensation aims at lowering the total claims volume by regulating claims more appropriately and without cash payouts to customers. In fact, Accenture (2003) sees the potential to reduce claims volumes by up to ten percent if insurance companies introduce systems with such adjustment methods. Ceeney (2011) identifies active communication with customers as a key success factor for the introduction of these methods. In an analysis of the acceptance of alternative compensation methods for car insurance, Brandstetter (2006) finds that customers support the introduction of alternative compensation methods on the condition that service is increased or product premiums are lowered. Finally, from a sustainability point of view, Meyricke (2010) considers the fact that damaged assets are most often replaced instead of repaired as a central issue in insurance companies' claims management.

- (2) *Activities to prevent insurance fraud.* Insurance fraud prevention measures cover strategic, personnel and systemic fields in insurance companies' claims management. The detection of insurance fraud is one of the major tasks of insurance companies in claims management. The Association of British Insurers (2012) reports detected fraudulent claims in the U.K. amounting to £1 billion in 2011; the German insurance association estimates the volume of annual insurance fraud to be around €4 billion in the German non-life insurance segment.³¹ An effective fraud detection system therefore targets a reduction in insurers' overall claims volumes by keeping an eye on auditing costs (see, e.g., Müller, Schmeiser, and Wagner, 2013). The pivotal question is how much effort insurance companies have to invest in order to reduce their fraud exposure to a sustainable level. In the past, insurance companies have generally been too tolerant of insurance fraud (see, e.g., Viaene and Dedene, 2004) and, according to Bearing Point (2008), processes need to be more automated in order to improve fraud prevention. This also implies that insurance companies have to devise new detection methods that are highly adaptive to customer behavior (see Viaene, Dedene, and Derrig, 2005). Fenn and Rickmann (2001) and Gracey (2009) see the low level of information on individual claims cases that insurance companies collect as an important reason why insurance fraud often cannot be detected. Different fraud patterns and categories of fraudulent customers increase the complexity for insurance companies. Most insurers also segment potentially fraudulent customers into professional and amateur fraudsters. According to Fähnrich (2013), the reduction of amateur fraud holds the most potential in fraud management. Tennyson (2011) and Pratt (2009) find that the identification of amateur fraud (also opportunistic fraud) is most difficult and also holds the most risk of damaging the customer relationship. In all activities, insurers face the potential risk that the market may detect the auditing strategy of the insurer and the latter may thus be cheated (see Lang and Wambach, 2013).

³¹See <http://www.gdv.de/versicherungsbetrug>.

- (3) *Customer requirement to use contractors.* The requirement that customers use contractors is closely linked to alternative compensation methods (compare with topic 1). This involves the requirement that customers use only pre-defined contractors in loss events. This requirement can help insurers reduce claims volumes significantly, because it allows companies to make use of economies of scale. Furthermore, it allows insurers to increase the vertical integration of the adjustment process, which results in an information advantage over customers. For example, HUK Coburg (2009), a German insurance company, defines its nationwide contractor network as a key success factor in having average claims costs that are below-market. Nevertheless, the applicability of contractor requirements largely depends on the business segment. Because the car insurance line has the least complexity it is the most appropriate segment for contractor requirements. However, in order for a contractor system to receive high acceptance, customers need to see direct advantages from that requirement (for example, increased service levels or reduced product premiums, see Brandstetter, 2006).
- (4) *Active claim case steering.* Continuous and active routing of the claim case along the handling processes is called active claim steering. This applies to the internal and external processes (e.g., the transfer of cases to contractors or outsourcing of processes to third party providers) of an insurance company. Such a system can keep the insurer informed at all stages of the process and thus enables the company to intervene in a timely manner in the processes whenever necessary. Active claim case steering can lower the total claims volume of insurers in different ways, e.g., through a reduction of insurance fraud and the selection of service providers with the lowest prices.

(B) Claims administration costs

- (5) *Outsourcing of claim processes.* The outsourcing of processes involves all initiatives through which insurance companies transfer

claims-related processes to third party providers. The primary motivation is to reduce administration costs. Given the importance of claims management, particularly with regard to the customer relationship, insurers are generally very selective when outsourcing operational processes. This is in sharp contrast to players in the manufacturing and retail industries. Practitioners from insurance companies as well as researchers have not yet found an optimal level of contractor usage. However, there are success stories involving process outsourcing (see the example of HUK Coburg, 2009, described above) and some authors even define process outsourcing in claims management as a trend (see, e.g., Khiruddin, 2011). Other industry experts (see Johnson, 2013) consider the outsourcing of claims processes as a cyclical trend without a clear right or wrong either way. Contrary to these findings, Hood and Stein (2003) see increasing efforts by U.K.-based insurance companies to return to in-house claims handling. In an analogy involving insurance distribution and claims management, Regan (1997) shows that outsourced sales agents are more expensive for insurers than in-house sales agents. Higher income margins as well as higher customer service levels are the main reasons for this. Larsen, Manning, and Pedersen (2011) and Bental, Deffains, and Demougin (2012) find evidence for increased monitoring and controlling costs for companies with off-shored business activities. Increased monitoring efforts are rooted in the principal-agent theory, where the external contractor is seen as the agent. Higher controlling costs result from a larger complexity in the steering processes of contractors.

- (6) *Detailed claims segmentation.* Retail claims are segmented according to claim complexity in the insurer's back office to enable appropriate claims handling. Claims segmentation methods differ to a significant extent among insurance companies. The rationale behind claims segmentation is, to provide the right handling pattern for a maximum number of incoming claims (see Crawford & Company, 2007). Next, we discuss detailed claims segmentation, when claims either are segmented into many categories (e.g., according

to the amount of claimed losses), or are partitioned on the basis of multiple factors (see also Mahlow and Wagner, 2014). New developments show that insurance companies are trying to introduce more complex segmentation systems because traditional segmentation models often lead to higher levels of wrongly segmented claims. One aspect of these systems is that claims are not only segmented according to historical data, but also that customer behavior can play an important role in claim case steering (see Smith, Willis, and Brooks, 2000). The overall ability of insurance companies to use cutting edge technologies like predictive analytics can lead to competitive advantages, going beyond the sole operational area of claims settlement (see Salvino and Duganier, 2010, and Amoroso, 2011). Although an increasing number of insurers are aware of the importance of an elaborate claims segmentation system, some insurers still fail to devise one (see Accenture, 2007). According to Bart (2012), what most of these companies have in common is that they see insurance claims management as too individualistic to apply standardized segmentation systems.

- (7) *Industrialization of payout claims (one-step-closing)*. “One-step-closing” of claims means that all necessary handling activities from the initial reporting to the settlement of the claim are executed in a single step. Internal or external claim auditors are therefore not needed in the adjustment process. Due to the abbreviated handling process, the one-step-closing of claims cases can largely only be applied to simple payout claims that are not very complex. One-step-closing of claims is often a trade-off between a reduction in administration costs (lower use of back office resources) and higher claims volumes (e.g., due to potentially inadequate auditing procedures). Both systems, with and without one-step-closing of claims, can be found in the insurance industry. One-step-closing procedures allow the insurer to communicate reliable claims handling service levels because internal cycle times can be defined in advance (see InterRisk, 2013). In order to be able to provide a one-step-closing claims handling procedure, insurance companies have to drastically increase their technological capabilities. A study by

Accenture (2010) reveals that, according to insurance executives, the main claims handling processes, such as claims notification and claims settlement, are still mostly manually handled. Baecker and Bereuter (2010) recommend a process architecture that integrates customers' mobile devices in the process chain of insurers to a high degree.

- (8) *Back office specialization.* We define back office specialization in the claims handling units of insurers as the employment of highly specialized personnel. As in other industries, a specialized workforce results in a task-oriented working pattern with narrow qualifications. By contrast, in a generalist approach employees fulfill broader tasks. Both approaches can be found in the insurance industry. V. Fürstenwerth and Weiß (2001) state that a specialized workforce is most suitable for complex business segments (e.g., non-retail business) and insurance companies that have several business lines (e.g., health, life, non-life). In their study on the German insurance market, Postai, Wannke, Weixelbaumer, and Höglinger (2005) find that claims handling units are already highly specialized. To the best of our knowledge, there are no empirical studies that focus on the degree to which back office personnel in claims management units should be specialized.
- (9) *Flexibility of adjustment limits.* A flexible system of settlement limits allows insurance companies to switch claims adjustment competencies quickly within the claims organization. If the insurer uses a flexible adjustment system, it can adapt adjustment limits (e.g. general increase in adjustment competencies for internal or external personnel) and adjustment responsibilities (e.g. shift from internal to external adjustment) according to predefined mechanisms. Usually, flexible adjustment limits are used in the context of extraordinary loss events (e.g. hail damages, hurricanes and flooding). Such events can lead to tremendous claims handling arrears if the insurer does not use flexible adjustment limits. However, due to the enormous complexities of the claims handling processes,

the implementation of more flexibility is often difficult (see Postai et al., 2005).

(C) Customer satisfaction

- (10) *Active customer communication.* Active customer communication means that the insurer keeps the customer updated about the claim status on a regular basis. This includes the utilization of all communication channels (e.g., telephone, e-mail, text messages). Industry practices with regard to customer communication along the claims adjustment processes differ greatly from one company to another. Current research and discussions in the industry show that communication and information are critical to customer satisfaction. Often, informing the customer on a regular basis is considered more important than fast settlement of the claim (see the discussion of topic 12 for references). When trying to introduce customer communication systems, insurers are likely to struggle with technological investments (see the study by IBM, 2006).
- (11) *Digitization of touch points.* Through the digitization of touch points, insurers allow their customers to use online and electronic access channels (e.g., mobile device applications, social media platforms) for claim events. Customers increasingly link the ease of communication to their perceived satisfaction with services. Digitization developments go hand in hand with the shrinking importance of previously important communication channels such as letters, faxes and phone calls. Naujoks, Huelsen, Schwarz, and Phillips (2013) note that only a very small number of insurance companies are currently able to offer digitized claims handling processes to their customers. Aside from technological aspects, that is often driven by heterogeneous (claims) processes used along the different sales channels. Insurance companies in German-speaking countries are well behind U.S. companies with regard to digitization initiatives, even though customers actively prefer electronic access channels (see CapGemini, 2013). Qualitative and quantitative results from Baecker (2011) underline the increasing importance of

this topic. The author comes to the conclusion that insurers with mobile claims handling processes achieve greater customer trust and satisfaction. Higher satisfaction rates are often achieved by offering new services in addition to the current core processes in claims handling, such as intelligent routing tools and automated emergency situation procedures (see, e.g., Baecker, Ackermann, Ackermann, and Fleisch, 2010).

- (12) *Reduction of claims cycle times.* Reducing cycle times shortens the time between the customer's report of the damage to the insurer and the settlement of the claim. Besides the provision of adequate settlement payments, claims cycle times are seen as a potential lever for greater customer satisfaction. To the best of our knowledge, there is no empirical evidence that the mere length of claims cycle times has a significant impact on insurance companies' customer satisfaction. On the contrary, Dab et al. (2007) find that the meeting of communicated deadlines within the claims process can be more important than the mere reduction of claims cycle times. Results from Macgard (1990) point into the same direction. The author finds that the prompt taking of customer orders is more important than the total waiting time. Another work on customer satisfaction concludes that perceived customer waiting time strongly depends on the physical and emotional surrounding in which the customer has to wait (see Pruyn and Smidts, 1998). This may be strained in the case of important losses. In all initiatives that insurers follow to increase customer satisfaction, direct competitors have to be monitored carefully. Kumar (2005) finds that the reduction of waiting times is perceived differently by customers if competitors improve their services simultaneously. Considering the technological requirements, insurers' operations have to undergo tremendous developments (see IBM, 2006).
- (13) *Transfer of claims processes to sales agents.* Transferring claims processes to sales agents results in increased proximity between customers and insurance companies' sales agents. Centralizing claims processes in companies' main offices is the counter measure to this

strategy. Some insurers consider settlement through sales agents to be an effective measure to increase customer satisfaction, since it is regarded as softening the insurer's anonymity among customers. The side effects of such a strategy may include increases in good-will payouts or decreases in fraudulent claims. However, there is also an increasing number of insurers that do not consider the effects of such a process transfer to be significantly beneficial. These insurers focus on initiatives to re-centralize claims processes (see, for example, Zurich Insurance Austria, 2009).

The survey of our study contains the above 13 topics which are framed by the claims management triangle. A summary of topics (1) to (13) is given in Table 36. While we discussed goals in claims management at a strategically high level in Section B, our survey aims to provide deeper insights into current and future aspects. All survey participants were asked to evaluate the current and the future impact of each topic on a five-point Likert scale 1 = "very low" impact, 2 = "low" impact, 3 = "neutral" or no impact to 4 = "high" and 5 = "very high" impact. Results were obtained via an electronic survey from September to December 2013. In addition to the qualitative survey results, we had (unstructured) discussions with some of the participants. The insights that we gained from these interviews deepened our knowledge, and we will partly reference these in the remainder of our paper.

D Data basis and results

This section provides information on the data basis used in our study and presents and discusses the results. In Section D.1 we provide information on the methodology applied to collect our data and on the sample of the participating insurance companies. In our data analysis, we detail the rating differences obtained for the current and future importance of the 13 strategic topics for the whole set of respondents (Section D.2). The focus in this analysis is on the question: How will the importance of different topics in claims management change in the future? Then we study differences in the appreciation of small and large insurers (Section D.3)

| | |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| (A) Claims volume | |
| (1) Alternative compensation methods | Settlement methods, where the occurred damage is regulated on other basis than customers' own invoices |
| (2) Insurance fraud prevention | Measures include strategic, personnel and systemic fields in insurance companies' claims management |
| (3) Obligation to contractor usage | With such obligation, insurers require customers to use only pre-defined contractors in loss events |
| (4) Active claims case steering | Continuous and proactive routing of the claims case according to the claims settlement process by the insurer |
| (B) Claims administration costs | |
| (5) Outsourcing of claim processes | Initiatives in which insurance companies transfer claim processes to third party providers |
| (6) Detailed claims segmentation | Segmentation according to different criteria to provide individual settlement procedures |
| (7) Industrialization of payout claims | All handling activities in the adjustment, from reporting to settlement, are executed in a single process step. |
| (8) Back office specialization | Specialization of the employees in the claims handling units of insurance companies |
| (9) Flexibility of adjustment limits | Adjustment limits and claim adjustment competencies within the organization can easily be adapted |
| (C) Customer satisfaction | |
| (10) Active customer communication | Regular updates about the claim status to the customer during all claims process steps |
| (11) Digitization of touch points | Insurers allow their customers to use online and electronic access channels for claims processes |
| (12) Reduction of claims cycle times | Shortening of the time period between a customer's damage report and the claims settlement by the insurer |
| (13) Transfer of claims processes | Increased proximity to the customer by transferring part of the claims settlement to sales agents |

Table 36: Summary of the selected 13 topics labeled (1) to (13) according to the claims management triangle (A) claims volume, (B) claims administration costs and (C) customer satisfaction.

and differences arising between market players in Germany and Switzerland (Section D.4). In all comparisons, we will apply t -tests to identify

the significance of differences between current and future impact, small and large insurers as well as German and Swiss companies.

D.1 Data collection: methodology and data basis

For our survey we use a questionnaire based on the 13 topics identified in Section C. Participating insurers come from Germany and Switzerland. Initially, we contacted 57 C-level representatives of insurers from Germany and from Switzerland.³² A total of 22 representatives of different insurance companies returned the questionnaire. This corresponds to a response rate of 39 percent. Of the 22 insurers, 17 are from Germany and 5 from Switzerland. In each country, we split our sample into two groups according to the size of the company (in terms of gross written premiums from 2012 in the three relevant retail business lines: Car, property and liability; see also Mahlow and Wagner, 2014).³³ The median company size of all participating insurers is € 868 million gross written retail premiums. This premium level serves to divide the two subgroups of smaller and larger insurers in our forthcoming analysis.

Our study covers 42.4% of the relevant retail market in Germany and 67.9% in Switzerland, respectively. In both countries, the group of 11 large insurers contributes the largest share to the total volume with 33.0% for the German market (eight companies) and 52.8% for the Swiss market (three companies). Table 42 summarizes the market shares and numbers of participating companies in each group.

Due to the composition of the participants in our study, we face a potential low degree selection bias that might arise from the following factors. Since the aim is to consider only firms giving direct access to C-level representatives or top management, insurers with opinions from representatives from lower management levels have been omitted. Aside

³²Since our study focuses on the non-life retail customer segment, we only consider insurance companies with significant market shares in this business segment. In 2012, these companies had a combined market share in terms of gross written premiums of 87% in Germany and 68% in Switzerland. The questionnaire has been communicated as a complementary part to the survey instrument used in Mahlow and Wagner (2014).

³³In currency conversions the exchange rate €1 = CHF 1.2007 as of 31st December 2012 is utilized.

| | Small insurers | Large insurers | Total |
|-----------------|----------------|----------------|------------|
| Germany | 9.4% (9) | 33.0% (8) | 42.4% (17) |
| Switzerland | 15.2% (2) | 52.8% (3) | 67.9% (5) |
| Number of firms | 11 | 11 | 22 |

Table 37: Categorization of participating insurers in the survey according to their total market share per country and company size.

