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Effects of Liberalization and Deregulation in the German Insurance Market:

Essays on Distribution Channel Structures, Efficiency and Market Performance

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Dipl.-Kffr. Lucinda Trigo Gamarra, geb. am 7. Dezember 1978 in Uelzen

aus Rostock

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Dekan:	Prof. Dr. rer. pol. habil. Stefan Klaus Erhard Göbel
Gutachter:	Prof. Dr. rer. pol. habil. Doris Neuberger, Wirtschafts- und Sozialwissenschaftliche Fakultät, Institut für Volkswirtschaftslehre, Universität Rostock
Gutachter:	PD Dr. rer. pol. habil. Martina Eckardt, Professur für Finanzwissenschaft, Andrassy Gyula Deutschsprachige Universität, Budapest
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Rostock, im August 2008 Lucinda Trigo Gamarra

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List of Abbreviations

AE	Allocative efficiency
Bafin	Bundesanstalt für Finanzdienstleistungsaufsicht (Federal Financial Supervisory Authority)
CE	Cost efficiency
CE^{CRS}	Cost efficiency under the assumption of constant returns to scale
CE^{VRS}	Cost efficiency under the assumption of variable returns to scale
COLS	Corrected Ordinary Least Squares
CRS	Constant returns to scale
DEA	Data Envelopment Analysis
DFA	Distribution Free Approach
DRS	Decreasing returns to scale
EC	European Union Council
ECC	European Communities Council
EFFC	Efficiency change
FE	Fixed effects
GDV	Gesamtverband der Deutschen Versicherungswirtschaft (German Insurance Association)
HHI	Herfindahl-Hirschman-Concentration Index
IRS	Increasing returns to scale
LP	Linear programming problem
LR	Likelihood ratio
M&A	Merger and acquisition
ML	Maximum Likelihood
NDRS	Non-decreasing returns to scale
NIRS	Non-increasing returns to scale
NSPF	Non-standard profit function

OLS	Ordinary Least Squares
OPEX	Operating expenses
PE	Profit efficiency
PE^{VRS}	Profit efficiency under the assumption of variable returns to scale
PEC	Profit efficiency change
RE	Random effects
RTS	Returns to scale elasticity
SCP	Structure-Conduct-Performance
SD	Standard deviation
SE	Scale efficiency
SEC	Scale efficiency change
SFA	Stochastic Frontier Analysis
TC	Technical change
TCE	Technical cost efficiency
TCEC	Technical cost efficiency change
TE	Technical efficiency
TFP	Total factor productivity
VRS	Variable returns to scale

1 Introduction

The creation of a single European market for financial services is a major objective of the European Union. The process seeks cross-border integration of financial markets and institutions, including equity, bond, and money markets, as well as banking and insurance markets. By increasing the integration of these markets, the European Union aims to enhance competition, and thereby to improve efficiency and market performance and increase the public welfare. The adoption of the Third Life and Non-Life Directives in the early 1990s was a major step towards integrating European private insurance markets. These directives allow every European insurance company to operate freely throughout the member states either through direct cross-border trade under the supervision of the home country or through establishing a branch or an agency in a foreign member state. They also removed, to a large extent, material price and product regulation, which still existed in some of the member states, including Germany.

Until 1994, the German insurance markets were subject to extensive material regulation; the regulation of minimum price levels and product conditions led to stable profit levels and price and product homogeneity. Because of the cost-plus regulation of premium levels, insurers pursued a revenue-maximizing objective by focussing on turnover, rather than profit. The Third Directives and the subsequent deregulation had a major impact on the German insurance firms, as they faced increased price and product competition, and on insurance customers, who had a much larger choice of insurance providers and products.

This doctoral dissertation examines the effects of the liberalization process on the structure and choice of distribution channels and on the performance of the German insurance market. The first two articles focus on changes in the structure and choice of distribution channels, while the third article analyzes the development of market performance in the German life insurance industry and answers to what extent the aims of the liberalization process have already been achieved. By doing this, the present work contributes to the analysis of liberalization and deregulation on market conduct and structure and examines resulting changes in market performance, which makes it possible to evaluate the outcome of the liberalization and deregulation process. The articles are arranged in order of their inception and can be read independently.

The distribution of insurance products in German private insurance markets before liberalization was characterized by a large predominance of exclusive sales forces. As a consequence of restricted competition and large homogeneity in prices and products, there was only limited demand for counseling by independent insurance agents and brokers, who do not act on behalf of the insurance firms but are able to choose the firms they work with and the products they sell. The influence of independent agents and brokers was also limited by the prescription of minimum price levels, which motivated firms to engage heavily in selling activities best performed by large, exclusive sales forces. As a consequence of the liberalization and deregulation of the market, the variety and complexity of insurance products and the number of insurance providers increased. This has led to the rising importance of independent agents, as these agents are better able to compare insurance products of different providers. The share of insurance products, particularly life insurance lines, distributed by independent agents and insurance brokers in the German market has actually increased since the liberalization.

Chapter two analyzes whether the increasing importance of insurance brokers in private insurance markets may be explained by their ability to provide higher service intensity and product quality, as stated in the product quality hypothesis. According to this hypothesis, independent insurance agents provide better service quality as they focus on counseling-intensive, more complex insurance products, which enables them to recoup their higher costs, while exclusive agents sell more standardized products. As a result, both intermediary types coexist in a separating equilibrium. To test the product quality hypothesis for the German market, we conducted a survey among insurance intermediaries to obtain information about input activities and output performance indicators. The resulting data set contains information about 608 exclusive and independent insurance intermediaries which were active in the German market in 2005. Multivariate regression models were used to analyze the influence of each intermediary type and of other exogenous variables on input and output indicators which served as proxies for service intensity and the performance of the intermediaries. The results showed that, in five of the seven models analyzed, independent insurance agents have a higher service intensity, as measured by the input indicators, and better performance, as measured by the output indicators. We also found limited evidence for a separating equilibrium in the market: Independent agents are represented above average in some complex insurance lines, while exclusive agents have a larger share in only one standardized insurance line. Thus, our results explain the increasing importance of independent agents in German private insurance markets, as these agents seem better able to meet the requirements for financial counseling in the liberalized insurance market.

Abolishing both ex ante approval of contract conditions and regulation of premium levels, together with the liberalization of insurance services throughout the European Union, was expected to lead to increasing price competition in insurance markets. Concerning the distribution of insurance products, this was expected to give rise to lower-cost direct distribution of insurance products; this development being backed by technological progress which permits to sell insurance products via the internet. In direct distribution, insurance firms do not use agents to distribute their products, but sell them directly by mail, phone, or via the internet. The share of insurance products, particularly less complex, more standardized insurance lines, sold via direct sale has increased since the liberalization, as there is less need for personal counseling in these lines. Hence, as a consequence of the liberalization of the market, changes in the relative importance of distribution channels have included a decrease in the market share of exclusive agents in favor of direct distribution and distribution by independent agents.

Chapter three deals with how these changes are reflected in the distribution channel decisions of German life insurance firms. Several distribution strategies can be found among German insurance firms: Multi-channel insurers use multiple channels to distribute their products, including exclusive sales forces, independent agents, and direct sale. Single-channel insurers use one distribution channel: Direct insurers use no agents, relying instead on the internet to provide a cost advantage which translates into lower prices, while independent agent insurers distribute their products only through independent agents, thus focusing on high-quality services. However, although the use of direct distribution and the distribution via independent agents has increased, the market share of single-channel insurers which rely exclusively on direct distribution or the distribution via independent agents remains small in the German market. Most insurance firms have simply added additional direct and independent agent channels to their existing exclusive agent distribution channels, opting by this for a multi-channel distribution approach.

Chapter three thus addresses the coexistence of single- and multi-channel distribution strategies in the German life insurance market and explains why single-channel distribution strategies are still limited to a small number of insurers, though the importance of direct distribution and distribution via independent agents has increased after the liberalization of the market. Hypothetically, single-channel insurers should be superior to multi-channel insurers if they are able to realize a cost advantage as direct insurers, or an advantage in terms of quality as independent agent insurers. To test these hypotheses, we conducted an analysis of cost and profit efficiency in the German life insurance industry over the period from 1997-2005. The data set contained information about firms' outputs, costs, and revenues obtained from periodically published industry reports. We applied the non-parametric Data Envelopment Analysis (DEA) to estimate cost, scale and profit efficiency of single- and multi-channel insurance firms for each year.

By comparing the two different single-channel distribution strategies with the multi-channel approach, we found that neither of the single-channel distribution strategies was able to realize its hypothesized advantage. Direct insurers did not have higher cost efficiency compared to multi-channel insurers and thus, were not able to realize an advantage in terms of costs. This can be explained primarily because of their limited growth; in the presence of increasing returns to scale, direct insurers were not able to reach an optimal firm size which would permit them to operate at the point of minimum average costs. Similarly, independent agent insurers showed significantly lower levels of cost efficiency and profit efficiency compared to multi-channel insurers, from which we concluded that they were not able to recoup their higher costs by higher revenues, i.e. they do not realize a marketable advantage in terms of quality which would translate into higher prices and revenues. In the end, then, multi-channel distribution strategies proved superior to single-channel approaches in the German life insurance market, which is why the market share of single-channel insurers remains small.

Chapter four analyzes the development of market performance in the German life insurance industry for the post-liberalization period 1995-2002 and to what extent the aims of the liberalization of European insurance markets, as a part of the single market process for financial services, have been achieved in the German life insurance market. Within the framework of the revised Structure-Conduct-Performance (SCP) paradigm, we analyzed the effects of the liberalization process on market performance. The development of market performance was measured in terms of changes in technical cost, scale and profit efficiency levels and technical change since the liberalization. We applied the parametric Stochastic Frontier Analysis (SFA) to a panel of German life insurance firms for the years 1995-2002 and, as above, obtained data about outputs, costs, and revenues of the firms from periodically published industry reports. We estimated a stochastic input distance frontier to obtain technical cost efficiency levels and accounted for unobserved firm-specific heterogeneity by applying a true fixed effects estimator, in keeping with Greene (2005). Profit efficiency was derived in a second step, following Kumbakhar (2006).