Note: Market shares are calculated on the basis of gross written retail premiums. Small/large insurers have premiums below/above the median premium level of all participants, that is €868 million. Values in brackets reflect the absolute number of answers received.

from this, our focus was on larger insurance companies in order to reach a higher level of market coverage. The 22 responding companies have an average volume of written retail premiums of €832 million (figures for 2012), whereas all German and Swiss companies together have an average size of €636 million. Also note that we achieve a significantly higher market coverage in Switzerland than in Germany (67.9% versus 42.4%). In fact, in Germany we count 17 participants, while in Switzerland we only received five responses. However, the German and Swiss insurance markets differ significantly with regard to the number of market participants. From an industry point of view, the total retail market is composed of roughly 10 important insurance companies in Switzerland, compared to around 100 companies in Germany.

D.2 The current and future importance of the topics

We first consider the whole set of respondents, i.e., small and large firms from both Germany and Switzerland. The focus is on the discussion of differences in assessment of the current and future importance of each of the 13 topics (1) to (13). For this purpose, we provide a graphical illustration of the ratings and expected developments in each topic in Figures 7, 8 and 9. Subsequently the descriptive statistics are reported in Table 38.

In order to provide a first overview on the assessment of the current and future importance of the 13 topics, we first report the distribution

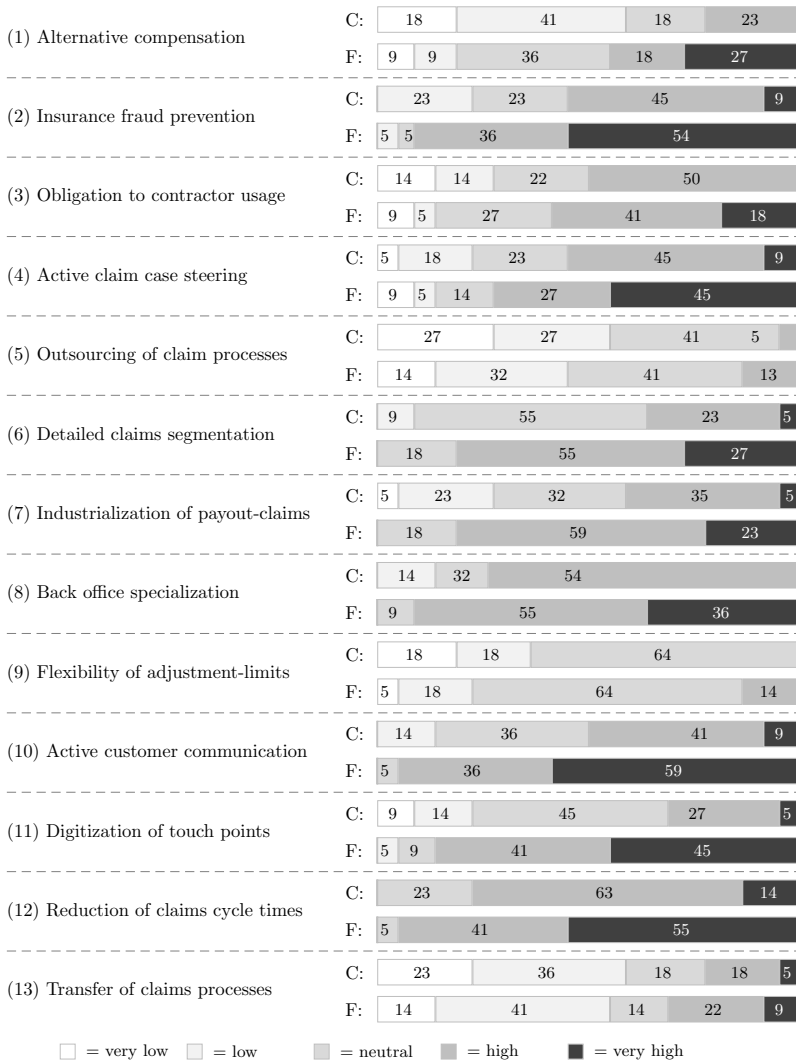


Figure 7: Illustration of the distribution of the survey responses (numbers reflect % of all responses) of the selected 13 topics labeled (1) to (13) for current (upper bars, label “C”) and future impact (lower bars, label “F”).

of the survey answers in Figure 7. The distribution of the answers in per cent is given for each topic and for the rating of current (labeled “C”) and future impact (labeled “F”). This representation allows to see how the different answers are distributed before we focus on average values of the ratings in the sequel.

For further differentiating the responses between current and future impact, we define a two-dimensional plot as follows. We consider the dimensions “current impact” (horizontal axis) and “future impact” (vertical axis). Each topic is characterized by its coordinates in these dimensions. The coordinates are calculated as the average current and future rating of the topic for the whole set of respondents. The possible values for the rating follow the setup of the questionnaire, that is, each of the impact categories range from very low to very high (1 = very low, 2 = low, 3 = neutral, 4 = high to 5 = very high). The plot of the results is given in Figure 8. In order to graphically support our further discussions, we introduce quadrants. This enables us to distinguish more easily the topics with lower/higher current impact and those with lower/higher future impact. For example in the right-hand upper quadrant the current and future impact are high, while in the left-hand bottom quadrant the current and future importance have a low rating. Furthermore, we draw two diagonals. The position of a topic in one of the domains has an impact on its strategic implications. In fact, a topic positioned in the left-hand upper half space indicates increasing importance. Topics positioned in the right-hand lower half space are assessed to have decreasing importance in the future.

From Figure 8 we see that topics (2), (10) and (12) are rated with the highest future impact. That is fraud prevention, active customer communication and the reduction of claims cycle times are assessed to be most important in the future. We note that there are no topics in the domain labeled “decreasing importance”. In fact, all surveyed topics are rated with a future impact that is higher than the perceived current impact. The topics (1), (2), (10) and (11) are positioned most prominently (furthest away from the diagonal) in the “increasing importance-domain”. That is, alternative compensation methods, fraud prevention, active customer communication and the digitization of customer touch points gain

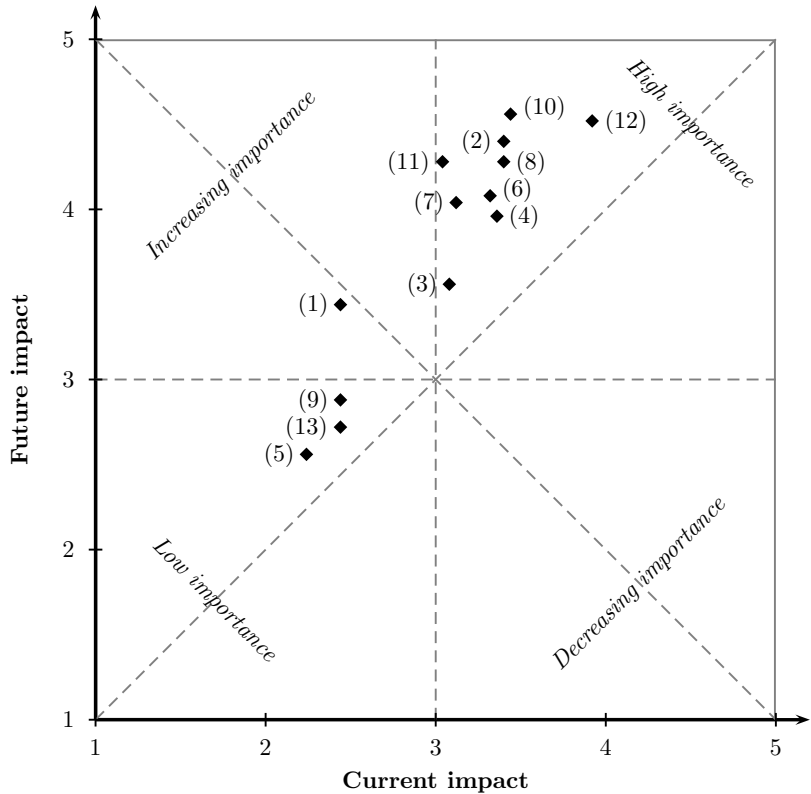


Figure 8: Illustration of the participants’ rating of the current and future impact of the selected 13 topics labeled (1) to (13) as introduced in Section C, see Table 36.

Note: Each point reflects the average current/future rating (mean μ) of the topic for the whole set of respondents as reported in Table 38 (columns labeled “ μ ”). Combinations of current and future impact levels lead to a position in one of four quadrants and above/below the diagonals with different strategic implications. The value either indicates lower (left-hand bottom quadrant) or higher (right-hand upper quadrant) impact as well as increasing (left-hand upper half space) or decreasing (right-hand lower half space) importance.

most in importance. In Figure 9 we illustrate this graphically. The figure allows us to identify the topics the greatest increase in importance (difference between future and current rating, darker color) and the ex-

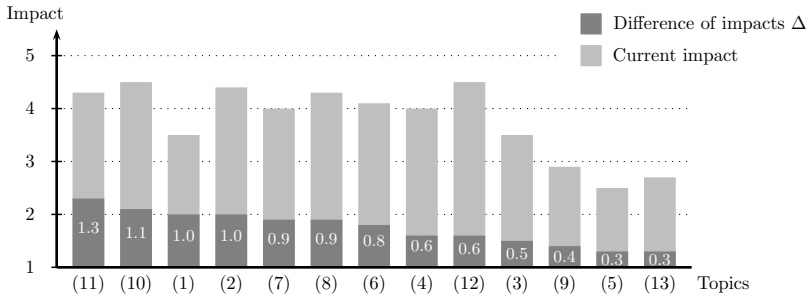


Figure 9:

Illustration of the participants' rating of the current and future impact of the selected thirteen topics labeled (1) to (13), see Table 36.

Note: In each topic the difference between the future and current impact is reported and graphically depicted in gray. The rating of the current impact is illustrated through a stacked bar in lighter gray. The total height of the bar yields the future impact of the topic.

pected future impact (full height of the stacked bar). The part colored in lighter gray corresponds to current impact. The different topics are sorted from the greatest increase in importance to the lowest increase in importance.

In Table 38 we report the full set of descriptive statistics. For each topic we give the mean value (column “ μ ”), the standard deviation (column “(σ)”) and the mode (column “ m ”, that is the most frequent answer) of the insurers' ratings for the current (column “current”) and future impact (column “future”). Furthermore, we calculate the mean difference of future versus current impact (column “ Δ ”). Finally, we report the results from t -tests on the significance of the differences in the assessment of current and future impact. We note that the impact of each topic is rated as increasing over time. Most of the topics show a significantly higher rating for future impact than current impact.

Next, we want to discuss the results of the 13 topics in detail. First, looking at the strategic dimensions claims volume, administration costs and customer satisfaction we consider the overarching results. In Table 39 we report the aggregated descriptive statistics on the level of

| Topics | Current | | | Future | | | Difference | |
|----------------------------------------|---------|------------|-----|--------|------------|-----|------------|------|
| | μ | (σ) | m | μ | (σ) | m | Δ | sig. |
| (A) Claims volume | | | | | | | | |
| (1) Alternative compensation | 2.5 | (1.0) | 2 | 3.5 | (1.2) | 3 | 1.0 | *** |
| (2) Insurance fraud prevention | 3.4 | (0.9) | 4 | 4.4 | (0.8) | 5 | 1.0 | *** |
| (3) Obligation to contractor usage | 3.1 | (1.1) | 4 | 3.5 | (1.1) | 4 | 0.4 | |
| (4) Active claim case steering | 3.4 | (1.0) | 4 | 4.0 | (1.3) | 5 | 0.6 | * |
| (B) Claims administration costs | | | | | | | | |
| (5) Outsourcing of claim processes | 2.2 | (0.9) | 3 | 2.5 | (0.9) | 3 | 0.3 | |
| (6) Detailed claims segmentation | 3.3 | (0.7) | 3 | 4.1 | (0.7) | 4 | 0.8 | *** |
| (7) Industrialization p. claims | 3.1 | (1.0) | 4 | 4.0 | (0.6) | 4 | 0.9 | *** |
| (8) Back office specialization | 3.4 | (0.7) | 4 | 4.3 | (0.6) | 4 | 0.9 | *** |
| (9) Flexibility of adjustment-limits | 2.5 | (0.8) | 3 | 2.9 | (0.7) | 3 | 0.4 | * |
| (C) Customer satisfaction | | | | | | | | |
| (10) Active customer communication | 3.5 | (0.8) | 4 | 4.5 | (0.6) | 5 | 1.0 | *** |
| (11) Digitization of touch points | 3.0 | (1.0) | 3 | 4.3 | (0.8) | 5 | 1.3 | *** |
| (12) Reduction of claims cycle times | 3.9 | (0.6) | 4 | 4.5 | (0.6) | 5 | 0.6 | *** |
| (13) Transfer of claims processes | 2.5 | (1.2) | 2 | 2.7 | (1.2) | 2 | 0.2 | |

Table 38: Results of the participants' rating of current and future impact of the selected 13 topics labeled (1) to (13) as introduced in Section C, see Table 36.

Note: For each topic we report the rating of the current and future impact (columns "current" and "future") as well as the difference between both ratings (column "difference"). The ratings are given on a five-point Likert scale 1 = very low, 2 = low, 3 = neutral, 4 = high to 5 = very high. For both current and future importance we give the mean value μ , the standard deviation σ and the mode m of the participants' ratings. The column " Δ " indicates the difference between the future and current mean values. Statistical results from t -tests on the significance of the difference between both ratings are reported as follows: *** = significance at the 1% level, ** = 5% level, * = 10% level.

the three strategic dimensions. The average values of current and future impact are given along with the calculated difference Δ (increase in impact). With the help of t -tests we learn that the difference in the rating of the current impact with respect to dimensions (B) and (C) is significant at the 5% level. This means that currently strategic topics in the dimension customer satisfaction are considered more important than the efforts in administration costs. However, when considering the assessments of future impact and the differences among the three dimensions, we find an even stronger difference between dimensions (B) and

(C) (significance below the 1% level) and a significant difference between (A) and (B) (at the 10% level). From this we conclude that the topics regarding customer satisfaction are considered to gain even a stronger importance in the future. Furthermore, the strategic goal of reducing the claims volumes is expected to have a higher impact than measures on claims administration costs.

| Strategic dimensions | Current | | Future | | Difference Δ |
|---------------------------------|---------|--------------|--------|--------------|------------------------|
| | μ | (σ) | μ | (σ) | |
| (A) Claims volume | 3.1 | (1.1) | 3.8 | (1.2) | 0.7 |
| (B) Claims administration costs | 2.9 | (1.0) | 3.6 | (1.0) | 0.7 |
| (C) Customer satisfaction | 3.2 | (1.1) | 4.0 | (1.1) | 0.8 |

Table 39: Aggregated results of the participants' rating of the current and future impact at the level of the three strategic dimensions.

Note: See the note in Table 38 for information on the labeling of the columns.

Subsequently, considering the individual topics with regard to a reduction of the *claims volume* (topics 1–4), we come to the following findings. The prevention of insurance fraud (2) and active claims steering (4) are currently the topics with the highest impact rating (mean of 3.4). And going forward they will remain the most prominent levers for claims volume management. In particular, the finding about topic (4) underlines the insurance companies' efforts to get better control of the current claims handling process. The two topics with the highest increase are alternative compensation methods (1) and fraud prevention (2). The topic of fraud prevention is the one where the future impact rating differs most from the current rating. This result is not surprising to us, since this topic dominates insurance claims management research and literature. This also reflects well the discussions that we had with industry experts in the context of the study. Experts stated that alternative compensation methods can have significantly positive impacts, including in terms of reducing insurance fraud. To realize such potential, insurers will often have to deepen their vertical integration into the claims handling value chain (for example with regard to car garages). We interpret the moderate increase in importance of topic (3) in that insurers prefer

to convince customers of the own contractor usage, for example, through offering an increased service level instead of pure obligations.

Under topics (5) to (9) regarding a reduction of *claims administration costs*, we notice that the outsourcing of claims processes (5) shows only little impact for current and future claims operations. On the one hand, this result supports the general attitude of the insurance industry as being averse to outsourcing initiatives. On the other hand, this is a striking finding with significance for the future, since many experts, including those outside the insurance industry, see significant optimization potential in process outsourcing. Among the remaining topics, back office specialization and detailed claims segmentation (topics 8 and 6) are rated most important, both for the present and the future. It is also in these two levers and in the industrialization of payout claims where industry representatives see the most significant increases in importance in the future. These topics (6, 7 and 8) argue for claims segmentation, a higher level of one-step closing of claims cases and more back office specialization. What is noticeable in all aspects is that the current impact is on average only at a slightly relevant level, despite the fact that insurance companies have been dealing with these topics regularly in recent years. By means of interviews with industry experts, we found evidence that the currently low level of importance for claims segmentation and one-step closing of claims cases is driven by a non-ready IT environment in many insurance companies. In addition to the IT-related aspect, both topics require insurance companies to handle tremendous amounts of historical customer and claims data holistically. The flexibilization of claim adjustment limits (topic 9) is expected to experience a significant increase in importance over time. However, the level of its future importance is still at a neutral level. This is most likely driven by the fact that this topic only becomes relevant in extraordinary loss cases (e.g. significant hail damage), which seldom occurs. Furthermore, the flexibilization of claim adjustment limits requires highly standardized claims operations to transfer single process steps properly. Many insurance companies are currently not able to provide this level of standardization.