Our results showed that the intended liberalization effects have been achieved to only a limited extent in the German life insurance market. We did not find an increase in technical cost and profit efficiency over time, but we found positive changes in scale efficiency, which indicates that market consolidation in the presence of increasing returns to scale led to efficiency gains. Further, the industry experienced substantial positive technical change, driven by progress in information technologies. Our findings emphasize that the success of the European liberalization process remains limited in private insurance markets. Chapter five summarizes and combines the main findings of the articles, offers conclusions and addresses issues for future research.

2 Does the Product Quality Hypothesis Hold True? Evidence for the German Market for Insurance Intermediation

2.1 Introduction

The liberalization of the European insurance sector in 1994 has led to major changes in the highly regulated German insurance market. Now, consumers have a larger choice of insurance products and providers, and private old-age and health provision is gaining importance because of the decline in public provision in these sectors. Both factors have led to private customers' increasing need for advice. This need is attributed to the characteristics of insurance products, often characterized as credence or trust goods, that present high information asymmetries.

Generally, insurance intermediaries act as experts and help to inform customers (e.g., Bosselmann, 1994), so the insurance sector is characterized by different types of insurance intermediaries: Exclusive (dependent) agents act on behalf of one or more selected insurance companies and are allowed to sell only the corresponding products, while independent insurance agents (insurance brokers) act primarily on behalf of the insurance customer and are free to choose the insurance products they sell and the companies with which they work.[1] However, both exclusive and independent agents are paid for their services on a commission basis by the insurers (e.g., Traub, 1995). In many cases, insurance companies distribute their products via both independent and exclusive intermediaries but, in the German market, exclusive agents had been the dominant distribution channel until the liberalization of the industry. Since then, independent agents have gained importance. Thus, an explanation for the growing importance of the independent insurance agency system is needed.

This study analyzes the coexistence of independent and exclusive agents on the German insurance market from a demand-side view by analyzing the services provided by independent agents as compared to exclusive agents. Therefore, it offers an answer to open questions concerning how different insurance distribution channels can coexist and how the liberalization of the market has affected their relative importance. Thus, this study adds new

[1] The terms *exclusive agent/ exclusive intermediary* and *dependent agent/ dependent intermediary* are used interchangeably. Further, the term *independent agent/ independent intermediary* encompasses all agents who are free to choose the companies with which they work and the products they sell. In most cases, these independent agents acts as insurance brokers, although they may also act as financial advisors. (See section 2.4 for more details.) In the following, *insurance broker/ independent agent/ independent intermediary* are also used interchangeably.

results to the existing research on the coexistence of distribution channels in insurance markets and is the first to analyze the question specifically in terms of the German market.

The existing literature provides two main explanations for the coexistence of different distribution channels: the product quality hypothesis and the market imperfections hypothesis. The product quality hypothesis states that the two systems coexist because they differ in the services they offer and the clientele they attract, and the higher costs of the independent agency system are compensated for by a higher level of service intensity and product quality compared to that provided by exclusive agents (e.g., Pauly et al., 1986; Barrese and Nelson, 1992). The result, according to this hypothesis, is a separating market equilibrium which leads to the coexistence of both types of intermediaries. In terms of product supply, independent insurance agents would rather focus on counseling-intensive, complex insurance products, whereas exclusive agents prefer to specialize in standardized, less counseling-intensive insurance products.

The market imperfections hypothesis, on the other hand, states that exclusive agents and independent agents do not differ in the level of service intensity and product quality they offer to the customer but that the two systems coexist because of prevailing information asymmetries, a lack of market transparency and other differences between the two distribution channels. The more cost-intensive independent agent-based distribution channel might exist because of the information asymmetries (Joskow, 1973; Cummins and VanDerhei, 1979; Weiss, 1990), which may be attributed to a slow diffusion of information (Berger, Kleindorfer and Kunreuther, 1989) or to high search costs which prevent inefficient firms from being identified (e.g., Dahlby and West, 1986). The result, according to this hypothesis, is that both intermediary types coexist in the market in a pooling equilibrium, even though the higher costs of the independent agency system are not reflected in a superior level of service. In fact, in the long run, if the information asymmetries decrease, it would lead to a declining market share of independent intermediaries.

To analyze the coexistence of different channels of distribution in German insurance markets, this paper empirically tests the product quality hypothesis by analyzing differences in service intensity and output performance of independent and exclusive agents. A direct test of the market imperfections hypothesis would require testing for differences in the cost levels of different intermediary types by comparing costs incurred by exclusive and independent agents or agencies, but data for this is highly limited. In the German insurance market, most insurers work with both independent and exclusive insurance agents, so our hypotheses are tested directly by using indicators that measure the service intensity, and selected indicators for output performance provided by exclusive and independent insurance agents.[2]

To evaluate the hypotheses, an online survey among 3500 exclusive and independent German insurance intermediaries was carried out in the spring of 2005. Indicators chosen as proxy variables for differences in service were split into two groups: indicators describing the input activities of the insurance intermediary which measure service intensity, and indicators for the output performance, measuring the output quality of the intermediation services. The analysis of both the input activities of the intermediary, as well as the results of his/her counseling activities gives a more complete insight into the provided services than would analyzing only one group of indicators.

This paper is organized as follows: Section 2.2 contains the theoretical background on the coexistence of dependent and independent insurance agents and reviews previous research. Section 2.3 overviews changes in the relative importance of exclusive agents and independent insurance brokers since the liberalization of the insurance markets in 1994. Section 2.4 illustrates the empirical design of this study, overviews the applied variables, and presents the estimation approach. Section 2.5 presents the main descriptive results and the results of the multivariate estimations. Conclusions are drawn in section 2.6.

2.2 Theoretical Background and Previous Evidence

This section focuses on the product quality hypothesis' explanation of the coexistence of independent and exclusive agents in insurance markets. The hypothesis states that both kinds of agents exist because insurance brokers provide higher service intensity and product quality than dependent agents, which compensates for their higher costs and allows them to persist in the market. In the U.S. insurance market, independent agents have higher expenses because of the structure of the relationship between the insurance company and the different types of agents: In contrast to dependent agents, independent agents own their individual client lists and have the right to policy renewal, so they directly contact the customer at the end of the contract period and decide which of the insurers represented will receive the renewal business. By contrast, with exclusive agents, it is the insurance company which decides on the renewal of an insurance policy. Therefore, typically, independent agent renewal commissions

[2] Other distribution channels can also be found in the German insurance market (e.g., multi-level marketing, direct distribution, distribution via bank offices). A detailed description of several distribution channels in the German life insurance market is given in section 3.2.2.

are higher than the commission level in exclusive distribution systems since the insurer must ensure that an independent agent acts in its sense and does not move the client to another insurer. Thus, insurers incur higher monitoring costs in case of dealing with independent agents (Barrese and Nelson, 1992).

In the German insurance market, the independent agent does not own his or her client list, and it is the insurance firm which decides on the renewal of the contract (e.g., Grieß and Zinnert, 1997). Even so, independent agents usually receive high commission levels from the insurance firms to ensure that the independent agent places the most profitable business with them (e.g., Scheiper, 1996; Zweifel and Eisen, 2003; Dahmen, 2004). Still, since information about individual compensation levels of insurance intermediaries is usually not available, there are only few studies which analyze the remuneration levels of insurance intermediaries. In a study for the Swiss market, Zweifel and Ghermi (1990) found higher expense ratios for exclusive agents compared to independent agencies by analyzing financial data provided by a Swiss insurer. However, the authors stated that that the result may strongly depend on the specific incentives set by this insurance firm. To our knowledge, there is no study so far which has analyzed cost differentials between exclusive and indepdendent agents for the German market. However, as this study centers on testing the product quality hypothesis by directly comparing the provided service level of different intermediary types, information about cost differences between both groups is of only minor importance.

According to the product quality hypothesis, the choice of the independent agency system by insurance companies is justified by the higher level of service quality delivered by independent agents. This can be analyzed from a supply-side view, where it is the insurance company which receives a higher level of quality by the services from independent agents (e.g., Regan and Tennyson, 1996; Regan, 1997; Anderson et al., 1998), or from a demand-side view (Finsinger and Schmid, 1993), where insurance brokers provide superior services to the customers (e.g., better information, superior counseling quality), which leads to increased demand from customers for these services. As this study focuses primarily on the consequences of the liberalization of the insurance market on the need for customer counseling, the service quality is tested from the demand-oriented view.

Previous literature provides several demand-side explanations for the higher service intensity and product quality of independent agents, but the central reasoning is found in the seminal paper by Grossman and Hart (1986). The authors stated that, in the U.S., the difference in ownership of the central asset, the client list, leads to higher investments in the client list by independent agents compared to exclusive agents. These higher investments are reflected in the effort with which the insurance policy is chosen and designed, and in the level of efficiency when dealing with claims settlement. The higher effort results in a higher level of service quality. Although, in the German market, it is the insurance firm which owns the client list, insurance brokers may still have incentives to provide higher service quality, as they are subject to stricter liability rules (e.g., Nell and Traub, 1994). For example, according to German law, independent insurance brokers are liable for losses from poor counseling, whereas insurance firms, not their agents, are liable for the actions of their exclusive agents. Thus, insurance brokers may face higher incentives to pursue a more detailed risk analysis and careful design of the chosen policy.

Other explanations for a higher service intensity provided by independent agents include the rationale that which contends that, in contrast to exclusive agents who work only for a single or a few insurance firms, insurance brokers compare products of many different providers and attain more information, so they are able to give better-informed advice to the customer and to reduce the customer's search costs (Posey and Tennyson, 1998). From a customer's point of view, higher service quality could also consist of better ongoing monitoring of the insurer by brokers for the purposes of renewal (Regan, 1997), including screening different insurers for appropriate coverages, low prices, and financial stability. Mayers and Smith (1981) and Barrese and Nelson (1992) also stated that independent agents are more capable to deal with conflicts between insurers and policy holders, as they can threaten moving the customer to another insurer if the insurance company acts unreasonably. Venezia et al. (1999) stated that independent agents provide better claims services in case of a loss. These better claims services are also explained by the fact that independent agents can threaten to switch their clients to a different insurer.

Summarizing, several theoretical arguments provided by previous literature support the product quality hypothesis. Following these arguments, the result would be a separating equilibrium in the market for insurance intermediation where independent agents engage in more complex insurance lines where the customers' need for information is comparatively high and a high level of service quality is of great importance. In contrast, exclusive agents have a comparative advantage in the distribution of standardized insurance products because information and counseling of the customer are of lower importance in these cases and customers may prefer lower costs to more counseling.