Participants in our survey see significant changes in claims operations with regard to the optimization of *customer satisfaction*. While

the reduction of claims cycle times (topic 12) and active customer communication (topic 10) are currently seen as the most important levers, they are rated as significantly more important in the future. The future relevance of these strategies has the highest rating of all 13 topics (4.5 points). Furthermore, the digitization of customer touch points, from a current “neutral” rating, will see the greatest increase in importance according to the participants (+1.3 points). This illustrates that insurance companies are well aware of increasing customer demand for electronic access and communication channels in claims events. There are already some insurance companies that offer selected online access channels to customers, but these initiatives are mostly too separated from the overall claims handling process. Even though customer communication and claims cycle times are the future top levers, the increase in importance of the former is higher than the latter. In fact, focusing on active customer communication supports the concept of added customer value through a high level of information in contrast to focusing solely on operational excellence, i.e., the continuous reduction of claims cycle times. We also assume that the attempts to reduce claims cycle times are not relevant for the whole industry, because insurers differ significantly from each other with regard to cycle time performance. This assumption is confirmed by a recent study by Mahlow and Wagner (2014) in which the claims management process efficiency and claims cycle times of 11 insurers from Germany and Switzerland are analyzed. The assessment that a transfer of claims processes to customers (topic 13) only has a lower impact on customer satisfaction is in line with current discussions among practitioners. In fact, there is a tendency among insurance companies to try to centralize their claim adjustment allowances in order to have a more direct influence on the associated risk controlling and management.

D.3 Differences between small and large insurers

This paragraph discusses the potential impact of an insurance company’s size on the perception of the selected topics. In doing so, the central question is whether large insurers have significantly different views of the strategic levers than small insurance companies. In this context,

company size is seen as a potential source of differences in claims management due to economies of scale, the ability to invest in information technologies and other related factors. In fact, considering, for example, the dimension claims administration costs and the basic economic principle of economies of scale, the question should be answered positively. However, large insurance companies have to deal with higher levels of complexity and other factors that can reduce the positive effects of economies of scale. As Cummins and Weiss (1993) found out, large insurance companies are more efficient than small and medium insurers. The authors explicitly stress the fact that small and medium insurers lack efficient administrations because they are not able to make use of economies of scale at the same level as large insurance companies. Another empirical study by Fenn et al. (2008) comes to opposite conclusion. The authors find evidence that large insurance companies and companies with high market shares have higher levels of cost inefficiencies than smaller companies. Below, we report the evaluation results of the current and future importance of the 13 topics defined in Section C separately for smaller and larger insurance firms (refer to Section D.1 and Table 42 for the definition of the groups). We aim to identify differences on the one hand and evaluate similarities between both company segments on the other hand. Our results are reported in Table 40 and we discuss the figures below.

The comparison of the assessment of the topics by small and large insurance firms shows no significant differences in current impact. With regard to future importance we note that smaller companies see a very high impact (4.8 points) from the reduction of cycle times (topic 12). This is significantly higher than the average rating given by the group of large firms.

When taking a closer look at the topics in the strategic dimension *claims volume*, several trends can be identified. Currently, small insurers tend to see a higher lever in active claims steering (topic 4), whereas larger insurers tend to consider insurance fraud prevention and alternative compensation methods (topics 2 and 1) as more important. This may be because the claims management units of smaller insurers are not yet prepared for this strategic switch. For example, as mentioned

| Topics | Current | | | | Future | | | |
|----------------------------------------|-----------------------------|-----------------------------|-------------------|------|-----------------------------|-----------------------------|-------------------|------|
| | Small μ (σ) | Large μ (σ) | Diff. Δ | sig. | Small μ (σ) | Large μ (σ) | Diff. Δ | sig. |
| (A) Claims volume | | | | | | | | |
| (1) Alternative compensation | 2.2 (0.9) | 2.6 (1.1) | 0.4 | | 3.2 (1.2) | 3.6 (1.2) | 0.4 | |
| (2) Insurance fraud prevention | 3.4 (1.2) | 3.4 (0.7) | -0.0 | | 4.1 (1.0) | 4.6 (0.5) | 0.5 | |
| (3) Obligation to contractor usage | 3.1 (1.1) | 3.1 (1.1) | 0.0 | | 3.6 (1.3) | 3.5 (1.0) | -0.1 | |
| (4) Active claim case steering | 3.7 (1.2) | 3.2 (0.9) | -0.5 | | 4.0 (1.2) | 3.9 (1.3) | -0.1 | |
| (B) Claims administration costs | | | | | | | | |
| (5) Outsourcing of claim processes | 2.1 (0.9) | 2.3 (0.9) | 0.2 | | 2.6 (1.0) | 2.5 (0.8) | -0.1 | |
| (6) Detailed claims segmentation | 3.2 (0.6) | 3.4 (0.7) | 0.2 | | 4.1 (0.7) | 4.1 (0.6) | 0.0 | |
| (7) Industrialization of payout-claims | 3.3 (1.2) | 3.0 (0.8) | -0.3 | | 4.1 (0.7) | 4.0 (0.6) | -0.1 | |
| (8) Back office specialization | 3.4 (0.7) | 3.4 (0.7) | -0.0 | | 4.4 (0.7) | 4.2 (0.5) | -0.2 | |
| (9) Flexibility of adjustment-limits | 2.4 (0.8) | 2.5 (0.7) | 0.1 | | 3.0 (0.7) | 2.8 (0.7) | -0.2 | |
| (C) Customer satisfaction | | | | | | | | |
| (10) Active customer communication | 3.4 (0.8) | 3.5 (0.8) | 0.1 | | 4.7 (0.5) | 4.5 (0.6) | -0.2 | |
| (11) Digitization of touch points | 2.9 (0.9) | 3.2 (1.0) | 0.3 | | 4.2 (0.6) | 4.3 (0.9) | 0.1 | |
| (12) Reduction of claims cycle times | 4.1 (0.3) | 3.8 (0.7) | -0.3 | | 4.8 (0.4) | 4.3 (0.6) | -0.5 | * |
| (13) Transfer of claims processes | 2.1 (1.0) | 2.7 (1.2) | 0.6 | | 2.8 (1.1) | 2.7 (1.3) | -0.1 | |

Table 40: Results of the small and large insurance companies' rating of the current and future impact of the selected 13 topics labeled (1) to (13) from Table 36.

Note: For each topic, the rating by small and large companies of current and future impact ("current" and "future" columns, followed by "small" and "large") as well as the difference between the ratings from both company categories are reported ("Diff." column). The column " Δ " provides information about the difference between the large and the small companies' mean values. Statistical results from t -tests on the significance of the difference between small and large companies' ratings. For further details, see the note in Table 38.

In Section C, alternative compensation methods seek to substitute the invoice-based adjustment process, which requires the insurer to vertically integrate into repairment processes to a higher level. Such investments are naturally easier for large companies to make. Active claims case steering (topic 4) is assessed to be of great importance by both company segments with respect to future developments.

Considering the topics in *claims administration costs*, the difference in the assessment of both groups of insurers is even less prominent (no statistically significant differences). While large insurers currently assign the most importance to detailed claims segmentation (topic 6), smaller insurers focus more on back office specialization (topic 8). Large insurers seem to rate the industrialization of payout claims (topic 7) as less important than small insurers. The fact that large companies are often more industrialized than small companies might be a reason for the lower impact as assessed by large insurance companies. When looking at the

assessments of the future impact the differences between both groups are close to zero. Small and large insurers have an almost identical assessment of administration cost-related topics. No striking differences can be identified.

Within the topics related to *customer satisfaction*, the reduction of claims cycle times (topic 12) reveals a significant difference in both groups' rating on future impact. Small insurance companies see a very high impact, whereas large insurers evaluate the impact 0.5 points below this level. Although the absolute impact levels for both company segments are a high level, the difference leaves room for interpretation. The assessment in Mahlow and Wagner (2014) analyzes whether small insurers currently have higher cycle times than large companies. Depending on the business line, those companies put more emphasis on the topic in the future. Besides the reduction of claims cycle times, there are no topics with significant differences between small and large insurers. When considering current impact levels, the reduction of cycle times (topic 12) is of high importance for both groups of companies, followed by active customer communication (topic 10). These two topics are also seen as the top levers in future strategies.

D.4 Differences between German and Swiss insurers

Finally, we focus on differences in claims management topics between German and Swiss insurers. Different market conditions may have an impact on insurers' claims management. The following aspects are likely to be drivers for potential differences: The German insurance retail market is significantly larger than the Swiss market with regard to total market volume (in terms of premium volume and number of insurance companies). This leads to more intense competition in the German than the Swiss market, which is reflected, for example, in significantly lower average retail premium levels in Germany. We thus assume lower operational margins in Germany and as a result more pressure for insurance companies to excel in operations in general and also with regard to claims operations in particular. Swiss insurers have comparably lower claims ratios than German insurance companies, especially in car and home in-

| Topics | Current | | | | Future | | | |
|----------------------------------------|--------------------------|--------------------------|-------------------|------|--------------------------|--------------------------|-------------------|------|
| | DE μ (σ) | CH μ (σ) | Diff. Δ | sig. | DE μ (σ) | CH μ (σ) | Diff. Δ | sig. |
| (A) Claims volume | | | | | | | | |
| (1) Alternative compensation | 2.5 (1.1) | 2.2 (0.4) | -0.3 | | 3.6 (1.3) | 3.0 (0.6) | -0.6 | |
| (2) Insurance fraud prevention | 3.2 (1.0) | 4.0 (0.0) | 0.8 | *** | 4.3 (0.8) | 4.8 (0.4) | 0.5 | * |
| (3) Obligation to contractor usage | 3.2 (1.1) | 2.6 (1.0) | -0.6 | | 3.6 (1.2) | 3.4 (0.5) | -0.2 | |
| (4) Active claim case steering | 3.4 (1.1) | 3.2 (0.7) | -0.2 | | 4.0 (1.3) | 3.8 (1.2) | -0.2 | |
| (B) Claims administration costs | | | | | | | | |
| (5) Outsourcing of claim processes | 2.3 (0.9) | 2.0 (0.9) | -0.3 | | 2.6 (0.9) | 2.2 (0.7) | -0.4 | |
| (6) Detailed claims segmentation | 3.2 (0.7) | 3.6 (0.5) | 0.4 | | 4.1 (0.8) | 4.0 (0.0) | -0.1 | |
| (7) Industrialization of payout-claims | 3.2 (1.0) | 3.0 (0.9) | -0.2 | | 4.0 (0.6) | 4.2 (0.7) | 0.2 | |
| (8) Back office specialization | 3.4 (0.8) | 3.6 (0.5) | 0.2 | | 4.2 (0.6) | 4.4 (0.5) | 0.2 | |
| (9) Flexibility of adjustment-limits | 2.4 (0.8) | 2.8 (0.4) | 0.4 | | 2.8 (0.7) | 3.2 (0.4) | 0.4 | |
| (C) Customer satisfaction | | | | | | | | |
| (10) Active customer communication | 3.5 (0.8) | 3.4 (1.0) | -0.1 | | 4.5 (0.6) | 4.8 (0.4) | 0.3 | |
| (11) Digitization of touch points | 3.0 (0.9) | 3.2 (1.2) | 0.2 | | 4.2 (0.9) | 4.6 (0.5) | 0.4 | |
| (12) Reduction of claims cycle times | 3.9 (0.5) | 4.0 (0.9) | 0.1 | | 4.5 (0.6) | 4.6 (0.5) | 0.1 | |
| (13) Transfer of claims processes | 2.5 (1.0) | 2.2 (1.6) | -0.3 | | 2.8 (1.1) | 2.4 (1.5) | -0.4 | |

Table 41: Results of German (DE) and Swiss (CH) insurance companies' rating of the current and future impact of the selected 13 topics labeled (1) to (13) from Table 36.

Note: For each topic, the rating by German and Swiss companies of current and future impact ("current" and "future" columns, followed by "DE" and "CH") as well as the difference between the ratings from companies from both countries are reported ("Diff." column). The column " Δ " provides information about the difference between Swiss and German companies' mean values. Statistical results from *t*-tests on the significance of the difference between the German and Swiss companies ratings are also shown. For further details, see the note in Table 38.

surance lines (see Footnote 30). Another factor that might differentiate claims operations of German and Swiss insurers is the higher income level and associated higher human resources expenses in Switzerland. We would expect this to lead to increased claims automation efforts by Swiss insurance companies.

The results from the German-Switzerland side-by-side analysis are reported in Table 41. For the dimension *claims volume*, a significant difference in the assessment between German and Swiss insurers can be detected in topic (2) insurance fraud prevention. Insurance companies from Switzerland rate this topic significantly higher with respect to its current and future impact. In Switzerland, this topic has a very high impact rating, especially with regard to its future impact. In all other topics the differences in the ratings between firms of different origin are not statistically significant. However, we note that German insurers rate

the other three topics (1), (3) and (4) higher than Swiss insurers, as well with regard to their current and future impact. This trend between German and Swiss insurers may underline the hypothesis that German insurers are looking more intently for optimization measures in claims management.

In terms of efficiency improvements in *claims administration costs*, German and Swiss insurers reveal no significant differences. With regard to their current impact, the same topics (6) and (8) have the highest rating in Germany and Switzerland. Also, when looking at topics related to *customer satisfaction*, no significant differences are revealed. With regard to their future impact, Swiss insurers tend to focus more on the digitization of customer touch points (topic 11), whereas the transfer of claims processes (topic 13) is only considered to be of low importance in Switzerland. On average, Swiss companies view the transfer of claims processes to sales agents as having a low impact, while German insurers consider the impact to be neutral. Based on further discussions with industry experts, we discovered that insurers view the transfer of processes to sales agents negatively. This may be due to reduced control of claims cases and the potential increase of insurance fraud. Sales agents (tied agents or brokers) may try to extend their claims adjustment competencies to gain more impact on their customers. Summing up these points, our results contradict the expected findings to a certain extent. One reason for this might be that the participants consider the impact of sales agents to be very high, which does not allow for a reduction of the level of external claims adjustment, although it is economically necessary. Finally, it is worth mentioning that active customer communication is seen as the top lever in the future by both company groups.

E Conclusion

The target of this paper is to give an overview of current and future strategic topics in insurance claims management from a practitioner's point of view. For this purpose, we introduce the claims management triangular framework with the main competing goals, which are (A) the minimization of claims volume, (B) the minimization of claims adminis-

tration costs and (C) the maximization of customer satisfaction. First, we discuss the three targets and potential conflicts. Next, we define a set of 13 relevant topics in insurance claims management according to three key dimensions. Using a survey, assessments from C-level industry representatives regarding the relevance of the different levers were gathered. The responses from 22 insurance companies in Germany and Switzerland form the data basis for our study.

Many facets of claims management have been little studied by academic work in the field of insurance management. Completing these references with current industry studies and introducing analogies from other industries, we lay out the importance of the selected topics. According to our analysis, the largest goal conflicts in insurance claims management potentially arise between customer interests on the one hand and insurance companies' interests (efficient claims administration and low claims volumes) on the other hand. Secondly, we see conflicts within insurance companies, especially between actions to reduce claims volumes and keeping claims administration costs at a low level. From the survey of top management at insurance companies, a ranking of the most relevant topics in insurance claims management with respect to current and future impact is derived. The results show that several topics are of particular importance for the insurance industry.

At the level of the three strategic goals we find that initiatives concerning customer satisfaction currently have greater importance than efforts regarding administration costs. In the future, these differences are likely to increase. Furthermore, the reduction of claims volume will receive greater efforts in the future than administration costs. Looking at the different levers, the topics of alternative compensation methods and insurance fraud prevention will see the greatest increases in terms of reducing claims volume. With regard to claims administration cost, the industrialization of payout claims, detailed claims segmentation and back office specialization are likely to see the greatest increase in future impact. For improving the customer satisfaction, industry experts favor active customer communication, the digitization of customer touch points as well as the reduction of claims cycle times. Finally, only a few significant differences in the assessment of the topics could be iden-

tified between the groups of small and large insurers and the groups of companies in Germany and Switzerland.

We see a better understanding of goals and their potential conflicts in insurance claims management as a relevant research field. In particular, the quantification of interdependencies among the different topics and the firms' position and profitability in the market can add further value to discussions among researchers and practitioners. Our formal introduction of the goals, the assessment of the goal conflicts and the identification of relevant topics can serve as the structural basis in this regard. More detailed research hypotheses can be formed on the basis of our results. However, our interviews with experts from insurance companies demonstrated that data collection for such a research project will be extremely complex since each company uses its own claims handling procedures. To the best of our knowledge, there has not been such an effort in insurance management research to date.