A number of studies have addressed differences in performance and service quality of different insurance distribution channels. However, the majority of previous studies dealing with this issue have not measured provided services of insurance agents directly; instead, cost and revenue or profit functions of insurers working exclusively with exclusive agents and exclusively with independent agents have been estimated to compare the cost and revenue levels of the two distribution systems. The results have been mixed: while in most cases, independent agents were found to deliver higher service quality (e.g., Barrese and Nelson, 1992; Barrese et al., 1995; Berger et al., 1997), some studies did not find any significant differences in service quality or even evidence for better performance of exclusive agents in some aspects (Joskow, 1973; Etgar, 1976; Cummins and Weisbart, 1977, and Klumpes, 2004). Only two studies have compared exclusive and independent agents on the German market: Eckardt (2002) employed mean differences parametric tests to identify differences in quantitative and qualitative variables describing the information and counseling behavior of agents and to show that independent agents provide higher information quality; in a second study using the same data (2007), Eckardt used multivariate estimations to show that the information quality provided by insurance intermediaries increases with their independence from insurance companies. However, Eckardt did not center on the explanation for the coexistence of both distribution channels, but on the working of signaling instruments in the market for insurance intermediation, among them the intermediary type.

2.3 An Overview of Exclusive and Independent Agents in the German Insurance Market

Exclusive and independent agents have always been present in German insurance markets, although private insurance markets have been traditionally dominated by exclusive agents (e.g., Finsinger and Schmid, 1994). In most cases, exclusive agents are self-employed and act as commercial agents in the name of one or a selected number of insurance firms to which they are tied. In contrast, most independent insurance agents act as insurance brokers; from a legal point of view, they are commercial brokers subject to stricter legal and liability rules than exclusive agents (e.g., Nell and Traub, 1994). Before 1994, insurance brokers traditionally focused on services for large commercial and industrial clients, as well as wealthy private clients because of the strict regulatory system which prevailed in the German insurance industry until the liberalization of the markets. Among other things, contract conditions and elements were largely standardized, as new contract types had to be submitted to the regulatory agency. Since premiums were regulated according to a cost-plus price regulation, price competition was restricted to a large extent and, as a consequence of prescribed minimum price levels, German life insurers pursued revenue-maximizing, rather than profit-maximizing functions. Their main objective, then, was to increase their sales strength to maximize their turnover. As price competition was restricted, insurance firms competed for new business by increasing selling and advertising costs, i.e., competition occurred mainly on service (e.g., Hess and Trauth, 1998; Rees and Kessner, 1999). Thus, German life insurers engaged heavily in selling activities by large, exclusive sales forces, and customers were less interested in comparing several offers from different insurers by independent insurance agents (Finsinger and Schmid, 1993, 1994), because those offers tended not to differ in any substantial way.

Since the adoption of the Third Directive on Life Insurance (92/96/EEC) (ECC, 1992a) and the corresponding Third Directive for Non-Life Insurance (92/49/EEC) (ECC, 1992b) in 1994, however, the situation has changed. The key elements of this directive were the establishment of a single European market for insurance services by allowing every insurance firm to provide its services either by establishing a branch or subsidiary in a foreign country, or through direct cross-border trade. Further, price and product regulation were abolished.[3]

As a consequence of market liberalization and the abolition of material price and product regulation, insurance customers now face a much larger variety of insurance products and insurance providers. Price differences have also become larger, leading to a major need for price search in the market. Further complexity is introduced by the changes in the statutory pension systems, which have led to an increased demand for private old-age and health provision. In the German market, the so-called Riester pension reform (established in 2002), and the Rürup pension plans (established in 2004) encourage the private old-age provison. Thus, although insurance customers are expected to benefit from increased variety in products and prices, they also face more difficulties in obtaining a market overview and in choosing suitable products (e.g., Matusche-Beckmann, 1996).

As a consequence, customers have developed an increasing need for objective and independent information and advice in the fields of insurance and financial provision products, and the demand for services by independent agents has grown in private insurance markets (e.g., Scheiper, 1996). This is also reflected in an analysis of the supply side, i.e., the insurance firms: Insurers increasingly use independent brokers as a distribution channel to

[3] A more detailed analysis of the regulatory system in the German life insurance industry before 1994 and the liberalization and deregulation process can be found in section 4.2.

reach new customer segments. Most insurers use independent brokers as an additional distribution channel, and some even use independent brokers exclusively to distribute their products. Foreign insurers may use insurance brokers as a distribution channel with which to enter the market and to avoid the costs of building up their own local sales force (e.g., Grieß and Zinnert, 1997). The rising importance of independent insurance agents is also reflected in the results of annual surveys conducted by the international consultancy Tillinghast Towers Perrin to analyze the relative importance of different distribution channels in the German life and non-life insurance markets.[4]

In 2005, exclusive agents accounted for 27.1 percent of German life insurers' income from premiums, but independent agents and insurance brokers accounted for 32.4 percent, outperforming the exclusive distribution channel in the German life insurance market for the first time (Tillinghast, 2006a). This result has to be treated carefully, as so-called multi-level marketing (*Strukturvertrieb*) accounted for 7 percent of the premium income and was recorded separately. If the distribution via multi-level marketing had been treated as a special form of exclusive selling, exclusive and independent agents would have shown very similar levels of premium income. Nevertheless, the distribution via exclusive agents is decreasing; in 2002, the exclusive agents still showed a premium income share of 39.6 percent, while independent agents accounted for only 24.5 percent (Tillinghast, 2004).

In 2005, in the non-life insurance lines, exclusive agents still represented the most important distribution channel, with 63 percent of the premium income of the non-life insurance industry coming from exclusive agents. This is because insurance brokers are generally more interested in the distribution of life insurance products, as commission levels are usually higher in these insurance lines (Tillinghast, 2006b), so insurance brokers accounted for only 17 percent of the premium income in 2005. However, the importance of insurance brokers is expected to increase for non-life insurance products. In 2006,

[4] 43 life insurers participated in 2002, representing approximately 76 percent of the German life insurance market. 51 German life insurers participated in the survey in 2005, representing approximately 75 percent of the German life insurance market. Information about the missing firms was complemented by Tillinghast based on information from annual statements and their own market knowledge. Premium income was measured by the Annual Premium Equivalent, which is the sum of the current premium payments and 10 percent of the single premiums in a year (Tillinghast, 2004, 2006a). The survey for non-life insurance products was conducted for the first time in 2005 and covered approximately 67 percent of the German non-life insurance market. In 2006, approximately 77 percent of the non-life insurance market was covered by the survey. Again, information about the missing firms was complemented by Tillinghast based on information from annual statements and their own market knowledge. Premium income was measured by the current premium payments (Tillinghast, 2006b, 2007).

independent insurance brokers already accounted for 22 percent of the premium income, and the share of exclusive agents had decreased to 57 percent (Tillinghast, 2007). Further, insurance firms expect the importance of insurance brokers to further increase in the future, as insurance customers increasingly demand services by independent agents (Tillinghast, 2006b).

The results of these surveys demonstrate an increasing importance of independent agents in both the German life insurance and non-life insurance markets, as independent agents are better able to meet the requirements of both insurers and customers in the liberalized German insurance market. In this study, we conduct a survey among German insurance intermediaries to find whether the increasing importance of independent agents may be actually explained by their higher level of service intensity and better performance, as suggested in the product quality hypothesis.

2.4 Empirical Design and Estimation Approach

To directly measure service intensity and perfomance by insurance intermediaries in the German market, we generated a data set from an online survey sent to 3500 German exclusive and independent insurance intermediaries in the spring of 2005. The e-mail addresses were randomly chosen from sources like online directories, registers of members of professional organizations, and registers of members of chambers of commerce and industry.[5] The final data set consists of 608 answered questionnaires, with 58.4 percent from exclusive and 41.6 percent from independent agents, which corresponds to 355 and 253 observations, respectively. Tied or exclusive agents belonging to a single or several insurance companies or an insurance group have been classified as exclusive agents. Insurance brokers and financial consultants have been classified as independent agents.[6] Detailed information on the exact number of insurance intermediaries in each groups is not available, only rough estimates are

[5] There was no legal duty to register as an insurance intermediary in the German market until 2007. Thus, no central register was available from which to obtain addresses of insurance intermediaries and it was not possible to rule out that an agency received more than one survey. To ensure that only one member of an insurance agency answered the questionnaire, if it happened that more than one member of an agency received an e-mail, we included in the cover letter to the survey a remark to the effect that only one member of each agency responded to the survey. Further, it was not possible to determine the exact number of independent and exclusive agents in the initial sample, as the sources used for obtaining the e-mail addresses did not always reveal the status of the intermediary.

[6] Financial consultants are usually not tied to one or several companies, so they have been classified as independent agents, although the title is not linked to any requirements. Their share in the group of independent agents is very small, representing only 21 of 253 cases.

published by the German Insurance Association (GDV) (GDV, 2004). We did not include part-time intermediaries in our analysis, as this group accounts for only a very small amount of the premium income of the industry. According to the GDV (2002), the main part of the premium income is generated by exclusive agents, independent agents, and insurance brokers. Thus, our sample covers the main distribution channels.[7]

To identify the possible influence of differences in qualifications on the service quality, we asked for attributes of the interviewee, including age, professional experience (in years), the professional qualification level (educational level and additional skills), and membership in a professional organization. For the educational level, the different training levels available in the German insurance market were classified from 1 to 6, with level 1 the lowest (corresponding to the qualification level of *Servicefachmann/frau Versicherungen*, which is equivalent to a 240 hours of practical and service-oriented training) and level 6 the highest (university degree in economics or law).

Structural variables surveyed contain information about firm size (measured by the number of employees), product range (number of services provided besides the mediation of insurance products), and share of complex insurance products sold (old-age provisions, commercial insurance, industrial insurance, and private health insurance products were classified as complex insurance products). Compared to more standardized insurance lines, the conditions of insurance for more complex lines usually are formulated individually by the intermediary, according to the customer's needs and preferences.