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Part IV

Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark

Abstract

In view of the fact that claim payouts account for about 70% of annual direct costs in non-life insurance companies, an optimal claims management environment is of strategic importance. The purpose of this paper is twofold: on the one hand, we introduce a standardized claims management process model and, on the other hand, we apply process benchmarks to various operational parameters. The proposed claims management process landscape comprises current industry standards for claims handling from a theoretical perspective, supported by practice insights from the industry. Our model aims to reflect the most important claims processing activities. The claims handling work flow is structured into five core steps, namely, notification, registration, coverage audit, settlement and closing of the claim. For these core steps, we differentiate between three claim complexity categories and their associated back office levels. In the second part of the paper we assess the industrys claims handling efficiency. We benchmark industry processes with reference to detailed claims management data from 11 insurers in Germany and Switzerland. The benchmarks are based on the previously defined claims management model and are applied separately to the three retail business lines of car, property and liability insurance. We measure claim process times (cycle times) as well as claim quantities and average claim payouts at different levels. Overall, within each business line, more than 30 data points are gathered from each respondent insurer. This allows

us to compare the process performance of different insurance companies and to describe significant differences in their process patterns. Furthermore, principal findings are derived from descriptive statistics as well as ad hoc data analyses. The paper seeks to contribute to the discussion of how different insurance companies perform in claims management, and to define best practice. Our findings are relevant to academics and practitioners alike.³⁴

³⁴N. Mahlow and J. Wagner. Process Landscape and Efficiency in Non-Life Insurance Claims Management: An Industry Benchmark. *Working Papers on Risk Management and Insurance*, 2014.

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A Introduction

In recent years, insurance companies have been facing increasing competition for insurance clients. This is especially true of the non-life retail business lines that are attractive in offering higher profitability with lower risk exposure. These developments have been catalyzed by the problems that insurers have to solve in their life business lines. In this context, best practice in claims management in the retail business lines car, property and liability has been widely discussed, especially among executives and practitioners directly involved in the insurance industry. The core driver for these strategic discussions is the fact that claim payouts often account for around 60-70% of all operating expenses in the retail segments of insurance companies. Each claim payout that insurers are able to reduce in amount, together with efficiency improvements in their processes, have an immediate impact on the companies profitability, i.e., their costs and combined ratios. More and more insurance experts identify claims management units as potential sources of significant cost savings.

The increasing importance of claims management is reflected by a rising number of related publications. In 2004, the OECD published guidelines for good practice for insurance claims management and provided a general framework (see OECD (2004)). The guidelines offer operational recommendations for the most important process steps in insurers claims handling procedures. Dab, Frost, and Schwarz (2007) state that insurance companies are currently scarcely aware of their actual claims processes. For example, there is often no transparency surrounding actual settlement resources for different claims categories. The lack of transparency in such pivotal processes results in inadequate resource allocation. The identification of performance potentials in claims management through the use of innovative claim settlement methods is discussed by Accenture (2003). The authors name excellent claims triage, alternative adjustment methods and deepened vertical process integrations within insurance companies as important levers for optimized claims operations. Butler and Francis (2010) and Bart (2012) stress the importance of excellence in process knowledge and the necessity of in-

insurance companies exerting direct control over each step in the claims settlement process. Despite the number of publications from practitioners, there are hardly any quantitative analyses covering the field of insurance companies claims management in a comparative and comprehensive manner.

The aim of our paper is therefore to contribute to the debate concerning insurance companies claims management operations in terms of different strategic and operational aspects. We seek to do so by introducing a model describing the process flows and identifying industry best practice and discussing several success factors in claims management operations by means of an industry survey.

In a first step, we outline a basic claims management model. The model consists of five consecutive process stages and three different claims handling units along claims of different complexity. The core process steps comprise the notification, registration, audit, settlement and closing of a claim. Along this process model, we define detailed work flows for payout, standard and complex claims cases. Our model is fleshed out by input from industry practitioners. In a second step, we compile and conduct an industry survey with car, property and liability insurers from Germany and Switzerland. This survey focuses on process quantities, process times, organizational design, personnel capacities and aspects of claims management process strategy. In order to ensure the comparability of our results among the survey participants, all process data is evaluated with reference to our proposed claims management model. In each of the 11 participating insurance companies, more than 30 data points on the process are gathered in each of the retail business lines car, property and liability. Finally, we provide statistical analysis and benchmarking results for various measures.

Our numerical results point to multiple findings that are duly discussed in the paper. On the one hand, we can see that insurance companies are operating on very different efficiency levels with regard to claims management. This becomes apparent, for example, when looking at claims work and cycle times, or at the claims adjustment allowances of insurance agents and brokers. Such insights indicate that there is no generally accepted best practice claims management operating model in

use within the majority of insurance companies. On the other hand, from ad hoc analysis, we derived other new insights; for example, that insurance companies granting claims adjustment allowances to their insurance agents appear to face higher fraud occurrence, while this does not apply to insurance brokers with adjustment allowances. Further, we identified a tendency for shorter claims cycle times to lead to an increased level of detected insurance fraud (especially in property insurance). Insurance companies also manage to reduce claims cycle times significantly with the introduction of lump sum claims adjustment allowances. To the best of our knowledge, our study is the first of its kind in academic insurance claims management research.

The remainder of the paper is structured as follows: Section B introduces the basic concept and core elements of the claims management process model. The core process stages, the claim complexity categories and the relevant back office levels are described. On the basis of these elements, the work flows of the claims management framework are described in detail in Section C. In Section D we describe the research methodology, the panel of survey participants and their key characteristics. We then go on to summarize the questionnaire employed for the survey. The empirical findings of our study are reported in Section E. First, descriptive statistics for all relevant measures are reported, second, selected ad hoc analyses provide additional insights across several measures. Section F concludes the paper, summarizing the main findings and offering an outlook on future extensions and research.

B A standard claims management model and literature review

This section provides an overview of the core elements and process stages of the proposed standard claims management model and reviews the literature related to the different claims procedures. The idea behind the proposed standard claims management model is to create a paradigm representing the principal process steps for the most commonly occurring types of claims cases. Although in practice, claims operations differ sig-

nificantly between insurance companies, a standard claims management model serves to boost operational efficiencies (see, e.g., Bart, 2012). In the context of our research, our proposed model provides a solid basis for discussions with practitioners and enables us to collect data for the process benchmarking study. The standard claims management model discussed in the following concerns retail claims in the non-life business area among insurance companies. Since non-retail claims are handled to a much higher degree according to individual patterns, our study duly focuses on retail claims.

Given that overcomplexity in the process models of insurance companies claims management has been identified as one of the key issues for academic and practitioner research (see for example Postai, 2006), we propose and utilize a simplified claims management model. We derive our model from theoretical considerations and discussions with practitioners. The OECD (2004) guidelines for good practice for insurance claims management provide the initial theoretical basis.

In Section B.1 we introduce the core process stages that build the foundation of the claims management model. In Section B.2, the model is fleshed out with regard to claim complexities and the corresponding three back office levels (see Section B.3). With reference to the model defined in the remainder of this section, we detail the work flows for each process stage in Section C.

B.1 Core process stages

In the following, we break the standard claims management process model down into five core process stages. This segmentation of the claims management value chain follows the reports from a series of works by academics and practitioners (see, for example, Müller and Küfner, 2003, McFarland and Knipp, 2001, Little, 2006 and Capgemini, 2011). In addition to these sources, practical input has been gathered from expert

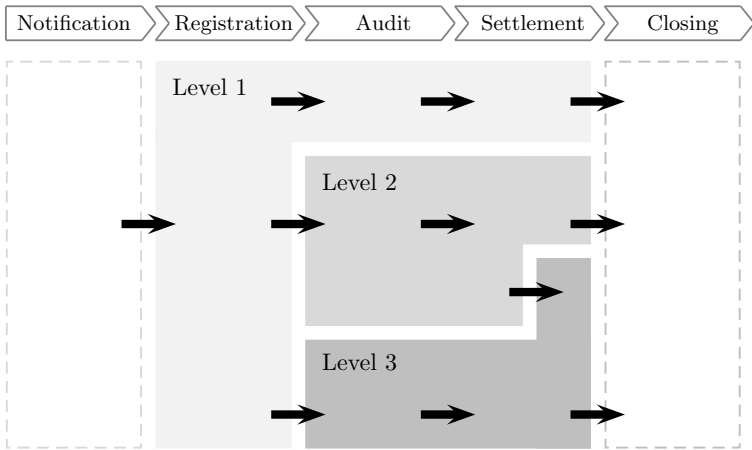


Figure 10: Outline of a standard claims management process model with its core elements.

Note: Core elements include five process steps for claims handling procedures and three levels of claim complexity and back office levels. The core process stages are described in Section B.1. Incoming claims are categorized as “pay-out” claims (level 1), “standard” claims (level 2) or “complex” claims (level 3) and are handled by the corresponding back office level, see Sections B.2 and B.3.

hearings which allowed us to fine-tune our proposed model.³⁵ Aggregating all the information, we define the following five process stages:

1. notification of claim,
2. registration of claim,
3. claim coverage audit,
4. settlement of claim,

³⁵These telephone interviews were held in the context of the initial stage of our data collection for the benchmarking among insurance companies in Germany and Switzerland (see Section D.1). Similarly to the panel contacts used in Mahlow and Wagner, 2014, the sample consists of more than 20 interviews with C-level representatives of different insurance companies who are also in charge of the claims management department at their company.

5. closing of claim.

In the following we discuss the different process steps individually.

Notification of claim. During the notification of claim process stage, the client notifies the insurer of the claim occurrence. It is important to define this process, because it is usually the operational starting point of the claim case in insurance companies (see, e.g., Maas and El Hage, 2006). OECD (2004) provides practical guidance on essential process elements in this process stage with respect to customers' and insurers' obligations. Defining this starting point allows us to define average claims cycle times, which is a key measure for claims management process benchmarking. Claims cycle times can, for example, be applied to test correlations between efficient claims operations (short cycle times) and the occurrence of insurance fraud (see Bearing Point, 2008, and Fenn and Rickmann, 2001). Furthermore the inbound channel of the claim notification, that is, the reporting of the loss via the insurer's agent network, online access points or back office, may also yield useful analytical insights (see Section C.1).

Registration of claim. In the registration process stage, the insurer transfers the case in its claims system and segments the claim according to its complexity (see Section B.2 where we define the three categories of "payout", "standard" and "complex" claims). In the model, the claim's registration is separated from the notification process stage, to place special emphasis on the claims segmentation procedure (see Amoroso, 2011). Claims segmentation is of major importance, since adequate claims segmentation (often performed along the estimated degree of claim complexity) determines the overall process efficiency (see Brunauer, Hiendlmeier, and Müller, 2011, and Butler and Francis, 2010). Expert consultations however revealed that in practice some insurers execute these two steps together.

Claim coverage audit. In the claim coverage audit, the insurer determines, if the claim is covered by an insurance contract. If this is not the case, the insurer can still settle the claim through a goodwill handling

(e.g., in borderline cases). Otherwise, the claim case is rejected. Some insurers also postpone the process step of claims goodwill audit towards the end of the adjustment process. The separation of normal claims from goodwill claims is of significant importance for insurance companies. Insurers with high amounts of goodwill claims are often building customer satisfaction (driven by voluntary claim payouts) at the expense of an increase in total claim payouts (see for example Huysentruyt and Read, 2010). Our model thus addresses both types of claims adjustment separately. In practice, however, many insurance companies have difficulties estimating their volume of goodwill claims because very often this type of claims handling is not adequately identified as such in their systems.

Settlement of claim. The most important task within this process stage is the definition of the individual claim settlement amounts. Depending on the complexity of a claim, this assessment is either done with or without the assistance of a claims auditor (insurers usually have in-house claims auditors as well as contracted claims auditors). This process stage is particularly crucial for the efficiency of an insurers claims operations. In summary, there is a trade-off between a higher level of manually audited claims cases which correlates with increased administration and personnel expenses on the one hand, and a lower level of manually audited claims cases which correlates with lower administration and personnel costs on the other hand.

Closing of claim. The claims adjustment process stage ends with the closing of the claim, that is, when the customer receives the payout and the closing notice. Depending on the adjustment method, the customer receives either a cash payment or a replacement in kind. It is important to track the closing time for each claim case in order to determine claims cycle times (see, e.g., IBM, 2006). Evaluations of claims cycle times allow us to assess the insurer's claims management performance.

In Section C we detail the claims work flows in each of the core process stages.

B.2 Claim complexities

The adequate segmentation of claims is a crucial process step in insurance companies claims management operations. Claims segmentation patterns have an immediate impact on process speed (claims cycle times) and proper claims handling (relation of audit intensity to claims complexity). Among practitioners within insurance companies especially, state-of-the-art segmentation models and patterns are often discussed (see for example Butler and Francis, 2010). According to our interpretation of the current discussions, there is no clear limit or best practice with regard to the number of segmentation categories, segmentation patterns and segmentation targets. In the following, we introduce three levels of claim complexities that we discuss in more detail below:

1. payout claims,
2. standard claims,
3. complex claims.

Payout claims. Payout claims typically represent a large share of all claims in the retail segment. The idea of this category is to group claims that can be relatively quickly adjusted either on a lump sum basis or with reduced auditing patterns. Lump sum adjusted claims are usually settled if the claim is below a defined claim amount. Determining the threshold for lump sum adjustment is crucial for insurance companies, because if customers identify this limit, insurance fraud is eased. Payout claims typically have claim amounts below €1 000. Furthermore, these claims have the shortest operational cycle times due to their low handling complexities. All claims within this category are settled immediately if the claim is contractually covered and if all claims information is made available to the insurer. This means that payout claims are not inspected by either internal or external claims auditors. This is due to the high costs associated with claim inspections in relation to average payout claim amounts.

Standard claims. Standard claims exceed the number of payout claims and account for the largest proportion of all retail claims in insurance

companies. Unlike payout claims, standard claims usually trigger a more detailed claims settlement procedure in the insurer back office. Depending on the individual claim complexity, insurers decide about the engagement of internal or external claims auditors. Most often, insurers employ more internal than external claims auditors. The reasons for this are lower adjustment costs (per claims case) and closer supervision of internal claims auditors. External claims auditors are mainly employed for special claims and during capacity peak periods to provide operational flexibility to the insurance company.

Complex claims. Claims with a very high estimated complexity are handled as complex claims cases in the adjustment process. Complex claims are mainly handled by specialists in the back office and represent a smaller share of all claims cases. All of these claims are inspected by internal or external auditors to determine the settlement amount. These inspections differ significantly from inspections in the other claims categories, thus resulting in overall significantly higher cycle times.

In the empirical study in Section D, we gather detailed knowledge and compile an industry benchmark for factors such as the number, average payout and cycle times of claims in the different segments, differentiating among the retail business lines car, property and liability.

B.3 Back office levels

From our discussions with industry experts, we found that three different back office levels are most commonly involved in insurance companies claims handling units. Thus we base our standard claims management process model on three back office levels. These levels are assigned to settle all claims in the three payout, standard and complex claims categories. The different personnel capacities and ability levels entail certain financial considerations. Our model makes the following assumptions regarding the back office levels:

First level. The first back office level is responsible for settlement of payout claims (see Section B.2). Due to the low complexity of the claims,

the personnel in this back office unit are less specialized and trained, compared to personnel in levels two and three. Usually, the first level is centrally located in the claims management organization of insurance companies. The back office personnel in the first level unit usually have no direct contact with the car, property and liability divisions of the insurer. Due to the high homogeneity of claims cases in the first back office level, these operations are most appropriate for outsourcing (see Khiruddin, 2011 and Hoying, Platt, Bongartz, and Sasaki, 2014).

Second level. This back office level processes all standard claims cases. Since standard claims are significantly more complex than payout claims, the second back office level makes the decision as to whether to use internal or external claims auditors. Either the back office personnel or the respective claims auditor is responsible for the determination of claim settlement amounts. Prior to the assessment of settlement amounts, the second level determines if the claim is contractually covered. If the claim case appears to be more complex than initially estimated, the case can be rerouted to the third back office level handling complex claims. Outsourcing of second-level claims operations is less common for first level claims operations.

Third level. The third back office level handles claims with the highest complexity (complex claims) and has the lowest total claim quantities. Claims handling personnel from the third level liaise closely with personnel from the car, property and liability divisions. Due to this high level of interaction, process outsourcings for third levels rarely occur. Back office personnel in the third level units have the highest level of specialization of all employees in the claims adjustment units.

In our empirical analysis, we will focus on detailing figures for personnel and their specialization in the different back office levels. For example, we will count the total number of general back office, managers, auditors and fraud specialists in terms of full time equivalents and put these capacities in relation to company sizes in order to rate their efficiency.

C Workflows in claims management

In this section, we define the claims management workflows in the framework of the proposed standard process model. In doing so, we detail the model introduced above and we provide a basic understanding of which data points are relevant for measurement in our study (see Section D.2 for the questionnaire used in our market survey). While Figure 10 provides an outline of the model with its process stages and back office levels, Figure 11 gives a detailed illustration of the claims workflows along the five process stages and the three back office levels. In further detailing the model, we make the following (restricting) assumptions: first, the representation of the model does not differentiate between different competencies within each back office level. However, in practice, each back office level employs personnel with different competencies such as junior and senior personnel as well as unit-managers. Second, the model does not explicitly reflect all possible customer-contact-points along the process chain. This is because customer involvement in the claim process differs significantly for various claims types at the different stages.

C.1 Notification of claim

This process stage includes all activities that take place during the time from when the policyholder sustained the loss until the time when the policyholder reports the loss to the insurance company. In practice two different points in time of claim occurrence are defined. First, the effective time when the loss occurred. Second, the time when the customer first discovered the loss. The first definition is appropriate for our purpose, since we analyze effective time periods between loss occurrence and loss reporting.

The standard claims management model differentiates three claims reporting channels for customers. First, customers can report the loss via the insurer agent network which comprises the companys tied agents and independent brokers. The second channel represents various online access points, for example, e-mail, insurer homepage and mobile-device-apps. A third channel includes all other means of reporting to the insurer back office. These include telephone, fax and letter.

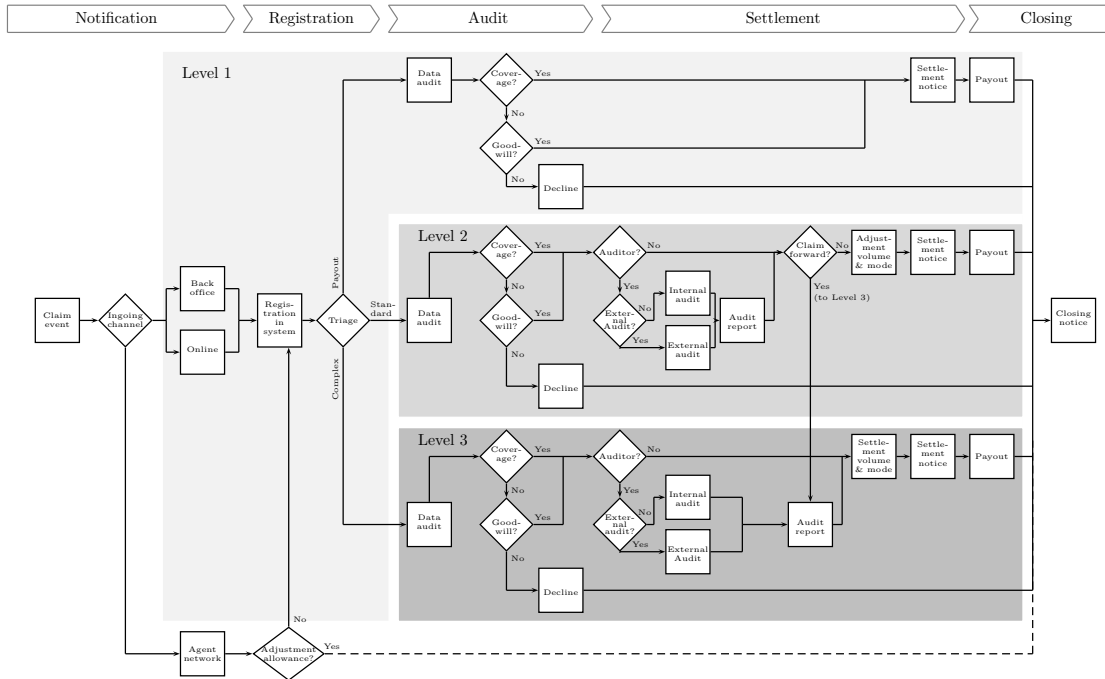


Figure 11: Illustration of the detailed work flows in the standard claims management model (extension of the outline in Figure 10).

Claim reports via the online and back office channels are initially reported and handled in the first level back office unit of the insurer. The remaining claims, which are filed through the insurer agent network are either completely handled through the agent network or also transferred into the first back office level. The latter is the case if the claim amount exceeds the agents maximum adjustment allowance.

C.2 Registration of claim

The registration of claim process step spans from the moment when the claim is received by the insurer until the claims case is categorized into the adequate complexity segment. Initially, when claims are routed to the insurers first-level back office, claims notifications are consolidated and the clerks are responsible for registration of all incoming claims in the central insurer claims system. For the claims registration process, we do not differentiate between the reporting media (i.e., e-mail, insurer homepage, mobile-device-apps, telephone, fax or letter).

After the initial registration of a claim, the first-level back office clerk completes any required claims information if missing. This completion of information is typically done by re-contacting the customer who reported the claim. Once the claim file has been completely registered in the insurer claim system, claims are segmented into three claims categories (see Section B.2). The claims segmentation is performed automatically by standardized procedures using attributes of the registered claims. Our model assumes a single claims segmentation step, but in practice insurers commonly apply a two-step procedure. In our model, claims are segmented automatically by the system in a first step. Any remaining claims that were not handled successfully are then segmented manually into one of the three claims categories. After segmentation, the claims are routed to the three back office levels for the coverage audit.

C.3 Claim coverage audit

During the claim coverage audit, the insurer decides if the claim is covered by the customers contract. At this process stage, claims are handled

for the first time according to their individual complexities in the different back office levels.

At this stage, all claims-related documents are integrated in the insurers electronic claims system. If any of the documents are incomplete, the back office clerk is responsible for completion of the data with the help of the client. Documents usually comprise the reporting document, and, if available, the settlement quote. The claim reporting document contains all basic data as well as a detailed description of the claim case. The claim settlement quote is the document which initially reports the claim amount to the insurer. This quote is client- and case-specific and uses different layouts for various claim types. For example, in the case of household insurance, the claim settlement quote might be the original invoice, whereas for car insurance, the quote might be a cost estimate from a garage. For the remaining cases, where the insurer has no such quote document at the beginning of the coverage audit, the insurer will deduce the initial estimated claim value. Our model does not explicitly differentiate whether or not the clients reports a claim settlement quote.

When all required claim documents are in place, the next step is the coverage audit. The audit is performed in the three back office levels according to the individual claim complexity. Depending on the level of the insurers internal process automation, the audit is more or less supported by IT systems. The level of audit automation is typically higher for retail claims than for commercial claims because of the higher level of individualized parameters in commercial contracts. On the basis of the contractual terms, the claim may be covered or not. Claims that are technically declined in the first step are audited for goodwill coverage in a second step (see Figure 11). Whether a non-covered claim can be adjusted through goodwill is decided by the respective back office clerk. Usually, in each back office level there is a pre-defined maximum amount up to which claims can be settled under goodwill. The criteria which allow such goodwill adjustment are, however, multifaceted. Finally, claims that are neither covered nor subject to goodwill treatment are declined and followed up at the closing process stage.

C.4 Settlement of claim

Following the claim coverage audit, the claim settlement amount and mode are determined. Depending on the claim complexity, both parameters are either determined in-house by the insurer, with or without claim surveyors, or with the assistance of external auditors. The settlement of claim process stage technically ends with the claim settlement clearance.

In our model, payout claims handled in the first back office level are not audited by claim surveyors. Those claims are settled immediately after the last process step of the claim coverage audit (see Figure 11). Unlike first level payout claims, standard and complex claims can be settled in three ways: without claim surveyors and with internal or external claim surveyors. For claim settlement with a surveyor, the back office personnel decide whether to involve an auditor. The decision as to whether to appoint internal or external claim surveyors is determined by the insurers strategy. Internal claim surveyors are typically less expensive per claim case than external claim surveyors, whereas the external claim surveyor can often be hired on a more flexible basis than the internal surveyor. External auditors have a tendency to overestimate claim amounts, since their remuneration often depends on amount. As a result, insurers often prefer internal over external surveyors.

After the claim report is processed, the back office personnel evaluate the report. During the evaluation, the clerks in the second back office level may also decide if the claim needs to be rerouted and handled by the third back office level, due to a now disclosed higher claim complexity. In the proposed model, each claim case is assessed by internal or external claim surveyors once only for purposes of simplification. In reality, however, there can be claim cases, which have to be assessed more than once. This is especially the case when claim cases are forwarded between different back office levels. Finally the settlement amount and mode are defined. After this step, the settlement of claim process stage closes with the clearance notice.

C.5 Closing of claim

The closing of the claim is the last process stage within claims management. The payout of the claim amount and the adjustment are initiated. The model assumes that the claim is paid out via the back office level that handled the claim. The means by which the claim is paid out to the customer depends on the claims settlement method that is applied. In practice, claim payouts are either made directly to the customer as cash settlements or indirectly. The latter is the case if a contractor of the customer or the insurer handles the loss item and is responsible for its repair or replacement. The model does not differentiate between the various payout scenarios since we are interested in the key claims management and handling processes. The claims process formally ends with the claim closing note sent to the customer.

D Methodology and description of questionnaire

In this section, we first describe the methodology for data collection and the participating insurance companies in our study (see Section D.1). We then describe the questionnaire in detail (see Section D.2).

D.1 Methodology and survey participants

Data was gathered over a period of four months from the end of August 2013 until the end of December 2013. Participating insurers were from Germany and Switzerland. Initially, we contacted 57 C-level representatives of insurers from Germany and from Switzerland. 52 insurers were from Germany and 5 insurers from Switzerland. Since our study focuses on the non-life retail customer segment, we only considered insurance companies with significant market shares in that segment. The 57 companies had a combined market share of 87% for Germany and 68% for

Switzerland.³⁶ In order to guarantee a maximum level of attention and tactical as well as practical knowledge, we mainly contacted board members or division managers of the claims units with our questionnaire. We conducted the questionnaire in two-steps with each participant.

In a first step, we sent out the questionnaire (spreadsheet format on a compact disc) accompanied by paper-based documentation, including an introduction to the questions and the claims management process model to lay the basis for a common understanding (see Section B). Although very detailed documentation was used, we found that many participants had difficulties in fully answering our survey. We had interviews and feedback loops with all potential participants to help with the difficulties and to guarantee accurate answers for our study. These first talks took place at the top management level (e.g., COO, CEO). Issues arose mainly out of the fact that relevant numerical parts of our survey had not been completed in a comparable manner in the past by those insurers. Several companies reported that they underestimated the time required to obtain the requisite data. On average, insurers needed two to three net working days to produce the necessary reports in their systems and the calculations for the numerical part of the survey. By the end of this step, a total of 11 representatives of different insurance companies had returned a completed questionnaire. This corresponds to a response rate of 19 percent. The lower rate can be explained by the extensive involvement required from respondents. Of the eleven insurers, 8 are from Germany and 3 from Switzerland.

After having received the completed questionnaires from the participants, we started the second step of data collection. This consisted of had individual interviews with each participant. These consecutive interviews typically involved insurers employees from the claims management units. We discussed the figures entered in the questionnaire to ensure a common understanding and that adequate figures were gathered. The individual results were also compared with other participating insurers

³⁶Market figures were retrieved from the Swiss Insurance Association (SIA, www.svv.ch) for Swiss insurance companies and from the German Insurance Association (GDV, www.gdv.de) for German insurers. For both countries, the market shares were calculated on basis of non-life annual gross written premiums in 2012 (for all customer segments, retail and non-retail).

in order to confirm and to try to account for any outliers already at the earliest stage. These discussions turned out to be very helpful in improving the overall quality of the data set. Important corrections and refinements of several data elements were incorporated at this stage. On average, each insurer was contacted three times at this stage and until the data set was finalized.

In Table 42 we summarize market shares and numbers of participating companies in the study. We grouped insurers in respect of company size (small and large) and country of main business activity (Germany and Switzerland). Premium value was used for each insurer to identify small (respectively large) insurers as having premiums below (respectively above) the median premium level of all participants, that is €942 million. For the latter the premium value of Swiss insurers is converted into euros (€).³⁷ For Germany our study covers a market share of 18% and for Switzerland a market share of 46%. Large insurers contribute the biggest share with 13% for the German market and 35% for the Swiss market.

| | Small insurers | Large insurers | Total |
|-----------------|----------------|----------------|-----------|
| Germany | 5.3% (4) | 13.1% (4) | 18.4% (8) |
| Switzerland | 10.8% (1) | 35.0% (2) | 45.8% (3) |
| Number of firms | 5 | 6 | 11 |

Table 42: Categorization of participating insurers in the survey according to their total market share per country and company size.

Note: Market shares are calculated on the basis of gross written non-life premiums. Small/large insurers have premiums below/above the median premium level of all participants, that is €942 million. Values in brackets reflect the absolute number of answers received.

D.2 Description of the questionnaire

In the following, we introduce the questionnaire that we used to conduct our numerical data. The questionnaire is separated into the three

³⁷In currency conversions the exchange rate €1 = CHF 1.2007 as of 31st December 2012 is utilized.

areas *company data* (see Section D.2.1), *process times and quantities* (Section D.2.2) and *general topics* (Section D.2.3). The remainder of this section describes each question.

D.2.1 Company data

First, and in order to characterize the participants with regard to company size and performance for our numerical analysis, we collected basic company data, as described in Table 43. For the retail segment of the three business lines car, property and liability, we consider the number of contracts, the volume of gross written premiums and the amount of claim payouts in the years 2010 to 2012. The number of contracts and the volume of gross written premiums allow us to evaluate the size of the business segment in the companies. The number of contracts reflects the total number of outstanding customer insurance contracts in each of the respective years from 2010 to 2012. Gross written retail premiums summarize the total premiums from these customer contracts. The amount of retail claim payouts reflects the total claims volume that the insurer has paid on the basis of the contracts. All claims volumes in our survey are considered in line with the claims year definition. The claims year definition assumes that all reported losses for the respective year are considered for the total claims volume. Thus, the claims volume also includes late claims which are reported at a later date to the insurer (after the end of the reporting year). Since we collect data from German and Swiss participants, currency values need to be converted to a common basis. In all reports in this study we convert Swiss francs into € (see Footnote 37).

D.2.2 Process quantities and times

According to Naujoks and Venohr (1998), improvements in processing speed tend to be an important success factor in insurance companies with excellent claims processes (see also Butler and Francis, 2010, and McFarland and Knipp, 2001). Consequently, data were collected for the purpose of measuring process times and relating them to processed quantities. This is a core part of our survey study. The data collection

| | 2010 | 2011 | 2012 |
|------------------------|-----------------|-----------------|-----------------|
| Number of contracts | [#] | [#] | [#] |
| Gross written premiums | [<i>C.U.</i>] | [<i>C.U.</i>] | [<i>C.U.</i>] |
| Claim payouts | [<i>C.U.</i>] | [<i>C.U.</i>] | [<i>C.U.</i>] |

Table 43: Excerpt from the questionnaire: collection of company data in the business lines car, property and liability.

Note: In the retail segment of each of the three business lines car, property and liability information on the number of contracts, the premiums and claims volume data are gathered for the years 2010 to 2012. In brackets [*·*] the format of the required input is given as follows: # stands for numerical input, *C.U.* stands for input with currency unit, i.e euro or Swiss franc.

in this and the following sections concerns the year 2012. With regard to process times, we differentiate between *claims cycle times* and *claims work times*. In characterizing the claims cases, we are interested in *claim quantities* (number of cases) and the corresponding *claim amounts*. The named items that we aim to measure need, however, to be clearly defined. Definitions for each element of data are provided in the following paragraphs in this section. The measurement of the process steps follows the previously proposed process model (see Section C and Figures 10 and 11). Figure 12 illustrates the basis for the measures that we introduce.

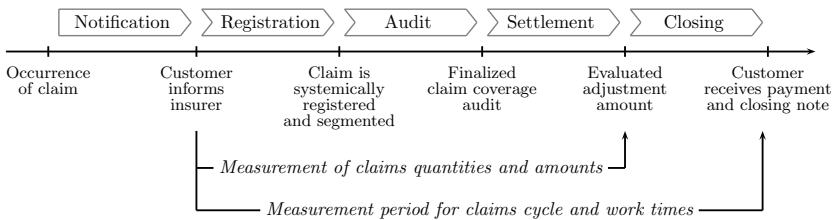


Figure 12: Illustration of the measurement of process times and quantities along the core stages of claims management (compare with Figures 10 and 11).

Each of the four metrics is differentiated with regard to the three claim complexity categories of payout, standard and complex claims

(compare with Section B.2). Further, we consider the effects of auditing claims, that is, the impact on cycle and work times of utilizing internal, external or no auditors. We also collect data on the corresponding claims quantities and amounts in the different segments. Table 44 provides an overview of the data collected in this part of the survey. Note that in line with the other parts of the survey, each measurement is considered separately for the three retail business lines car, property and liability. Thus, for each insurer a total of 72 data items is gathered.

| | Cycle time | Work time | Claims quantity | Claims amount |
|------------------------|------------|-----------|-----------------|---------------|
| <i>Payout claims</i> | | | | |
| with auditor | [days] | [hh:mm] | [#] | [C.U.] |
| without auditor | [days] | [hh:mm] | [#] | [C.U.] |
| <i>Standard claims</i> | | | | |
| with auditor | [days] | [hh:mm] | [#] | [C.U.] |
| without auditor | [days] | [hh:mm] | [#] | [C.U.] |
| <i>Complex claims</i> | | | | |
| with auditor | [days] | [hh:mm] | [#] | [C.U.] |
| without auditor | [days] | [hh:mm] | [#] | [C.U.] |

Table 44: Excerpt of the questionnaire: collection of process quantities and times in the business lines car, property and liability.