To test the product quality hypothesis, it is necessary to define and measure indicators of service intensity and performance by the intermediaries. As a direct measurement of service quality proves difficult, we divide our analysis into two parts: According to the product-quality hypothesis, independent agents should show a higher level of service intensity, which should also reflect in a better performance. We therefore asked the intermediaries about their input activities, as well as about selected performance indicators. The input indicators belong to the categories of acquisition of information, transfer of information, and documentation/ administration, since according to Cummins and Doherty (2006), and Eckardt (2007), intermediaries provide information, advisory, bargaining, and administrative services. They are thought to measure the service intensity of the intermediary's services. By taking into

[7] However, due to missing information about the total population, the possibility of a selection bias cannot be excluded. See also section 2.6 for a remark on this problem and a task for future research.

account these actitivities which are carried out during the counseling process, we are able to analyze if independent agents show a higher level of input intensity, as predicted by theory.

The second group of indicators consists of performance indicators: lapse rate, share of new customers, and contract conclusion rate. These indicators measure the outcome of the services the intermediary realizes, and are thought to approximate the output quality of the services. Since this study uses a demand-oriented approach, we focus on services the agents provide to their clients and on the output indicators that are primarily in the interest of the client. Summarizing, this approach allows to analyze in a first step if independent intermediaries show a higher level of service intensity measured by the input indicators, and in a second step, if this higher level of input activities translates into better performance by independent agents. Thus, by this two-step approach, we are able to test the product quality hypothesis without a direct measurement of service quality.[8]

We start with a discussion of the input indicators which represent the dependent variables in models 1-4:

- Model 1: *Working time information acquisition:* The variable is considered to measure whether there is a difference between the two agency types in time spent on information acquisition. The more time spent on information acquisition, the better advice the intermediary should be able to give. Independent agents are expected to spend a higher share of working time on information acquisition, as they have to collect and analyze information on a larger number of suppliers and products. The variable is measured as the ratio of working time spent on information acquisition to total working time.
- Model 2*: Importance of rating agencies:* This variable measures whether the two intermediary types differ in the importance and valuation they attach to information provided by rating agencies. Rating agencies help to overcome information asymmetries in insurance markets by analyzing and comparing the performance of different insurance firms and products. As these rating agencies do not act on behalf of insurance firms or customer associations and they specialize in insurance topics, their information tends to be objective and of high quality. Independent agents are expected to attach a higher value to the information by rating agencies, as they have to compare

[8] See also Eckardt (2007) who followed a different approach and approximated service quality by an information quality index, as well as the contract conclusion rate as performance indicator. As can be seen from a discussion of the results in section 2.6, the results of our study are quite consistent to those obtained by Eckardt (2007).

a higher number of products and providers to find the best suitable product for the customer. To measure the importance of information by rating agencies, we use a five-point rating scale ranging from 1: very important to 5: completely unimportant.

- Model 3: *Design of risk analysis*: The variable measures whether the two intermediary types vary in the complexity with which they perform risk analysis. To determine the insurance needs of a customer, the intermediary must first analyze the customer's risk profile, including personal characteristics, risk preferences, the customer's financial and professional situation, and the customer's existing insurance coverage. Because of the high volume and complexity of the information, service quality is expected to rise as the level of complexity with which the risk analysis is carried out increases; independent agents are expected to use more complex instruments to carry out the risk analysis. The respondents were asked to classify their risk analysis process according to three categories: 1: subjective classification of the client's risk profile, 2: grading of the client's risk profile in given risk categories, 3: computer-assisted determination of the customer's risk profile.[9] Thus, the risk analysis process is measured on a three-point scale, with the degree of complexity ranging from 1 to 3.
- Model 4: *Documentation of counseling interview:* This variable measures whether the two intermediary types vary with regard to the documentation of counseling interviews. Possible poor counseling by the intermediary can be detected only if a record of the counseling interview exists; this record could prove that the intermediary failed to inform the customer about relevant characteristics of the insurance product. Until the summer of 2007, there was no legal duty in Germany for an insurance intermediary to deliver a record of the counseling interview. Thus, the voluntary delivery of a record can be seen as a signal of higher service quality. We expect independent intermediaries to record their counseling intervies more frequently, as they are subject to stricter liability rules. The variable is measured with a binary variable (0/1) and takes the value of 1 if the counseling interview is documented and a copy of the record is both stored and given out to the customer.

[9] The categories were determined according to information obtained from personal interviews with industry experts before conducting the survey.

We now turn to those indicators which are output-oriented, i.e. which measure the performance of the intermediary.

- Model 5*: Contract conclusion rate*: The variable is surveyed to determine if different intermediary types vary with regard to the rate of counseling interviews which lead to the conclusion of an insurance contract. The higher the percentage of counseling interviews that lead to the signing of an insurance contract, the more satisfied the customers are with the counseling process. Thus, it can be expected that the more successful an intermediary is likely to be in analyzing the relevant information and choosing suitable contracts for the customers, the higher the contract conclusion rate is going to be. The variable is measured as the percentage of counseling interviews which result in customers actually signing an insurance contract.

- Model 6: *Lapse rate automobile insurance:* This variable measures whether the two intermediary types vary with regard to the rate of insurance contracts which are canceled within the first year of signing the contract. A cancelation of an insurance contract during the first year demonstrates probable customer dissatisfaction and is an indicator of a lower level of advisory quality by the intermediary. Thus, if the product quality hypothesis holds true, independent agents should show lower lapse rates. The variable is measured as the ratio of automobile insurance contracts canceled within the first year to the total number of automobile insurance contracts. However, an argument which may limit the appropriateness of this variable to measure the service performance by the intermediary is the following: If a customer uses an exclusive intermediary to purchase an automobile insurance contract and learns within a year that there are better automobile insurance products available, this may not indicate poor counseling by the agent, but poor quality of the insurance product. This holds especially true against the background of increasing competition in automobile insurance lines after the liberalization of the market (Wein, 2001). However, we decided to take this performance indicator into account, as the product quality hypothesis states that higher service intensity by independent agents also consists in the fact that these agents compare different products and choose the best suitable for the customer. Thus, a lower lapse rate by independent agents may be a result of this better performance in choosing suitable products, and thus provide evidence for the product quality hypothesis.

- Model 7*: Share of turnover by new customers:* This variable measures whether the two intermediary types vary with regard to the share of financial turnover by new customers. A higher share of turnover generated by new customers indicates faster growth of the agency, which can be explained by a higher perceived level of quality leading to higher demand by new customers. The variable is measured by the share of turnover which is gained by the conclusion of contracts with new customers.

The seven presented indicators are the dependent variables in the multivariate models.[10] The following variables are taken into account as explanatory variables in all seven models:

- *Intermediary type*: A dummy variable differentiates between exclusive (0) and independent insurance agents (1). Following the product quality hypothesis, we expect that independent agents show higher values of the analyzed indicators, and that the variable will show a positive sign.
- *Firm size:* This variable is measured on the basis of the number of employees, as financial data is not available. The expected influence on service intensity and performance is positive, as we assume increasing economies of scale to be realized during the acquisition and procession of information. This would make it possible to provide a given level of information at lower costs.
- *Product range* describes the number of additional services the intermediary offers besides the mediation of insurance products. The following services were considered: Investment counseling, financial advice, investment fund management, asset management, real estate agency, building society savings advice, legal advice, old-age pension counseling, and loss prevention advice. The expected influence on the dependent variables is positive, as economies of scope are expected to exist for the supply of different services. For example, information gained about the risk profile of a customer can be used to supply the customer with other products. The costs for obtaining the information can then be distributed among different services.

[10] Concerning the remaining indicators which were initially included in the questionnaire, it was not possible to conduct multivariate estimations, as the overall model fit proved to be insufficient. We further preferred to conduct separate estimations for the single indicators rather than constructing an index, as the indicators may differ according to their influence on the service quality, and the possible exogeneous factors which may have an influence on them. A copy of the questionnaire can be found in table A 1 in the appendix.

- *Share of complex insurance products s*pecifies the ratio of complex insurance policies (policies belonging to the insurance lines of old-age provisions, private health insurance, commercial insurance, and industrial insurance) to the total number of policies. The variable ranges between 0 and 1, and the expected influence on the service indicators is positive since intermediaries with a higher share of complex insurance products in their portfolios have to meet higher requirements in the acquisition and transfer of information, which should lead to higher service intensity and performance.
- *Membership in a professional organization:* This dummy variable takes the value of 1 if the intermediary is member in a professional organization and 0 otherwise. Membership in a professional organization is often linked to the fulfillment of certain quality standards (e.g., minimum qualification level, rules of conduct, professional indemnity insurance), so it can signal a higher level of quality. Thus, a positive influence on the indicators is expected.

Summarizing, we formulate the following hypotheses:

H 1: According to the product quality hypothesis, independent agents show higher levels of service intensity and output performance compared to exclusive agents, as measured by the input and output quality indicators.

H 2: Service intensity and output performance are positively influenced by firm size, product range, share of complex insurance products in the portfolio, and membership in a professional organization.

A separating equilibrium may result in the market if the product quality hypothesis holds true: Independent agents may focus on more complex insurance products, while exclusive agents sell more standardized insurance products. To test the existence of such a separating equilibrium, we formulate hypothesis 3:

H 3: Independent agents are engaged in more complex insurance lines than are exclusive agents.

2.5 Results

Table 2.1 summarizes the main descriptive statistics that compare the mean values of the structural and exogenous, as well as the dependent variables for the groups of independent and exclusive agents, and the total sample.

Table 2.1: Descriptive Results

	Exclusive agents		Independent agents		Total	
	Mean	Median	Mean	Median	Mean	Median
Structural and exogeneous variables						
Number of customers	1565	1200	1106	575	1352	970
Qualification level (1-6)	2.75	2.00	2.75	2.00	2.75	2.00
Professional experience (years)	16.93	15.00	16.59	16.00	16.79	15.00
Firm size	2.94	1.5	5.08	2.00	3.83	1.5
Product range (1-9)	3.80	4.00	3.37	4.00	3.62	4.00
Share of complex insurance products	0.39	0.36	0.44	0.40	0.42	0.37
Member in a professional organization (0/1)	0.29	0.00	0.35	0.00	0.32	0.00
Time spent on counseling interviews (minutes)	81.10	75.00	103.70	90.00	90.48	90.00
Share of new customers	0.07	0.04	0.11	0.07	0.09	0.05
Input Indicators						
Working time information acquisition	0.21	0.20	0.35	0.30	0.27	0.25
Importance of rating agencies (1-5)	2.32	2.00	1.88	2.00	2.11	2.00
Design of risk analysis (1-3)	1.92	2.00	1.96	2.00	1.94	2.00
Documentation of counseling interview (0/1)	0.28	0.00	0.57	1.00	0.40	0.00
Output Indicators						
Contract conclusion rate	0.48	0.50	0.68	0.75	0.56	0.50
Lapse rate automobile insurance	0.0385	0.00	0.0180	0.00	0.0300	0.00
Share of turnover by new customers	0.24	0.20	0.31	0.20	0.27	0.20

Source: Own calculations.