Note: Cycle time, work time, claims quantity and claims amount are determined for the three claims complexity categories in the year 2012 (see also Figure 12 for the measurement along the core process stages and Section B.2 for the claims categories). In brackets [·] the format of the required input is given as follows: *days* stands for input in days, *hh:mm* for input in hours and minutes, # stands for numerical input, *C.U.* stands for input with currency unit, i.e euro or Swiss franc.

Claims cycle times Claims cycle times reflect the time elapsing from when the customer informs the insurer of the occurrence of the loss until the claim is closed and settled. In Figure 12, the relevant points in time are illustrated graphically. In the survey, we measure cycle times in days (see also Table 44). For comparative reasons, we introduce the following common rules: all days except Sundays and holidays are included in

the calculation of total cycle times. In the questionnaire documentation we also provide an example of a claims case reported to the insurance company on September 3rd 2013 at 10:00 am and closed on September 18th 2013 at 05:30 pm. In this case the resulting claims cycle time is 13.31 days. For all claims cycle times, average values are used. As pointed out above, claims cycle times are collected for the three claim complexity categories with differentiation according to the use of auditors and for the three retail business lines and. This results in 18 individual data items per insurer for this metric.

Claims work times Unlike claims cycle times, claims work times are a measure of the actual time that the insurer needs in order to perform all necessary process steps from registration until the closing of the claim (see Figure 12). We measure claims work times in hours and minutes (see also Table 44). For the survey respondents we provide the following example: An insurer starts working on a claim case at 10:00 am and closes the case at 10:45 am that same day. The claim work time is 0 hours and 45 minutes, which translates into 0.75 hours in our subsequent analyses. For each insurer, claims work times are the average values for work times in all claims cases. Like the data for claims cycle times, data on claims work times yields 18 data items.

Claims quantities Claims quantities are measured along the core process chain, from the start of the process of registering a claim to the settlement of that claim. Each claim filed by a customer is counted according to our definition of claims quantities. This way of counting can potentially result in more than one claim case per customer contract (see also the discussion of the results in Section D.2.1). Based on our definition of claims quantities along the process model, the differences in segmentation patterns and the business composition of insurers can be assessed. Furthermore, we require the same segmentation for claims quantities as used for claims cycle and work times, that is, three claim complexities, differentiation with regard to the use of auditors, and three business lines (see Table 44).

Claims volumes The claims volume is defined as the total accumulated claims expenses reported by the insurer for the year 2012. In order to be consistent with the historical claims data gathered in the previous part of the survey, we apply the claims year definition (see Section D.2.1). Since claims volumes are reported in German and Swiss currency units (euros and Swiss francs), we convert all values into euros.

D.2.3 General topics

In this part of the questionnaire, a set of general survey topics related to the strategic processes and organization in claims management are introduced. The different topics mainly cover organization setup and personnel aspects as well as the strategies in the claims adjustment processes.

Organization setup The survey covers organizational topics to identify which organizational designs are present in insurers claims management operations. Consequently, we differentiate and count main locations, branch locations and agent network locations for the insurers. Main locations are defined as the organizational unit(s), where the insurer sets up the main claims management operations. Branch locations provide significantly smaller operational capacities than main locations and are often only responsible for specific claims categories or parts of the claims operations processes. Under agent (network) locations, all tied agents with own offices and adjustment allowances are summarized. In addition to location factors, we collect data on the degree to which claims operations units are outsourced. We differentiate between outsourced own units and outsourced units. Outsourced own units are units that are outsourced, but still owned by the respective insurer (or the group it belongs to). Outsourced units in contrast to this are not owned by the insurer. An overview of the presentation of this part of the questionnaire is provided in Table 45.

Human resources In order to add quantitative results to discussion surrounding administrative efficiencies in insurers claims management we measure personnel quantities in respect of employee role and claims

| Type of unit | Own | Outsourced own | Outsourced |
|------------------|-----|----------------|------------|
| Main locations | [#] | [#] | [#] |
| Branch locations | [#] | [#] | [#] |
| Agent locations | [#] | n.a. | n.a. |

Table 45: Excerpt of the questionnaire: organization setup by location types and legal status of the units.

Note: Number of own, outsourced own and outsourced units for each type of location (main, branch, agent). Since agent (network) locations cannot be outsourced, they are prefilled with the reference “not applicable” (n.a.). [#] stands for numerical input.

handling competence. This adds to the current discussions found in McFarland and Knipp (2001) and Butler and Francis (2010). The amount of human resources is assessed along the different back office levels 1 to 3 and the corresponding claims segments that are handled. Our questionnaire covers the separate groups of back office personnel, line managers, claims auditors and fraud personnel. Back office personnel and line managers typically form the largest group of employees in insurers claims management units and are responsible for the general claims handling. Claims auditors are the insurers internal specialists for claim coverage audits (compare with Section C.3). While we focus on internal auditors in the personnel quantities, it should be borne in mind that insurers also often integrate external claims auditors for these tasks. Fraud personnel are responsible for all anti-fraud activities of the insurer. All of the foregoing personnel capacities are measured as full-time equivalents (FTE) in order to compensate for the effect of part-time employees. This means that two employees, each working under a 50% part-time contract, are counted as $0.5 + 0.5 = 1.0$ FTE in our calculations. In our analysis, the organization setup and personnel efficiencies can be contrasted to the process times and quantities. Findings for the personnel efficiency ratio, for example, are discussed in Section E.1.4, see Table 51.

Process strategies In the following, we introduce ten survey questions concerning claims management process strategies. The questions in the ten topics are summarized in Table 47. The topics can be aggre-

| | Back office | Line manager | man- agers | Claims audi- tors | Fraud per- sonnel |
|---------|-------------|-----------------|---------------|----------------------|----------------------|
| Level 1 | [FTE] | [FTE] | | [FTE] | [FTE] |
| Level 2 | [FTE] | [FTE] | | [FTE] | [FTE] |
| Level 3 | [FTE] | [FTE] | | [FTE] | [FTE] |

Table 46: Excerpt from the questionnaire: personnel quantities by back office level and type of personnel.

Note: Personnel quantities are measured as the sum of full-time-equivalents (*FTE*) for back office, line managers, claims auditors and fraud personnel. In order to reflect capacity requirements for different claim complexities, results are reported for the back office levels 1 to 3.

gated into the categories of *claims case steering*, *adjustment process and limits* and *customer service providers*. Responses to these questions are gathered from the perspective of the three business lines car, property and liability.

Claims case steering. Topics (1) and (2) cover claims steering aspects with regard to claims automation and fraud detection. Process automation reflects the percentage of all claims that are handled without back office interaction from claims registration until the final adjustment process stage. Closely related to this topic is the automated and manual identification of insurance fraud. Topic (2) reveals which part of incoming claims is identified as fraud.

Adjustment process and limits. The core adjustment processes and limits are addressed through questions (3) to (7). All of these topics are of high strategic relevance in claims management. Goodwill adjustment (see Topic 3) reflects the willingness of insurers to regulate claims without formal contract coverage. In complement to goodwill settlements, we ask respondents to state the percentage of rejected incoming claims (question 4). Topics (5) to (7) deal with allowances enabling insurance companies to reduce their own administration burden in claims handling. This can be done through an increase in lump sum adjustment or by transferring adjustment allowances to either tied agents or brokers. Since tied agents are selling insurance contracts exclusively as intermediaries on behalf of one insurance company, the insurer is liable vis--vis the agent. Brokers

have the freedom to sell insurance contracts from any company. Unlike tied agents, insurance brokers are acting on behalf of the customer and are thus obliged to advise the customer in the best way, which may have an impact on its adjustment procedures.

Customer service providers. The three last topics (8) to (10) consider aspects of service provider usage. Service providers in insurance companies claims management allow insurers to better control the adjustment patterns of their customers in claims events. For example in car insurance, damages may be repaired by a selected repair shop network only. Such repair shop networks are considered service providers. We ask for the number of service providers (question 8), current insurance contracts with service provider obligations (question 9) and the level of voluntary service provider usage (question 10).

E Results and discussion

In the following, we report the results and empirical findings from our survey study. First we provide descriptive statistics for the numerical results (see Section E.1). The wide basis of the panel yields an interesting picture and benchmark of claims management practice in retail non-life insurance. In Section E.2 we consider selected aspects in more detail. We perform ad hoc analyses on parts of the data set. We derive results and discuss management implications in several dimensions.

E.1 Industry benchmark: descriptive statistics of the survey results

The presentation of the descriptive statistics closely follows the structure of the survey described in Section D.2. We start with the characterization of survey participants, both on the panel and at the individual company level (Section E.1.1). Next, results from the process quantities and times survey part are reported in Section E.1.2. These are the key benchmark results for the claims management model. In Sections E.1.3 and E.1.4 we present and discuss results with regard to organization

| Topic | Unit | Survey question |
|--------------------------------------|------|---------------------------------------------------------------------|
| <i>Claims case steering</i> | | |
| (1) Black-box operation | % | What share of all claims is processed automatically? |
| (2) Fraud volume | % | What proportion of incoming claims is classified as fraud cases? |
| <i>Adjustment process and limits</i> | | |
| (3) Goodwill adjustment | % | What share of claims cases is adjusted on a goodwill basis? |
| (4) Claims rejection | % | What proportion of claims cases is rejected? |
| (5) Lump sum adjustment | € | Up to what amount are claims adjusted on a lump sum basis? |
| (6) Agent adjustment | € | What is the claims adjustment limit for tied agents? |
| (7) Broker adjustment | € | What is the claims adjustment allowance for brokers? |
| <i>Customer service providers</i> | | |
| (8) Service providers | # | How many services providers are contracted to the insurer? |
| (9) Service provider obligation | % | What proportion of contracts carries a service provider obligation? |
| (10) Service provider usage | % | What proportion of customers use service providers voluntarily? |

Table 47: Excerpt of the questionnaire: claims management process strategies in the business lines car, property and liability.

setup and personnel capacities in insurer claims management units. Finally Section E.1.5 considers the process strategy topics.

E.1.1 Characteristics of the data panel

In Table 48, we summarize key data for the characterization of the 11 survey participants from Germany and Switzerland (see Table 42 for the panel composition). In order to allow for a linkage of our results to total market analysis, we provide results for panel and at firm levels. Company data is reported for the business lines car, property and liability from the retail business segment for the year 2012. A final column reports

| | Measure | Unit | Country | Car | Prop. | Liab. | Total |
|--------------------------|-------------------------|-------|---------|-------|-------|-------|-------|
| Panel level | Premium volume | € bn | DE | 4.34 | 2.13 | 0.57 | 7.03 |
| | | | CH | 2.44 | 0.57 | 0.15 | 3.16 |
| | Claims volume | € bn | DE | 3.48 | 1.52 | 0.28 | 5.28 |
| | | | CH | 1.51 | 0.33 | 0.13 | 1.96 |
| | Number of firms | # | DE | 8 | 6 | 6 | 8 |
| | | | CH | 3 | 3 | 3 | 3 |
| | | | | | | | |
| Firm level | <i>Premiums</i> | | | | | | |
| | Avg. premium amount | € mn | DE | 542 | 354 | 95 | 879 |
| | | | CH | 812 | 190 | 50 | 1 053 |
| | Avg. number of policies | # mn | DE | 1.88 | 2.02 | 1.10 | 5.00 |
| | | | CH | 0.89 | 0.55 | 0.52 | 1.96 |
| | Avg. policy premium | € | DE | 289 | 175 | 86 | |
| | | | CH | 612 | 640 | 182 | |
| | <i>Claims</i> | | | | | | |
| | Avg. claims amount | € mn | DE | 435 | 254 | 57 | 745 |
| | | | CH | 502 | 110 | 42 | 654 |
| | Avg. number of claims | # thd | DE | 204 | 141 | 68 | 412 |
| | | | CH | 249 | 57 | 52 | 357 |
| | Avg. claims case size | € | DE | 2 135 | 1 802 | 835 | |
| | | | CH | 2 019 | 1 934 | 822 | |
| Avg. claims ratio | % | DE | 80% | 72% | 60% | 85% | |
| | | CH | 62% | 58% | 84% | 62% | |
| <i>Key growth ratios</i> | | | | | | | |
| Premium CAGR (10–12) | % | DE | 5.0% | 2.4% | 1.3% | 3.8% | |
| | | CH | 0.3% | 1.9% | 0.1% | 0.5% | |
| Claims CAGR (10–12) | % | DE | 2.0% | 3.4% | −4.1% | 3.7% | |
| | | CH | −0.6% | 9.1% | −2.5% | 0.9% | |

Table 48: Characteristics of the data panel for the business lines car, property and liability.

Note: Basic company data of all participating companies for the year 2012 are reported on the panel and firm levels. Summarizing figures on panel level consider cumulated premium and claims volumes of all participants. Data on firm level reflects average values on the single company level. The following abbreviations are used: “Avg.” for average, “DE” stands for Germany, “CH” for Switzerland and “CAGR” for the compound annual growth rate

the total values for all of the three business lines. In each item, we

differentiate between companies from Germany (denoted by “DE”) and Switzerland (“CH”).

The panel level (see the upper part of Table 48) shows the total premium and claims volumes for the survey participants from Germany and Switzerland. For Germany, our study covers €7.03 bn in cumulative annual premiums and for Switzerland €3.16 bn. Although the premium volume in Germany is more than twice that in Switzerland, the market coverage of the panel in Switzerland yields 45.8%, while the German market coverage is merely 18.4% (compare with Table 1). This is explained by the significantly different market sizes of Germany and Switzerland. In both countries, the largest parts of premiums come from car insurance, followed by property and liability insurance. Looking at cumulative claims volumes, we see a slightly different distribution among the business lines, compared to the distribution of premium volumes. This points to the discussion of claims ratios (see also the reported average claims ratios per business line in the same table) raised in the remainder of this section.

Data at the firm level is reported for premiums, claims and key growth ratios. All numbers reflect average values for the participating insurers. For the premiums, we notice that Swiss insurers in our survey (average premium volume of €1,053 mn premiums) are on average slightly larger than German companies (€879 mn premiums). The distribution of premiums among car, property and liability also differs for the two country groups. For example, car insurance premiums for German insurers have a share of around 62% of total premiums (€542 mn against €879 mn), while Swiss insurance companies have significantly higher shares of 77% (€812 mn against €1,053 mn). The average premiums per policy also reflect substantial differences between insurers from the two countries. The average premium per policy of Swiss insurance companies is around two to three times as high as the average premium per policy for German insurers. The main reasons for this are firstly the higher competition in the German retail insurance market and secondly the higher production costs in Switzerland, which result in higher price levels.

Looking at *claims* figures, we find that German insurers have higher total average claims volumes than Swiss insurers. This is an important finding, in view of the fact that Swiss insurance companies in our cohort have higher average total premiums than German companies (see above). As a result, total average claims ratios, that is the claims volume divided by the premium volume, are significantly higher for German insurers (average total claims ratio of 85%) compared to Swiss companies (average total claims ratio of 62%). This finding holds true for car (80% versus 62%) and property insurance (72% against 58%), while the reverse applies to liability insurance, where Swiss companies have a higher claims ratio (84%) than German insurers (60%). Due to the relatively smaller amounts of liability premiums, this has only low impact on average total claims ratios. We notice the largest spread (18%) in claims ratios between German and Swiss insurers for car insurance, which is at the same time the segment with the largest premium share. This finding underlines the lower profitability of car insurance in Germany. According to the GDV, *gdvsvv* the claims ratio for the total German car insurance segment averaged 96.6% for the period from 2010 to 2012. When looking at average claims sizes per case, we see very similar values for German and Swiss insurers. Higher average claims case sizes for Swiss insurers compared to their German peers might have been expected.

Key growth ratios reveal a significantly stronger premium growth among German insurance companies for the period from 2010 to 2012 than for Swiss companies for our cohort. The compound annual growth rate (CAGR) measured on the basis of total retail premiums reveals that German companies grew by 3.8% p.a. and Swiss companies by 0.5% p.a. The total market growth rate for German non-life insurers was 3.2% (derived from GDV data) for the same period, while the total Swiss non-Life insurance industry grew by 1.2% (SIA data). *gdvsvv* At the same time, total claims volumes also increased. However in Switzerland, car insurance claims were decreasing slightly (−0.6%).

E.1.2 Process quantities and times

In the following, we report and discuss the results obtained for process quantities and process times in Table 49. These results are key elements

of the benchmark results of our survey. Readers should bear in mind that all figures for volumes, quantities and times were determined according to the definitions for the claims management model (see Section D.2.2). Each metric in Table 49 is reported for the three different claims complexities, namely, payout claims (“P”), standard claims (“S”) and complex claims (“C”). Furthermore, the metrics are separately reported and discussed for the business lines car, property and liability. In the following results presentation, we do not differentiate between insurers from both country groups. In all metrics the average values (column “mean”) and their standard deviation (column “sd”) are reported.

| Metric | Unit | Cat. | Car | | | Property | | | Liability | | |
|------------------------|-------|------|--------|----------|-----|----------|-----------|-----|-----------|----------|-----|
| | | | mean | (sd) | d/r | mean | (sd) | d/r | mean | (sd) | d/r |
| Amounts and quantities | | | | | | | | | | | |
| Average amount | € mn | P | 43 | (44) | 10% | 13 | (12) | 6% | 5 | (4) | 8% |
| | | S | 286 | (184) | 66% | 106 | (63) | 47% | 30 | (15) | 55% |
| | | C | 105 | (113) | 24% | 105 | (120) | 47% | 20 | (19) | 37% |
| Average quantity | # thd | P | 65 | (52) | 31% | 34 | (32) | 28% | 17 | (19) | 29% |
| | | S | 134 | (101) | 63% | 78 | (53) | 64% | 39 | (30) | 68% |
| | | C | 13 | (21) | 6% | 10 | (7) | 8% | 2 | (2) | 3% |
| Average amount | € | P | 629 | (198) | | 889 | (328) | | 316 | (253) | |
| | | S | 2 337 | (1 006) | ×4 | 4 167 | (3 030) | ×5 | 872 | (392) | ×3 |
| | | C | 24 803 | (24 784) | ×11 | 102 291 | (175 522) | ×25 | 20 409 | (22 652) | ×23 |
| Times | | | | | | | | | | | |
| Average cycle | days | P | 7.0 | (6.0) | | 1.8 | (2.0) | | 2.5 | (3.4) | |
| | | S | 62.4 | (13.2) | ×9 | 69.7 | (6.9) | ×38 | 66.4 | (17.9) | ×27 |
| | | C | 410.3 | (431.6) | ×7 | 120.6 | (70.2) | ×2 | 294.0 | (304.9) | ×4 |
| Average work | hours | P | 0.4 | (0.1) | | 0.2 | (0.0) | | 0.2 | (0.0) | |
| | | S | 1.7 | (0.3) | ×4 | 1.4 | n.a. | ×7 | 1.2 | n.a. | ×6 |
| | | C | 12.2 | (2.8) | ×7 | 7.1 | n.a. | ×5 | 10.0 | n.a. | ×8 |

Table 49: Benchmark of average process quantities and process times in the three claims complexity categories for the business lines car, property and liability.

Note: The three claims complexity levels are abbreviated as follows in column “cat.”: “P” = payout, “S” = standard, “C” = complex. For each metric average values (column “mean”) and standard deviations (column “sd”) are shown. Further in column “d/r” the distribution of the volumes/quantities is given in % or the ratio or factor (value followed by the sign ×) between the values of categories payout versus standard and standard versus complex are calculated. “n.a.” stands for not applicable.

For claims *volumes and quantities*, we analyze the average claims volumes, average number of claims (quantity), the average claims size

(volume per case). Furthermore we indicate the distribution of the volumes and quantities between the different claims complexities (as percentage shares) and for each business line (see the columns “d/r”). Both the average claims volume and the average quantity show that standard claims are the dominant claims category in insurance companies claims management. This holds true for car, property and liability insurance. In terms of volume, standard claims account for 66, 47 and 55% of the total claims in the three business lines. In terms of number of cases, standard claims account for 63, 64 and 68% of all cases in the three business lines. Overall, a 30–60–10 distribution of payout-standard-complex claims can be identified for the quantities in all business lines. In current industry segmentations, liability insurance lines have the lowest share of complex claims (3%), followed by car insurance (6%) and property insurance (8%).

The analysis of average claim payouts per claims case produces several important findings. Claim payouts are very similar for all participants (see the relatively low standard deviations). For standard claims, we see increased levels of standard deviations, especially for car and property insurance lines. Overall this may indicate that insurers are segmenting payout and standard claims with similar patterns. In contrast to this, complex claims have very different average claim payouts reflected by the much higher values of the standard deviation. Such a finding is to be expected since complex claims are characterized by small numbers of claims cases and claims events with high occurrence volatilities. In order to underline the segmentation of claims we furthermore indicate the multiplication factor driving the average claims case payout from the payout claims category to the standard claims category, and from the latter to the complex claims category (see columns “d/r”). These factors or ratios between categories show how far the complexity category is driven by the volume of cases. We further analyze the segmentation of claims in Section E.2.1.

In the remaining part of Table 49, claims cycle and claims work *times* are analyzed (see Section D.2.2 for the definitions). According to our definition, the claims cycle time measures the time period that each claims case needs from the initial customer claims report until the

claim is adjusted. While the average cycle times for standard claims are at a similar level for the business lines car, property and liability, we see larger variations for payout and complex claims between the business lines. For car insurance, the average cycle time is around 7.0 days for payout claims, which is around two to three times the length of cycle times for property and liability claims cases in the payout category. From our discussions with industry experts we conclude that the reason for this spread lies in intensified auditing strategies for car insurances due to higher claims ratios (80% for Germany) and the occurrence of fraud. Note, that claims cycle times for payout claims in all business lines differ significantly between the survey participants (see the relatively high standard deviations). Cycle times for standard claims range from 62.4 days for car insurance claims to 69.7 days for property claims. According to our interpretation, these cycle times have a low level of variance for each business line (see the lower values of the standard deviation ranging from 6.9 to 17.9 days). Due to the higher level of claims specificity, cycle times for complex claims are difficult to interpret. Especially for car insurances, cycle times exceed one year on average.

Although only two of the 11 participants provided us with information on claims work times in car insurance, only one participant in property and liability insurance, we report and briefly discuss these figures. Claim work times reflect the cumulative back office time necessary for adjustment of claims cases. Like cycle times, claims work times for car insurances are higher than for property and liability insurances. The figures however must be considered with caution due to the small number of underlying data points. In addition to the raw values, one may also consider the ratios of the cycle and work times in the different claims complexity categories which provide insights into the segmentation logic and industry practice.

E.1.3 Organization setup

Using the answers from the *organization setup* survey part introduced in Section D.2.3 allows us to discuss the organizational designs in the claims management units. In Table 50 we report the numbers of units by

location types (main, branch, agent) and legal status (own, outsourced own, outsourced).

We identify one trend that is also supported by earlier discussions and findings: outsourcing in insurance companies' claims management is at a low level. This becomes apparent when looking at figures for outsourced own and outsourced units. On average, insurance companies do not fully outsource any of their claims handling units (see in particular the column "outsourced unit"). The participants with maximum outsourcing efforts have only one fully outsourced main location. Slightly greater efforts seem to be made regarding outsourcing to outsourced own units. These units are legally run by the insurer but are not part of the core business, which allows the insurer, for example, to use labor agreements other than those in force for the core company. Here we find that, on average, each insurer has one outsourced main location. In fact, since claims management is a core part of an insurers value chain, insurers seem to keep this in-house (see also the discussion on the outsourcing of claim processes in Mahlow and Wagner, 2014).

Besides the outsourcing aspect, some strategic pointers can be derived by considering the number of own units among the survey participants. On average, insurers have three main locations and five branch locations. Furthermore an average of 935 agent locations is reported. Maximum location numbers go up to six main locations, 26 branch locations and 3 000 agent locations. Especially large numbers of branch locations reflect insurance companies efforts to achieve better control of claims handling processes by being closer to their customers. Historically, insurers often relied on their agent networks in claims adjustments; hence the large number of agent locations.

E.1.4 Human resources

We now turn to discussion of personnel capacities in claims management units. For this purpose, using the survey results in the matrix on personnel capacities introduced in Table 46 (*human resources* survey part in Section D.2.3), we benchmark and analyze the efficiency of personnel allocation. In doing so, we introduce the personnel efficiency ratio metric (*PER*). This ratio is calculated as the required personnel measured

| Location type | Own unit | | | Outsourced own unit | | | Outsourced unit | | |
|---------------|----------|------|-------|---------------------|------|------|-----------------|------|------|
| | min | mean | max | min | mean | max | min | mean | max |
| Main | 1 | 3 | 6 | 0 | 1 | 4 | 0 | 0 | 1 |
| Branch | 0 | 5 | 26 | 0 | 0 | 1 | 0 | 0 | 0 |
| Agent | 0 | 935 | 3 000 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |

Table 50: Benchmark of the organization setup by location types and legal status of the units.

Note: Number (#) of own, outsourced own and outsourced units for each type of location (main, branch, agent). Minimum (column “min”), average (column “mean”) and maximum (column “max”) number of locations in each combination for all participants in the panel are reported. Agent locations include all agent units with claims adjustment allowances (agent locations without claims adjustment allowances are not considered). Agent (network) locations cannot be outsourced (n.a. = not applicable).

in FTE per 1 000 claims cases processed in the claims management unit of the insurer.

Looking at the efficiency of the different back office levels, we find large differences with regard to the three different back office levels. The most significant differences occur for level 3, where the most efficient insurer (*PER* of 1.38) outperforms the least efficient company (*PER* of 14.56) by a factor of about 11. For levels 1 and 2 we find less significant differences. For level 2, the least efficient insurer needs around twice as much personnel as the most efficient company.

These findings reappear for the other three types of personnel: line managers, claims auditors and fraud personnel. Taking a closer look at fraud personnel capacities, we find very low numbers especially for the first level (processing of payout claims). Looking closer at the raw data we find that all but one insurer allocate no fraud personnel at all to the first back office level. Given that industry executives perceive fraud prevention strategies as highly important (see Mahlow and Wagner, 2014), this finding is surprising.

| Level | Back office | | | Line Manager | | |
|---------|-------------|-------|-------|--------------|------|-------|
| | min | mean | max | min | mean | max |
| Level 1 | 0.27 | 0.50 | 1.11 | 0.01 | 0.03 | 0.05 |
| Level 2 | 0.57 | 0.90 | 1.32 | 0.02 | 0.08 | 0.17 |
| Level 3 | 1.38 | 16.77 | 95.96 | 0.00 | 2.37 | 11.78 |

| Level | Claims Auditors | | | Fraud personnel | | |
|---------|-----------------|------|-------|-----------------|------|------|
| | min | mean | max | min | mean | max |
| Level 1 | 0.00 | 0.09 | 0.24 | 0.00 | 0.01 | 0.02 |
| Level 2 | 0.00 | 0.20 | 0.50 | 0.00 | 0.03 | 0.08 |
| Level 3 | 0.00 | 3.57 | 10.86 | 0.01 | 1.49 | 5.30 |

Table 51: Benchmark of personnel efficiency ratios by back office level and type of personnel.

Note: For each combination of back office level (1 to 3) and type of organizational unit, the personnel efficiency ratio (*PER*) is calculated as the number of personnel (in full time equivalents) required to handle 1 000 claims. Minimum (column “min”), average (column “mean”) and maximum (column “max”) *PER*-values in each combination for all participants in the panel are reported.

E.1.5 Process strategies

Topics in claims management process strategy comprise *claims case steering*, *adjustment process and limits* and *customer service providers*. In the following, we discuss each of the ten survey topics introduced earlier in Section D.2.3. Under each topic, survey answers were collected along the three business lines car, property and liability insurances. In Table 52 we report the average values (column “mean”) and standard deviation (column “sd”) for all questions.

In the area of *claims cases steering*, we collect data for black box operations, i.e., automatic processing (topic 1) and fraud volume (topic 2). The degree to which insurance companies have black box operations depends largely on the business line. For car insurance, the automation level is 17.9%, whereas for property and liability insurances, the automation degree is below 10%. This observation meets our expectations, since car insurance claims permit higher process automation due to simplicity of the product. This is not the case for property and liability insurances

| Topic | | Unit | Car | | Property | | Liability | |
|-------------------------------|--------------------------|------|-------|---------|----------|---------|-----------|---------|
| | | | mean | (sd) | mean | (sd) | mean | (sd) |
| Claims case steering | | | | | | | | |
| (1) | Black box operation | % | 17.9% | (23.2%) | 9.5% | (25.1%) | 7.7% | (20.5%) |
| (2) | Fraud volume | % | 2.3% | (2.0%) | 1.7% | (1.1%) | 2.3% | (1.6%) |
| Adjustment process and limits | | | | | | | | |
| (3) | Goodwill adjustment | % | 1.0% | (1.5%) | 5.7% | (10.7%) | 5.3% | (6.4%) |
| (4) | Claims rejection | % | 9.4% | (2.4%) | 16.2% | (7.2%) | 27.2% | (15.2%) |
| (5) | Lump sum adjustment | | | | | | | |
| | with (4 firms) | € | 375 | (103) | 338 | (96) | 450 | (197) |
| | without (6 firms) | € | 0 | | 0 | | 0 | |
| (6) | Agent adjustment | | | | | | | |
| | with (6 firms) | € | 2917 | (1592) | 3300 | (1470) | 3300 | (1470) |
| | without (4 firms) | € | 0 | | 0 | | 0 | |
| (7) | Broker adjustment | | | | | | | |
| | with (2 firms) | € | 3750 | (1250) | 3750 | (1250) | 3750 | (1250) |
| | without (8 firms) | € | 0 | | 0 | | 0 | |
| Customer service providers | | | | | | | | |
| (8) | Service providers | # | 148 | (292) | 18 | (26) | 4 | (7) |
| (9) | Service prov. obligation | % | 5.9% | (5.8%) | 0.0% | (0.0%) | 0.0% | (0.0%) |
| (10) | Service provider usage | % | 14.4% | (7.1%) | 19.3% | (12.4%) | 0.0% | (0.0%) |

Table 52: Benchmark of claims management process strategies in the business lines car, property and liability.

Note: The numbers reported reflect the average values (column “mean”) and standard deviations (column “sd”) for the surveyed topics.

with significantly higher specificities and complexities in different claims. As regards the levels of detected fraud in car, property and liability insurance, survey participants estimate the level of fraud in car and liability insurance to be around 2.3%, while the fraud level in property insurance is on average 1.7%.

Regarding the *adjustment process and limits*, the survey results first reveal that insurers are adjusting claims on a goodwill basis significantly more often for property and liability insurances than for car insurances (topic 3). For car insurances, about 1% of all claims are adjusted on a goodwill basis, while this value is larger than 5% for both property and liability insurance. This finding is indicative of the tendency for

adjustment volumes for property and liability insurances to be more difficult to estimate, which may then result in higher goodwill adjustments. Topic (4) addresses the share of incoming claims cases rejected by the insurers. According to the survey participants, 27.2% of liability claims are rejected by the insurer, while only 9.4% of car insurance claims and slightly more than 16% of property insurance claims are rejected. The high rejection level for liability insurance claims is unexpected. In fact, in the interviews, several survey participants told us that there should be no significant difference in the rejection levels for property and liability business lines. The larger standard deviations on the values obtained partly reflect these different perceptions. In topic (5) the levels to which insurers allow for lump sum claim adjustments are reported. Topics (6) and (7) report the maximum adjustment limits of insurance agents and insurance brokers. Four out of ten companies from which data is available in our survey make claim adjustments on a lump sum basis (the respective number of companies in each configuration is reported in Table 52). The limits for lump sum adjustments are at relatively equal levels in the business lines car, property and liability, with claims in liability insurance having the highest adjustment limits. From the adjustment allowances for insurance companies sales force, and specifically the agent and broker networks, we deduce important findings. 60% (six out of ten companies) of the participants from our survey allow their own agents to make claim adjustments, while only 20% (two out of ten companies) of the insurers give adjustment allowances to their broker network. Claim adjustment allowances for insurance companies own agents are varying in the three business lines. On average, claims in car insurance see the lowest adjustment allowances of about €2 900, followed by property and liability insurance claims cases with an allowance of €3 300. We interpret the lower claims adjustment for car insurances as a countermeasure among insurance companies for high fraud occurrence in the car business lines. Comparing adjustment allowances to average claim payouts per case (see Table 8), we see that, on average, payout and standard claims cases for car and liability insurances are covered by insurance agent claims adjustment allowances. For property insurance with a higher average claims case payouts this does not hold true. Looking at insurance broker claims

adjustment allowances, identical values are found in the three business lines. With an average broker claims adjustment allowance of €3 750, insurance companies are offering higher adjustment allowances to their broker network than to their own agents. A reason for this difference may stem from the fact that insurance brokers usually demand higher adjustment allowances from insurance companies in order to better meet customer expectations. As a result, insurance companies have to meet these demands in order to attract the insurance broker segment for distribution purposes. In contrast to this finding is the fact that only 20% of the insurance companies from our survey provide claim adjustment allowances to brokers at all. This underlines the tendency that insurers try to centralize their claims adjustment competencies.

The number of customer services providers (topic 8) differs substantially for car, property and liability insurance business lines. For the car business line, insurers have on average 148 customer service providers, while there are only 18 and 4 for the property and the liability business lines. Although these figures are not unexpected, the values obtained from the survey need to be approached with some caution here. Given the extremely high standard deviations, we conclude that not all survey participants interpreted the question consistently. Further, the survey participants reflect that around 5.9% of all car insurance contracts contain a customer service provider obligation (topic 9). In property and liability insurance, there is not a significant number of rolling contracts with customer service provider obligations. Comparing this result with the voluntary usage of customer service providers shows that in car and property claims cases, customers use service providers to a high degree. This supports a finding from our previous research (see Mahlow and Wagner, 2014), where we concluded that not the pure service provider usage obligations but increased service levels lead to higher usages.