The results for the structural variables show that exclusive agents have, on average, a larger client base: Tied agents act as agents for an average of 1565 customers, whereas independent brokers act on behalf of an average of only 1106 clients. The reason for this difference could lie in the lower commission levels and less time-intensive services by exclusive agents, which allow the agent to handle more clients. As to the qualification level and professional experience, the groups do not appear to differ: Both exclusive and independent agents show an average qualification level of 2.75, with the median being 2 (corresponding to the qualification level of *Versicherungsfachmann-/frau,* which is equivalent to a 230-hour theoretical and practical training course) for both groups. Both groups show a mean experience level of nearly 17 years.

Firm size clearly differs between the two types of agents: Exclusive agencies have 2.94 employees on average, while independent agencies are larger, with 5.08 employees at the mean. Both groups offer their customers a comparable *range of products* in addition to insurance products, but independent agents have a larger share of complex insurance products in their portfolios. Independent intermediaries are also more often *members in professional organizations*. Further, independent agents spend more time on counseling interviews.

We now turn to the discussion of differences in the input indicators between both intermediary groups. The bivariate results show, first, that independent agents spend 35 percent of their *working time* on *information acquisition*, whereas exclusive agents dedicate only 21 percent of their working time to the acquisition of information.[11] Independent agents also show a higher median value for this variable. Second, independent agents more often prepare a *record of the counseling interview* compared to exclusive agents, as measured by the mean value, and also show a higher median value for this variable.[12] According to the median values, both intermediary types do not vary regarding the *importance* they attach to *information by rating agencies*, and level of complexity with which the *risk analysis* is carried out. Regarding the output performance indicators, independent agents show a much higher *contract conclusion rate*, with 68 percent of all counseling interviews leading to a contract, as against only 48 percent for exclusive agents. Exclusive agents also show a higher *lapse rate* in the *automobile insurance line*, with 3.85 percent of all contracts canceled within the first year of the contract, compared to only 1.80 percent of all contracts canceled for independent

[11] According to the t-test, the differences between the mean values of the indicators all proved to be significant.

[12] The variable is binary, so a higher mean value indicates that the variable takes the value 1 in a higher number of cases.

agents. Finally, the *share of turnover* generated *by new customers* is higher for independent agents, who show a 31 percent rate of turnover compared to exclusive agents' rate of 24 percent. They also have a higher share of new customers in their portfolio (11 percent) compared to dependent agents, who show a mean value of 7 percent. This variable is measured by the ratio of new customers to the total number of customers.

In a next step, multivariate estimations show whether the differences between the groups continue to exist when the chosen exogenous variables are considered. Table 2.2 shows the results of models 1-4, which analyze the four input indicators. Table 2.3 presents the results of models 5-7, which analyze the three output performance indicators. Multicollinearity between the independent variables was tested before conducting the multivariate estimations, but no indication was found.[13]

[13] The use of self-reporting variables as considered in this study raises the problem of a possible response bias. Interviewees asked about their performance tend to exaggerate. However, it can be assumed that the response bias occurs for all interviewees similarly, i.e., that there is no systematic difference between the groups of exclusive and independent insurance agents.

Table 2.2: Estimation Results – Input Indicators

	Model 1: Working time information acquisition [1]	**Model 2:** Importance of rating agencies	**Model 3:** Design of risk analysis	**Model 4:** Documentation of counseling interview
Intermediary type	0.777***	-0.428***	0.043	1.155***
	(7.674)	(-3.706)	(0.381)	(5.414)
Firm size [2]	-0.043	0.001	-0.044**	-0.005
	(-0.631)	(0.103)	(-2.409)	(-0.384)
Product range	-0.039	-0.045	0.099***	0.127**
	(-1.521)	(-1.543)	(3.415)	(2.324)
Share of complex insurance products	0.229	-0.313	0.408*	1.187**
	(1.084)	(-1.290)	(1.746)	(2.630)
Member prof. organization	0.150	-0.281**	-0.160	0.347
	(1.460)	(-2.149)	(-1.363)	(1.561)
Professional experience [2]	0.165**			
	(2.492)			
Constant	-1.842***			-1.933***
	(-7.815)			(-6.054)
Estimation method	OLS	ML – Ordered Probit	ML – Ordered Probit	ML – Binary Logit
n	291	374	429	423
R^2 (adjusted)	0.1859			0.0839 [3]
LR statistic (Prob (LR stat))	12.039 [4] (0.000)	25.646 (0.000)	22.894 (0.000)	47.961 (0.000)

Note: *: significant at a 10 percent level; **: significant at a 5 percent level, and ***: significant at a 1 percent level; z- values in parentheses (t-values in case of model 1); [1] Measured in log-odds form; [2] Measured in log-form; [3] McFadden R^2; [4] F statistic and (Prob(F stat)); Estimated with "EViews 5.0".

Source: Own estimations.

Table 2.3: Estimation Results – Output Indicators

	Model 5 Contract conclusion rate	**Model 6** Lapse rate auto insurance	**Model 7** Share of turnover by new customers
Intermediary type	0.910*** (5.237)	-1.178*** (-3.748)	0.306 (1.560)
Firm size [1]	0.121 (1.206)	-0.013** (-2.039)	-0.522*** (-3.996)
Product range	0.131*** (3.379)	0.047 (0.630)	0.083* (1.837)
Share of complex insurance products	0.077 (0.237)	-3.619*** (-6.785)	1.277** (3.143)
Membership in a professional organization	-0.241 (-1.559)	0.299 (1.026)	0.602** (2.586)
Professional experience [1]	-0.111 (-1.122)		-0.072 (-0.480)
Time spent on counseling interviews [1]	0.531*** (3.651)		
Working time information acquisition	-0.157 (-0.319)	0.073 (0.083)	
Share of private customers		-1.698** (-2.688)	
Total lapse rate			6.058 (1.085)
Constant	-2.533*** (-3.649)	-4.326*** (-7.119)	-2.014*** (-3.999)
Estimation method	OLS	OLS [2]	OLS
n	278	273	181
R^2 (adjusted)	0.2204	0.1421	0.1795
F statistic (Prob (F stat))	10.791 (0.000)	7.434 (0.000)	6.625 (0.000)

Note: *: significant at a 10 percent level; **: significant at a 5 percent level, and ***: significant at a 1 percent level; All dependent variables are measured in log-odds form; [1] Measured in log-form; [2] White-heteroscedasticity corrected estimation; Estimated with "EViews 5.0".

Source: Own estimations.

The dependent variables range between 0 and 1 for model 1, model 5, and model 7. Since the variables are continuously distributed between 0 and 1, Ordinary Least Squares (OLS) regressions were estimated for these models. Because the range of the variable is limited to between 0 and 1, we expressed the dependent variables (y_i) in log-odds form (y_i') according to:

$$y_i' = \log (y_i/1-y_i), \qquad (2.1)$$

where the subscript i (i = 1,….,n) represents the single observations in the sample. By doing this, the dependent variable y_i' can take any real value, as y_i varies between 0 and 1. This allows the variable to accommodate to the requirements of an OLS-regression better (e.g., Papke and Wooldridge, 1996). The coefficient size may not be interpreted as a marginal effect if the dependent variable is transformed into log-odds form, but positive coefficients still imply that increases in independent variables correspond to increases in dependent variables, and vice versa. However, this approach has a shortcoming in that all cases in which the dependent variable takes either the value 0 or 1 are left out of the estimation, as the log-odds of the variable is not defined in those cases. However, in our study, this appears to be a problem only in the case of model 6, where the dependent variable *lapse rate of automobile insurance contracts* takes the value 0 in nearly 46 percent of all cases. To avoid this problem, a small, positive value (0.0001) was added to every observation of the dependent variable in this model. This is a common approach taken in the literature (e.g., Addison et al., 2001). The estimation results remain very stable compared to the approach in which the dependent variable had not been transformed.[14]

The dependent variables in model 2 and model 3 are ordinal variables ranging from 1 to 5, and 1 to 3, respectively. Thus, we estimate a Maximum Likelihood (ML) model for ordered variables (Ordered Probit). Finally, model 4 was estimated with a ML Binary Logit model, since the dependent variable is binary.[15] As models 2 to 4 are limited dependent variable models, the estimated coefficients cannot be directly interpreted as the marginal effects of the associated exogenous variables. However, the direction of the effect of a parameter's change can be deduced from the sign of the coefficients: positive parameter values imply that an increase of the exogenous variable will increase the probability that the counseling interview

[14] The results of the sensitivity test are available on request from the author.

[15] Detailed information about the Ordered Probit model can be found in Zavoina and McElvey (1975). The Binary Logit model is analyzed in detail, e.g., in Cox (1970). A general overview about limited dependent data analysis can be found in Agresti (1990).

is documented ($y_i = 1$) in the case of the Binary Logit model. In the case of the Ordered Probit models, a positive coefficient is interpreted in the following way: In model 2, it implies that, with an increase in the exogenous variable, the probability that the intermediary considers information by rating agencies as totally unimportant ($y_i = 5$) increases. Simultaneously, the probability that the intermediary attaches high importance to information from rating services ($y_i = 1$) decreases, but the probabilities of being in the intermediate categories could move in either direction. In model 3, a positive parameter value increases the probability that the intermediary uses a computer-assisted program to determine the customer's risk profile ($y_i = 3$) and decreases the probability that only a subjective classification of the costumer's risk profile is performed ($y_i = 1$). Again, the probability of being in the intermediate category could move in either direction.[16] Concerning the exogeneous variables, we use the logarithms of the exogenous variable *firm size* in the regressions. By this, we are able to model the hypothesis that the influence of this variables on the dependent variables may increase at an decreasing rate.[17]

Model 1 analyzes the influence of the independent variables on the *share of working time* spent on *information acquisition*. We additionally incorporate (the logarithm of) professional experience as an exogeneous variable into this model, as learning effects may lead to a negative impact of this variable on the time spent on information acquisition.[18] The results indicate that independent insurance brokers spend more of their working time on information gathering than do exclusive intermediaries. This can be interpreted to mean that they show a higher level of service intensity, as predicted by the product quality hypothesis. This result is highly significant at a 1 percent level. Surprisingly, the time spent on information acquisition slightly increases with an increasing professional experience. This may indicate that intermediaries are rather engaged in other activities during the first years of their career, e.g. in the acquisition of customers and in advertising activities.