E.2 Discussion of results and management implications

In the remainder of this section, we address more specifically selected strategic aspects in insurance companies claims management using the

numerical inputs from our study. Utilizing figures reported in Section E.1, we focus on the following topics:

- insurers' claim segmentation, see Section E.2.1,
- influence of auditor engagement on claims cycle times, see Section E.2.2,
- influence of claims adjustment allowances on the occurrence of fraud, see Section E.2.3,
- influence of cycle times on the occurrence of fraud, see Section E.2.4, and,
- claims cycle times and lump sum adjustments, see Section E.2.5.

E.2.1 Segmentation of claims

In the following we take a closer look at the segmentation of claims under strategic considerations. We focus on how the volume of cases and scale of claim payouts break down across payout, standard and complex cases. Figure 13 graphically illustrates the results. For each of the business lines car, property and liability insurance, the first bar reflects the distribution of the number of claims in the three complexity categories. The second bar shows the distribution of the total claim payouts (expressed in euros) in each claims category.

One important finding applies to all three business lines: For payout and complex claims we see reversing shares when switching from the perspective of claims case numbers (left bar in each business line) to the perspective of claim payouts (right bar in each business line). For example in car insurance, payout claims account for 31% of all insurance claims (in terms of cases), while the corresponding claim payouts account for only 10% of the total payouts. This relationship between quantity and payouts is found in the three business line on a comparable level. In the complex claims, the relationship between quantities and payouts reverses and the levels differ between the business lines. Complex claims in property insurance (8% of the cases) account for nearly half (47%) of total claim payouts. The complex cases in car (6% of the cases) and

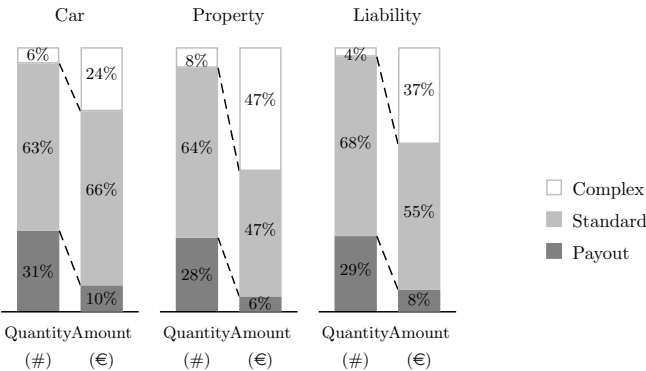


Figure 13: Graphical illustration of the distribution of claims cases in terms of quantity (number of cases) and amount (total payouts) in the three claims complexity categories for the business lines car, property and liability.

Note: The distribution into the different claims categories is illustrated as follows: payout claims = dark gray boxes, standard claims = light gray boxes, and complex claims = white boxes. The values of the shares in % reflect the average values for all participants in the panel.

liability insurance (4%) still account for 24% and 37% of total payouts in the business line.

These figures indicate how important it is to have dedicated claims handling strategies for low-complexity claims (payout claims) and high-complexity claims (complex claims). Insurance companies often underestimate the negative impact that payout claims can have on the firms total claims ratio. In our survey, we cover several aspects that indicate that insurance companies have very different strategies for handling payout and complex claims. Some companies allow, for example, lump sum adjustments, while others do not (see Table 52 above). Furthermore, the same Table shows agent and broker adjustment allowances that are also part of the claims handling strategies.

E.2.2 Influence of auditor engagement on claims cycle times

In the following, we concentrate on the impact of the use of claims auditors on the claims management process cycle times. Table 53 specifically reports the average cycle times in days and claims sizes in euros for payout, standard and complex claims along car, property and liability insurance business lines. Each figure is given separately for cases where (1) auditors are employed and (2) auditors are not used. These figures are very important when discussing the efficiency and effectiveness of insurance companies claims handling activities.

| Claims category | Car | | Property | | Liability | |
|-------------------------------------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|
| | cycle time (days) | claim size (€) | cycle time (days) | claim size (€) | cycle time (days) | claim size (€) |
| <i>Payout claims</i> | | | | | | |
| (1) with auditor | 13.8 | 1 412 | 2.4 | 1 181 | 3.1 | 185 |
| (2) without auditor | 6.5 | 579 | 1.8 | 364 | 2.5 | 340 |
| Difference $\Delta^{(1) \rightarrow (2)}$ | 7.3 | 833 | 0.6 | 817 | 0.6 | -155 |
| <i>Standard claims</i> | | | | | | |
| (1) with auditor | 55.8 | 3 864 | 84.6 | 4 284 | 66.6 | 2 165 |
| (2) without auditor | 52.6 | 1 848 | 64.8 | 814 | 56.4 | 370 |
| Difference $\Delta^{(1) \rightarrow (2)}$ | 3.2 | 2 016 | 19.8 | 3 470 | 10.2 | 1 795 |
| <i>Complex claims</i> | | | | | | |
| (1) with auditor | 248.1 | 23 135 | 97.5 | 16 734 | 146.8 | 24 623 |
| (2) without auditor | 96.0 | 32 775 | 55.6 | 4 794 | 109.6 | 7 846 |
| Difference $\Delta^{(1) \rightarrow (2)}$ | 152.1 | -9 640 | 41.9 | 11 940 | 37.2 | 16 777 |

Table 53: Average claims cycle times and sizes in the three claims complexity categories with or without the use of auditors for the business lines car, property and liability.

For car insurance claims, significant differences in cycle times for payout claims emerge when comparing claims adjustments with and without auditors. On average, claims adjustments with auditors (1) result in twice the length of cycle times than without auditors (2), or in other terms, show an absolute difference of $\Delta^{(1) \rightarrow (2)} = 7.3$ days. For the rele-

vance check, it should be borne in mind that the total underlying number of payout claims cases with auditor adjustments is much lower than the number of payout claims settled without auditors. In fact, payout claims are typically settled without either internal or external claims auditors (in all business lines). Cycle times for standard car claims only vary to a very small extent between the two adjustments scenarios. The difference is only 3.2 days. This finding might be an indicative of the fact that insurance companies have developed claims operations that allow time-efficient employment of claims auditors. On the other hand, we assume that claim complexities in standard claims do not increase to any great extent, for claims cases with auditor employment. This also suggests that auditing patterns for car claims cases even without auditors must be on a higher average level (compare the 50+ days for standard claims to the order of magnitude of 10 days for payout claims). For complex claims, interpretation of the figures is subject to some uncertainty. We note that numerical results show higher average claim amounts for claims settled without claims auditors (€23 235) as compared with claim settlements with claims auditors (€32 775). At the same time, the average claims cycle times are significantly lower when not using auditors. Naturally, as in the case of the payout and standard claims, we would expect larger average claims amounts for auditor-handled claims. These inconsistencies may be explained by the smaller total number of underlying complex claims that are settled without auditors and the already higher average claims sizes in that category.

In the property and liability business lines, the payout claims differences in cycle times between settlements with and without auditors are much smaller than for car insurance claims. For standard claims, cycle times increase by 19.8 days for property insurance claims and by around 10.2 days for liability insurance claims when claims auditors are employed. These increases in cycle times can be interpreted through significantly higher claims complexities within the standard category between settlements with and without auditors. When comparing these findings to the ones obtained for car insurance claims, the higher degree of claim individuality in property and liability insurance cases may also play an important role. High differences in claims cycle times between

the two settlement methods for complex claims in property and liability insurance are in line with what could be expected.

E.2.3 Influence of claim adjustment allowances on the occurrence of fraud

The impact of agent and broker settlement allowances on insurance fraud is considered in this section. In recent years, this topic has often been focal for discussions among practitioners. Nevertheless, to the best of our knowledge, numerical results have not previously been presented in elucidating this concern. In order to add to these discussions, we compare the insurance fraud ratios of insurance companies with claim settlement allowances for agents and brokers with the fraud ratios of insurers without settlement allowances for agents and brokers. The average fraud levels in each category and business line are reported in Table 54.

| Settlement mode | Car | Property | Liability |
|-------------------------------------------|------|----------|-----------|
| <i>Agent settlement</i> | | | |
| (1) with adjustment allowance | 3.43 | 2.47 | 3.41 |
| (2) without adjustment allowance | 0.82 | 0.77 | 0.82 |
| Difference $\Delta^{(1) \rightarrow (2)}$ | 2.61 | 1.70 | 2.60 |
| <i>Broker settlement</i> | | | |
| (1) with adjustment allowance | 2.50 | 3.60 | 2.20 |
| (2) without adjustment allowance | 1.99 | 1.21 | 2.22 |
| Difference $\Delta^{(1) \rightarrow (2)}$ | 0.51 | 2.39 | -0.02 |

Table 54: Average fraud levels in % as share of all claims for different settlement modes in the business lines car, property and liability.

Note: The settlement modes considered are the agents and brokers where we separately consider the companies with (1) and without (2) adjustment allowances in the channels.

Our main finding is as follows: there is a tendency for insurance companies granting settlement allowances to their agents to report higher fraud levels than insurers without agent settlement allowances. This finding is most pronounced in car and liability business lines, where the fraud ratio increases by 2.61% and 1.79% for firms with agent settlement

allowances. The same does not appear to be the case for broker claims adjustment allowances. Only in the property business line do fraud levels show a distinct increase (average of 2.39%) if brokers are entitled to claim settlements. In car and liability insurance, no relevant differences can be observed. With regard to the agent settlement allowances especially, one has to bear in mind that insurance agents often have a close relationship to their customers, and that such relationships might lower their resistance to fraudulent claims. Furthermore, insurance agents are often aware of the fact that their insurer is heavily dependent on their sales performance. This is far more pronounced among agents than individual insurance brokers, since agents usually have larger business shares than a broker at a single insurer.

E.2.4 Influence of cycle times on the occurrence of fraud

This section discusses the question of whether claims cycle times have an impact on the occurrence of insurance fraud. The motivation behind this research question stems from industry discussions as to whether insurers are able to establish fast claims operations with short cycle times and maintain efficient claims auditing patterns at the same time. We therefore compare average claims cycle times for payout and standard claims in the car, property and liability business lines with the corresponding percentages of detected insurance fraud in each business line. Figure 14 graphically illustrates these dimensions as extracted from our survey results. For this analysis, only payout and standard claims are considered. Complex claims are omitted because of their high complexity, cycle time volatility (see Table 49) and lower level of comparability between insurers.

No statistically significant relationship between claims cycle times and the occurrence of fraud can be detected. For liability insurance claims, such dependency is the weakest from all business lines. This is also partly related to the small numbers of participants with valid data and a reversing trendline (see Figure 14). Conversely, the trends in car and property insurance claims are suggestive of a tendency for insurance companies with shorter cycle times to have higher rates of detected fraud. This trend is most pronounced in property insurance (four valid data

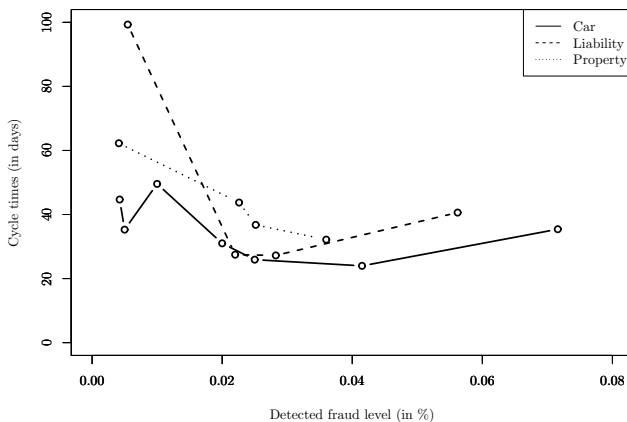


Figure 14: Graphical illustration of the relationship between claims cycle times and the occurrence of fraud for the business lines car, property and liability for the different participating insurers (points).

points). A decrease in cycle time of about 30 days (from the slowest to the fastest insurer) is linked to an increase in detected fraud of more than 3% in this business line. In car insurance, the seven valid data points show only a weak trend. A relatively similar trend to the one in property insurance can be observed. Although no conclusive results could be derived for this topic, our data points add to the discussion and will be confirmed by further analyses in future research.

E.2.5 Cycle times and lump sum adjustment

Finally, we concentrate on the influence of lump sum claims adjustments on the speed of insurers claims management operations. Insurance companies tend to cite the following reasons for introducing lump sum claims adjustment allowances: First, the aim of reducing claims cycle times in order to increase customer satisfaction (see Kumar, 2005, and Macgard, 1990). Second, the aim of minimizing total operating expenses per claim case by reducing auditing and handling complexities. Insurers usually

define a certain limit up to which claims are adjusted with reduced auditing procedures (for average amounts among our survey participants, see the results presented in topic (8) and reported in Table 52). The correlation of reduced claims operating expenses with the introduction of lump sum claims adjustments would seem to be indisputable. In the remainder of this section, we thus focus on the influence of lump sum claims adjustments on claims cycle times. We therefore consider payout and standard claims. The cycle times for both lump sum adjustment strategies (with, 1, and without, 2) are reported in Table 55.

| Adjustment mode | Car | Property | Liability |
|-------------------------------------------|------|----------|-----------|
| (1) with lump sum adjustments | 28.4 | 37.6 | 31.8 |
| (2) without lump sum adjustments | 35.9 | 33.0 | 38.5 |
| Difference $\Delta^{(2) \rightarrow (1)}$ | 7.5 | -4.5 | 6.7 |

Table 55: Average claims cycle times in days for claims adjustments with and without lump sum allowances for the business lines car, property and liability.

Relatively important differences in cycle times with regard to lump sum adjustments can be observed in all business lines. In car and liability insurance, the average claims cycle times are significantly reduced if the insurer applies lump sum claim adjustments, with differences of about 20%. Conflicting results are, however, obtained for property insurance, where average claims cycle times increase with lump sum claim adjustments. For car insurance, the reduction in the average claims cycle is $\Delta^{(2) \rightarrow (1)} = 7.5$ days. For liability insurance, the cycle times difference is on average 6.7 days. The reversed difference occurs for the property insurance line with -4.5 days (increase in cycle times when using lump sum adjustments). According to our interpretation, the significant reduction of claims cycle times in car insurance claims reflects the adequacy of lump sum adjustments in that business line. This is because car insurance claims are typically less complex than property and liability claims cases. Furthermore, car insurance claims cases have a higher frequency, which allows insurers to perfectly adjust their operations to these claims using economies of scale. In liability insurance, the difference of 6.7 days

reflects the trend for lump sum adjustment allowances to reduce average claims cycle times. We interpret the opposite trend for the property insurance line to be due to large differences in claims volumes for payout and standard claims.

F Conclusion

The paper discusses topics in insurance companies claims management, and addresses selected aspects of claim process handling patterns and efficiencies. In order to provide a strong basis for ongoing discussions within claims management, first a process model framework is proposed. On that basis, a benchmarking survey tool is employed with reference to the model. By means of a questionnaire, we gathered quantitative data from insurance companies in Germany and Switzerland. The 11 companies that responded to the survey cumulatively have significant market shares in the considered insurance retail business lines of car, property and liability.

Benchmark results reveal the following main findings. The study shows that insurance companies have different strategic principles with regard to claim management operations. For example, claim work and cycle times differ significantly among the companies, and about half of the participating insurers grant claim settlement allowances to their agents and brokers, while the other half do not. Such findings indicate that currently only few and basic industry-wide strategic best practice standards have been established. Established standards include, for example, the relatively sound use of claims segmentation into complexity categories. From our findings across the three business lines, we conclude that the car insurance line is the most standardized.

The operational implications of strategy differences reveal the following three trends. First, lump sum adjustments and the employment of claim auditors tend to impact insurer claim cycle times. While lump sum adjustments reduce average cycle times, the employment of claim auditors increases average cycle times. Both of these findings can have important implications for claim operations. Second, the transfer of claim adjustment allowances to the insurers sales force, namely agents,

tends to increase insurance fraud, especially in the car and liability insurance business lines. For insurance brokers, our data does not indicate this to be the case. Third, we observe no correlation between claim cycle times and the occurrence of insurance fraud. This indicates that insurers do not tend to implement fast operations at the expense of inaccurate claim auditing patterns.

We maintain that our results hold significant implications for insurance practice. Although the number of participating insurers does not allow for statistically significant results in all dimensions, the survey participants do represent a significant share of the market. A key proposition in our study is also the wealth of detail represented by the data. To the best of our knowledge, our analysis is the first of its kind covering claims management issues empirically in such depth. This is supported by motivating discussions held with executives from companies. The area of claims management clearly holds high potential for further applied research. For the proposed standard model, more process quantities and work flow times could be measured at key points to more accurately define best practice. Some of the reported results may be surprising, such that a focused analysis with even better representativeness for the industry will add value. Furthermore, changes and improvements over time will be useful to follow and analyze.

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