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[16] We conducted further tests to check for possible heteroscedasticity of the residuals (e.g., Greene, 2003), and insignificant variables were omitted.

[17] Taking the logarithm of these variables does not alter the results; the same variables remain significant with unchanged signs of the coefficients. This holds also true for all other cases, where the logarithm of an exogeneous variable was taken into account.

[18] We further tested for the influence of the *share of new customers* as additional explanatory variable, as a higher share of new customers may lead to more time which must be spent on information acquisition. The variable did not show any significant influence on the results. Due to the possibility that this variable may be endogenous, we preferred to leave it out of the model.

Model 2 shows the result for the second quality indicator, the *importance intermediaries attach to the information delivered by independent rating agencies*. Again, independent intermediaries attach higher importance to information from independent rating agencies than exclusive agents do.[19] The coefficient is significant at a 1 percent level. As expected, the importance of independent information also increases with the *membership in a professional organization*, and the coefficient is significant at a 5 percent level.

The third model analyzes the *design of the risk analysis*. Here, independent intermediaries do not show a higher level of service quality. However, we find that a larger *product range* increases the probability that a computer-assisted risk analysis is conducted by the intermediary. A larger product range increases the requirements for information processing, so a more professional risk analysis is needed. *Firm size* does not show the expected sign: a growing firm size lowers the likelihood of a computer-assisted risk analysis, although the size of the coefficient is very small. The results also show that an increasing *share of complex insurance products* in the intermediary's portfolio increases the professionalism with which the risk analysis is carried out.

Model 4 approximates the level of service quality based on whether a *record of the counseling interview* is prepared by the intermediary. Independent insurance brokers are more likely to make a record after a counseling interview. This relationship is highly significant at a 1 percent level. Further, as expected, a larger *product range* in the intermediary's portfolio raises the likelihood of record-keeping, showing a 5 percent significance level. The *share of complex insurance products* in the intermediary's portfolio also has a positive influence on the service quality, a relationship which is also significant at a 5 percent level.

In addition to models 1-4, which seek to explain input indicators, models 5 to 7 use output performance indicators. Model 5 analyzes the *contract conclusion rate* after counseling interviews. We incorporate two additional variables into this model: the share of *time spent on information acquisition*, as well as the average *length of the counselling interviews* should have a positive influence on the contract conclusion rate, as more time is spent to evaluate the needs and preferences of the customers, and to obtain information about eligible products and providers.[20] Independent insurance agents realize higher contract conclusion rates compared to exclusive agents (level of significance: 1 percent). Further, the contract conclusion rate

[19] According to the coding of the variable *importance rating agencies*, negative (positive) coefficients indicate a positive (negative) impact on service quality.

[20] The variable *average length of counselling interview* was incorporated as logged variable.

increases with a growing *product range* in the intermediary's portfolio, as could be expected. The *length of the counselling interview* also shows the expected positive influence on the contract conclusion rate, but no influence can be found for the *share of working time* which is spent on *information acquisition.*

Model 6 uses the second output quality indicator, the *lapse rate in the automobile insurance line*. This insurance line is well suited for an analysis of the lapse rate, as automobile insurance contracts can be canceled comparatively easily at low cost, and significant lapse rates can be found in this insurance line.[21] An additional exogenous variable which measures the share of private customers in the intermediary's portfolio (*share of private customers*) was included in this model because automobile insurance contracts are usually signed by private customers. Thus, this variable should be tested for the influence of the intermediary's specialization on private customers. We further included the share of *working tim*e which is spent on *information acquisition*, as a larger share of time which is spent on information acquisition may lead to a better product choice.

The results show that being an independent insurance broker lowers the chance of automobile insurance policies' being canceled, indicating a better product choice by independent insurance agents compared to exclusive ones (level of significance: 1 percent).[22] Further, a larger *share of complex insurance products* shows the expected influence on service quality: the lapse rate is reduced, with the relationship significant at a 1 percent level. This result shows that a large share of complex insurance products has a positive influence on the service quality of the intermediary, and that the effect also results in a lower lapse rate in the case of a more standardized insurance line like private automobile insurance. The variable *share of private customers* shows a negative coefficient (level of significance: 5 percent), indicating that intermediaries with a larger share of private customers have a lower lapse rate in the automobile insurance line. This effect might be explained by learning and experience

[21] However, it has to be noted that the mean of the lapse rate is 3.85 percent for exclusive agents and 1.8 percent for independent agents. Thus, the differences are rather small. We also examined lapse rate in long-term, more complex insurance lines (e.g., private health insurance, long-term life insurance policies). In all cases, the lapse rates were even smaller, and the models proved not to be significant overall. A reason for this result could be that cancelation of these kinds of insurance incurs much higher costs for the customer. Further, these insurance types are credence goods exhibiting large information asymmetries, which could also explain why the lapse rates are much smaller than those of the more standardized private automobile insurance.

[22] According to the coding of the variable *lapse rate auto insurance* negative (positive) coefficients indicate a positive (negative) impact on service quality.

effects, which are realized with an increasing number of customers in a certain insurance line. A larger *firm size* also shows the expected negative effect on the lapse rate, although the size of the coefficient is very small. In contrast to our expectations, more *time* which is *spent on information acquisition* does not lead to a lower lapse rate.

Finally, Model 7 analyzes the dependent variable *share of turnover* generated *by new customers*. An additional exogenous variable which measures the (logarithm of) professional experience of the intermediary in years (*professional experience*) was included in this model. It is important to test the influence of the intermediary's professional experience in this case, as it can be hypothesized that intermediaries gain a larger share of their turnover from new customers at the beginning of their career because of the need to build a customer base. Thus, intermediaries with a longer working experience should obtain a smaller part of their turnover by new customers. Further, it is important to test for the influence of the share of contracts which were canceled in the period (*total lapse rate*) in case this variable shows a positive influence on the share of turnover, indicating a lower, not higher, level of service quality. In that case, it would not indicate high growth resulting from a higher quality of service, and the variable could not serve as an indicator for the output quality.

The results of the model demonstrate that a higher share of turnover does not result from the cancelation of contracts by existing customers, since the included variable *total lapse rate* has no influence on the share of turnover by new customers. Hence, the share of turnover by new customers can be interpreted as serving as an indicator for higher growth and for higher output quality, as hypothesized. In this model, independent brokers do not have a higher share of new customers, i.e., independent agencies do not grow faster compared to dependent agencies. However, the exogenous variables *product range*, s*hare of complex insurance products* and *membership in a professional organization* show the expected positive influence on the share of turnover by new customers. A broader product range and the focusing on complex insurance products lead to a higher demand by new customers, which may be explained by the increasing need of customers for old-age and health provision. Also, being a member in a professional organization leads to a higher share of turnover by new customers, indicating that this variable may serve as an indicator for higher quality and better service, by this attracting new customers. Unexpectedly, an increasing *firm size* lowers the share of turnover generated by new customers.

Summarizing, independent agents usually provide a higher level of service intensity, as measured by the input indicators. Further, this higher level of input activities, at least to some extent, translates into higher levels of output indicators; i.e. better performance of independent intermediaries. Thus, there seems to be evidence to support hypothesis 1: five of seven models indicate that the product quality hypothesis holds true.

As to the additional exogenous variables, the *share of complex insurance products* has a positive influence on the indicators measured in four of seven models. In the case of the input indicators, this influence may be explained by the fact that, for complex insurance products, intermediaries have to meet higher requirements in the acquisition and transfer of information. In the case of the output indicators, a larger share of complex insurance products results in a lower lapse rate, indicating a better product choice by those intermediaries. Further, the share of turnover by new customers increases with a larger share of complex products, which may reflect an increasing demand for complex insurance products in the fields of old-age and health provision. The expected positive influence on the analyzed indicators is also found for *product range*: A larger product range raises the values of the indicators in models 3-5, and in model 7, which might indicate economies of scope realized during the acquisition and processing of information, since information about a customer's profile can be used for different products. *Membership in a professional organization* shows the expected influence on the level of service intensity and the performance in two cases (models 3 and 7), which only partially confirms that intermediaries who meet the requirements for a membership in a professional organization deliver a higher service quality to their customers. The limitation of the positive influence of this variable to only two models may be explained by the fact that the different professional organizations vary in the level of requirements they impose on their members; hence, it may be that membership in a professional organization works only to a limited amount as a quality-signaling instrument. Finally, *firm size* does not seem to have a relevant positive influence on the indicators, it even shows a negative influence in two cases; so the expected presence of increasing returns to scale during the acquisition and processing of information does not seem to be associated with a higher level of service intensity or performance. Thus, there seems to be evidence that supports hypothesis 2 as well: With the only exception of the exogeneous variable *firm size*, all the additional exogenous variables show the expected positive influence on the indicators, although to a different extent.

As for hypothesis 3, the theoretical considerations in section 2.2 suggest that, if the product quality hypothesis holds true, there should be a separating equilibrium in the market for insurance intermediation in which independent agents would mediate more complex and less standardized products, and exclusive insurance agents would focus on selling more standardized products. Table 2.4 shows sample means of the share of single insurance lines in the intermediaries' portfolio for the groups of exclusive and independent agents.

Table 2.4: Shares of Turnover in Different Insurance Lines

	Exclusive agents	Independent agents	Total
Complex insurance lines			
Industrial insurance			
Mean	0.0153	0.0228	0.0186
(SD)	(0.1126)	(0.1055)	(0.1094)
Old-age provisions			
Mean	0.2305	0.2664**	0.2454
(SD)	(0.1965)	(0.2260)	(0.2098)
Commercial insurance			
Mean	0.0645	0.0876**	0.0742
(SD)	(0.0969)	(0.1084)	(0.1024)
Private health insurance			
Mean	0.0976	0.0658**	0.0843
(SD)	(0.1645)	(0.0925)	(0.1398)
Standardized insurance lines			
Private property insurance			
Mean	0.2330	0.1784**	0.2170
(SD)	(0.1403)	(0.1296)	(0.1392)
Automobile insurance			
Mean	0.2521	0.2502	0.2513
(SD)	(0.1805)	(0.1829)	(0.1813)
Private indemnity insurance			
Mean	0.1337	0.1544	0.1398
(SD)	(0.0869)	(0.1177)	(0.0971)

Note: **: Differences in mean values between groups of exclusive and independent agents significant at a 5 percent level; Turnover is measured by the ratios of placed insurance policies in the different insurance lines to the total number of placed policies.

Source: Own estimations.

Industrial insurance, old-age provisions, commercial insurance, and private health insurance serve as proxies for complex insurance lines, and private property insurance, automobile insurance and private indemnity insurance represent more standardized insurance products. We tested for significant differences in the sample means by applying parametric t-tests.

The results partly confirm the hypothesis of a separating equilibrium: As expected, independent agents show significantly higher shares of turnover in complex insurance lines like old-age provisions and commercial insurance lines. By contrast, exclusive agents show significantly higher shares of turnover in the more standardized private property insurance line. Surprisingly, exclusive agents show a significantly higher share of turnover in the private health insurance line compared to independent agents. This contrasts with our expectation that independent agents would dominate in this complex insurance line. An explanation could be that respondents included more standardized additional health contracts (e.g., additional travel health or dental health insurance contracts) with full-coverage private health insurance contracts under the category of private health insurance contracts. In the case of automobile insurance contracts, which are more standardized, a predominance of exclusive agents was expected, but there is little difference between the share of turnover in both groups, a finding which may be because automobile insurance contracts are often used as a first contact with customers, with the aim of building up a long-term relationship. Thus, both types of intermediaries are interested in selling this type of insurance.

The analysis of the share of turnovers in different insurance lines shows that independent agents are over-represented in some complex insurance lines. However, according to our data, exclusive agents do not sell primarily standardized insurance products.

2.6 Conclusions

The coexistence of two different distribution systems in insurance markets has often been a subject of research in the past. In this study, the situation in the German market for insurance intermediation is analyzed: Until the liberalization of the European insurance markets in 1994, exclusive, firm-owned agents were the dominant distribution channel in the German market but, since then, independent agents have gained importance. As a consequence of market liberalization and deregulation, the number of insurance products and providers has increased. At the same time, private health and old-age provision is gaining importance, as the public health and pension coverage is declining. Both facts lead to an increasing demand for intensive counseling and high-quality advisory services by the customers. This study provides an answer to the question of whether independent insurance intermediaries are better able than dependent agents to perform these tasks, and to mediate complex insurance products.

Two hypotheses seek to explain the coexistence of the two distribution systems: According to the market imperfections hypothesis, the more cost-intensive independent distribution channel does not deliver higher service quality but exists only because of persisting information asymmetries. On the other hand, the product quality hypothesis accredits a higher level of service intensity and product quality to independent agents, leaving both intermediary types to coexist in a separating equilibrium.

To prove the product quality hypothesis, the service intensity and the performance by independent and exclusive agents is analyzed using a demand-oriented approach. The results of an online survey among 608 German insurance intermediaries are used to obtain indicators for the service intensity (input indicators) and the performance (output indicators) of the intermediaries, and the influence of the intermediary type and other exogenous variables on the indicators is analyzed.

The results of our analysis show that the product quality hypothesis holds true in the German life insurance market when exclusive and independent insurance intermediaries are compared with each other: In five of seven analyzed models, independent agents show higher levels of both input and output indicators compared to exclusive agents, thus providing evidence for superior service intensity, and performance. Service intensity and performance also increase with a growing *share of complex insurance products* in the intermediary's portfolio, and the *number of additional services* an intermediary provides has a positive effect on the quality indicators. This result has also been found by Eckardt (2007), where the number of additional services an intermediary provides had a positive influence on the provided information quality and the contract conclusion rate.

Positive influence of *membership in a professional organizatio*n is limited to two models. A possible explanation for this comparatively weak effect may lie in the large differences in the requirements imposed on members of professional organizations. Also, Eckardt (2007) found that the influence of a membership in a professional organization on the contract conclusion rate of an insurance intermediary depends on the rationale of the intermediary for being in the professional organization. Finally, the effect of *firm size* on the measured quality indicators is also weak, a result previously confirmed by an empirical study on the U.S. insurance market that found only limited evidence for the realization of economies of scale in insurance agencies (Barrese and Nelson, 1992). Eckardt (2007) also failed to find evidence for positive influence of firm size on information quality and contract conclusion rate in her study.

The analysis of the insurance portfolios further indicates that the existence of a separating equilibrium in the market can be at least partially confirmed. Independent agents show larger market shares in most complex insurance lines, whereas the dominance of exclusive agents in more standardized lines is supported only for private property insurance.

However, due to missing information about the total population, the possibility of a selection bias cannot be excluded. Thus, as a task for future research, the survey could be re-conducted based on information obtained from the newly created central register for insurance intermediaries. From 2009 on, this register will contain information about every insurance intermediary operating in the German market (Bundesministerium der Justiz, 2007).[23] By this, it would be possible to test the sensitivity of the results to the sample selection.

Summarizing, independent agents seem to be able to deliver higher service intensity which translates into better performance, which is of special importance in complex, long-term insurance lines. This higher level of service intensity and output performance can explain the growing importance of this distribution channel after the liberalization of the market. As the importance of complex insurance products is expected to increase further in the future (particularly in the fields of private old-age and health provisions), it can also be expected that the importance of independent insurance agents will continue to increase in the German market.

[23] In 2007, the European Directive on Insurance Intermediation (EC/2002/92) (EC, 2002b) was implemented in the German market. Since then, every insurance intermediary operating in the German market has to be registered and meet a minimum qualification level. Further, they must hold professional indemnity insurance or a comparable guarantee. Finally, the directive introduced new information requirements for intermediaries, and a duty for documentation of counseling interviews.

3 Single- versus Multi-Channel Distribution Strategies in the German Life Insurance Market: An Analysis of Cost and Profit Efficiency†

3.1 Introduction

Following the liberalization of the European insurance markets in 1994, German insurance markets were deregulated. This has allowed insurance companies to choose their prices (premium levels) freely, which has led to increasing price competition in the German insurance sector. In addition, insurers are no longer required to acquire authorization for the design of their products from the regulatory agency, which has led to a greater variety of products in the market. Both effects are intensified by the introduction of the European Single Market, which has enabled European insurance firms to operate throughout the EU under a single license. Further, new insurance products have been created as a result of the German government's promotion of the private old-age provision.

These developments were supposed to have a strong impact on the structure of the distribution systems of German life insurance firms, which had been dominated by exclusive, firm-owned agents. The increased price competition was expected to lead to a rise of lower-cost direct distribution channels (e.g., Muth, 1993), backed by technological progress, which permits selling of insurance products via the internet (e.g., Cattani et al., 2004). The increased product variety has also led to the hypothesis that distribution by independent insurance brokers would become more important in the German market, as these agents are able to compare a higher number of insurance products and so deliver higher service quality to their customers (e.g., Finsinger and Schmid, 1993). The rising importance of the private old-age provision in the German market should reinforce this development, as customers' need for counseling, which is better met by independent agents, increases (see chapter 2 and Eckardt, 2007).

Both expected changes have been reflected in the development of the German life insurance distribution since the liberalization. Direct distribution and distribution via independent agents have gained importance while distribution via exclusive agents has decreased. Specialized insurance firms using exclusively direct distribution or independent

† I would like to express my gratitude to the participants of the X European Workshop on Efficiency and Productivity Analysis for helpful comments and discussions and especially to Christian Growitsch for participation and support.

agents show only a small increase in their market shares, while most German life insurance firms, which have traditionally distributed their products through dependent agents, now use a multi-channel distribution strategy of direct, exclusive, and independent channels.

The aim of this paper is to analyze specialized insurers versus multi-channel distribution channels in the German life insurance market by comparing the performance of both distribution systems. According to previous studies, specialized suppliers should be superior to multi-channel insurers if they were able to realize either cost advantages by being direct insurers or an advantage in terms of quality by distributing via independent agents.

Methodologically, these hypotheses can be tested by analyzing the firms' cost efficiency to identify organizational cost advantages and profit efficiency to account for presumable quality related price differences. Our data set of German life insurance firms was taken from periodically published industry reports for 1997-2005. Company-specific efficiency scores are estimated by using efficiency-frontier estimation to compare cost and profit efficiency levels. Thereby, it is possible to analyze multidimensional input-output technologies. The non-parametric DEA is employed since it does not require a priori specification of a functional form of the production function making it a very flexible instrument concerning the modelling of the industry's technology (Charnes et al., 1978). Here, the production function is calculated from all existing input-output observations.

Our paper contributes to the literature on insurance organizations and market economics in two ways: First, research on the coexistence of different distribution systems in life insurance industry is broadened by our study, as, to our knowledge, we are the first to compare different types of single- and multi-channel distribution insurers. While previous research has been limited, to a large extent, to the comparison of exclusive and independent agency insurers (e.g., Berger et al., 1997; Klumpes, 2004), our research adds a new facet to the discussion about the coexistence of distribution channels in insurance markets by comparing different types of single- to multi-channel distribution strategies. This paper also contributes to the explanation of the German insurance market's structure. Up to now, analyses of differences in the structure of German insurance firms have focused on the influence of the ownership structure (Ubl and Diboky, 2007), but the question of the influence of distribution systems on the performance of companies in the German insurance industry has not been addressed.

Our study also provides insight into the situation of the German life insurance industry after the liberalization of the German insurance industry in 1994 by analyzing cost and profit efficiency, and tackles the question if scale economies in the German insurance industry exist.

Fenn et al. (2008) investigated the cost and profit efficiency of European insurance firms and reported country results, although without differentiating among life insurance firms, property-liability insurance firms, and health insurance firms on country levels. Ubl and Diboky (2007) analyzed the cost efficiency of German life insurers from 2002 to 2005 but did not provide profit efficiency levels or results for scale economies. Mahlberg and Url (2007) also analyzed cost efficiency levels of German insurance firms but, again, made no distinction among the different insurance lines. Finally, Hussels and Ward (2004) analyzed cost efficiency for a small sample of German life insurance firms over the period 1991-2002. They applied a DEA analysis to a randomly chosen, balanced panel of 31 German life insurers which persisted in the industry over the whole sample.

The paper is organized as follows: section 3.2 provides an overview of the German life insurance industry and its distribution structure. In section 3.3, we present the hypotheses and give an overview of earlier studies. Section 3.4 illustrates the methodology and our modelling approach. In section 3.5, the data and the estimation model are described. Section 3.6 presents the results of our efficiency estimations. Conclusions are drawn in section 3.7.

3.2 The German Life Insurance Industry

3.2.1 Size and Structure of the German Life Insurance Industry

In 2005, the German life insurance market ranked fifth in the world and fourth in Europe in premiums with a volume of 72600m €. While the U.S. market remains the biggest market on a country level, in Europe, only the U.K., France, and Italy show larger life insurance premium volumes than Germany (SwissRe, 2006). Total invested assets in the German life insurance industry were 642812m € in 2005, representing 27.6 percent of the GDP. German life insurance premium income represents 48 percent of total premium income in the German insurance industry (GDV, 2006) and 3.1 percent of GDP. The number of life insurance firms active in the German market declined slightly during our observation period, from 119 in 1997 to 115 in 2005 (Bafin, 2006).[24] Most of the reduction can be explained by merger and acquisition (M&A) activities as a consequence of the liberalization of the German insurance market in 1994.

[24] We consider only life insurance firms which are active in the retail insurance market, although there are also pension funds and friendly societies in the German market. The majority of these companies provide occupational retirement benefits for employees. (See Maurer and Somowa, 2007.)

With regard to ownership, several different organizational structures can be found in the German life insurance industry, including stock companies, mutuals, and publicly owned firms. Most are stock companies, followed by mutual insurance firms and insurers under public law (Maurer and Somowa, 2007).

Among the insurance products in Germany, individual endowment policies are the most important products, accounting for 63.4 percent of total life insurance premium income in 2005. Within this group, the predominant products are cash-value life insurance policies, which account for 51.2 percent of total life insurance premium income. Index- and unit-linked endowment policies play a subordinate role in the German market, with 7.4 percent of total premium income. The second most important group is life annuities, with a market share of 30.1 percent of the total premium income and unit-/index-linked annuities accounting for 6.1 percent of that. A third group, pure term life policies, accounts for 4.8 percent of total premium income. Life insurers also offer so-called supplementary policies, which are sold in addition to disability or private accident policies, for example. Supplementary policies represented 28 percent of all insurance policies sold by life insurance firms in 2005, but accounted for only a small part of the premium income (GDV, 2006).

Endowment policies and participating policies play a very important role in the German market as private old-age provision instruments. There are about 55 million endowment policies in the German market, bringing the total number of life insurance policies (excluding supplementary policies) to over 94 million policies. The attractiveness of these endowment products can be traced back to the fact that (under certain requirements) increases in the cash value of cash-value policies were free from taxation until the end of 2004. Although they became taxable in 2005, several governmental programs are likely to foster the demand for private life insurance products. First, tax inducements for occupational pension provisions were established. Second, the so-called Riester pension reform (established in 2002), and the Rürup pension plans (established in 2004), both subsidized by the government, are thought to encourage private old-age provisions by which individuals can invest part of their income in individual pension accounts on a pre-tax basis. These programs are thought to compensate for the cut in benefits from the public pension systems (see also Maurer and Somova, 2007).

3.2.2 Distribution Channels in the German Life Insurance Industry

In the following the structure of distribution channels in the German insurance market is reported. A distribution system can be defined as "the network of people, institutions or agencies involved in the flow of a product to the customer, together with the informational, financial, promotional and other services associated with making the product convenient and attractive to buy and rebuy" (O' Shaughnessy, 1988, p. 298). German insurers are not obligated to reveal the structure of their distribution system in detail, so detailed figures about the contribution of single distribution channels to the insurance business are not available. Even so, we can derive the structure of an insurance company's distribution systems from its annual financial statements.

Before 1994, in the German insurance industry as a whole, but especially in the life insurance sector, distribution via exclusive agents had been the dominant distribution channel. Exclusive (or tied) agents are allowed to sell only the products of specific insurance firms or groups, although these agents are usually self-employed. This distribution channel dominated because of the strict regulation of the German insurance sector before 1994, which prescribed minimum premium levels. Thus, insurers were interested in maximizing sales, which could be best achieved by a large own sales force (e.g., Finsinger and Schmid, 1993).

In addition to exclusive agents, the majority of German life insurers also use independent insurance agents and insurance brokers to distribute their products. Both of these are free to choose the products they sell and the companies with which they work and, while exclusive agents act predominantly on behalf of the insurer, independent agents and insurance brokers act predominantly on behalf of the customer (e.g., Bosselmann, 1994).

A third distribution channel is the bank branch network, which was used primarily by German public insurance companies (e.g., Provinzial Lebensversicherung, which distributes its products via German savings banks) but is increasingly used by many private life insurance firms (e.g., Allianz Lebensversicherung, which acquired Dresdner Bank in 2001 and, since then, has sold its products through that bank). Life insurers also use direct distribution channels to sell their products. Direct distribution encompasses all distribution channels in which insurance products are sold to the customer without any direct contact with a salesperson. The internet has become the main direct distribution channel, but insurance products may also be sold via telephone, television or mail.[25]

In total, the premium income of German life insurers was distributed as follows in 2005: Exclusive agents accounted for 27.1 percent of premium income, independent agents and insurance brokers for 32.4 percent, the distribution via banks for 24.8 percent, and the distribution via direct channels for 5.5 percent (Tillinghast, 2006a).[26] According to Tillinghast, the distribution via independent agents outperformed the exclusive distribution channel in the German life insurance market in 2005 for the first time. This result has to be treated carefully, as so-called multi-level marketing (*Strukturvertrieb*) accounts for 7.0 percent of the premium income and was recorded separately. If the distribution via multi-level marketing is treated as a special form of exclusive selling, exclusive and independent agents show very similar levels of premium income (Tillinghast, 2006a).

Nevertheless, it can be stated that the distribution via exclusive agents is decreasing. In 2002, the exclusive agents still showed a premium income share of 39.6 percent, while independent agents accounted for 24.5 percent and distribution via bank offices remained stable. However, distribution via direct channels increased from 2.4 percent in 2002 to 5.5 percent in 2005 (Tillinghast, 2004).

Approximately 85 percent of life insurance firms in Germany use a multi-channel approach that combines at least two channels: mainly exclusive and independent agents or insurance brokers. However, an increasing number of life insurers also incorporate direct distribution channels and distribution via bank offices into their systems. By contrast, specialized life insurance firms in the German market use only a single distribution channel. Among these, one of two single-distribution approaches is most likely: Direct insurers which exclusively distribute their products without the use of salespeople and independent agency insurers which distribute exclusively through independent agencies and insurance brokers. The

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[25] It is important to distinguish *direct distribution* from the broader concept of *direct marketing,* as the latter term decribes “any communication (advertising or direct mail) that invites the potential customer to communicate directly (via mail or telephone) with the company” (Easingwood and Storey, 1996, p. 227), whereas direct distribution means that the policies are sold without the use of any salesperson.

[26] These numbers are based on a survey conducted by the international consultancy Tillinghast Towers Perrin. 43 life insurers participated in 2002, representing approx. 76 percent of the German life insurance market. 51 German life insurers participated in the survey in 2005, representing approx. 75 percent of the German life insurance market. Information about the missing firms was complemented by Tillinghast based on information from annual statements and their own market knowledge. Premium income was measured by the Annual Premium Equivalent, which represents the sum of the current premium payments and 10 percent of the single premiums in a year (Tillinghast, 2004, 2006a).

number of direct insurers remained stable over the observation period with 8 direct life insurers in 1997 and 9 in 2005. As for independent agency insurers, 10 were in the market in 1997 and 9 in 2005.

The Tillinghast survey reported aggregate market shares only for single distribution channels and did not state whether the reported premium income by the different channels was generated by multi-channel distribution insurers, direct insurance firms or life insurers working only with insurance brokers. Our own data set, which will be described in section 3.5.1, shows that premium income by direct insurers amounted to 3.3 percent in 1997 and had increased to 4.3 percent in 2005; among independent agency insurers, the premium income was 4.5 percent in 1997 and had increased only to 5.0 percent in 2005; and the remaining premium income was generated by multi-channel insurance firms. This shows the large dominance of multi-channel distribution compared to insurers that use specialized distribution systems.

3.3 Single- versus Multi-Channel Distribution Systems ─ Hypotheses and Previous Evidence

3.3.1 Hypotheses

The aim of this paper is to analyze the reasons for the development of the market shares of specialized insurers and multi-channel distribution channels in the German life insurance market by comparing the performance of both distribution systems. We begin with a theoretical discussion of the advantages and disadvantages of multi-channel distribution systems and the two single-distribution channel systems, and then derive the hypotheses to be tested in this study.

Multi-channel insurers: A multi-channel approach allows insurance firms to extend their market coverage by employing various distribution channels (Coelho and Easingwood, 2004). The German life insurance market has an increasing number of products as a consequence of the industry's liberalization and an increasing demand for private old-age provisions. A multi-channel approach also allows the insurer to share knowledge and information about customers among its channels (Easingwood and Coelho, 2003). In addition, an insurer which uses multiple channels can also target many different customer segments and reach new customer segments more efficiently. Chen et al. (2002) showed in a formal model that the incorporation of an online channel may increase the insurer's ability to price-discriminate between users and non-users of the channel, leading to increased profit. Moreover, the use of multi-channel distribution may be more able to meet the needs of existing customers because existing customers can purchase the firm's products via the channel that suits them, depending on the characteristics of the product and their preferences (Tsay and Agrawal, 2004). Thus, firms with broad product lines will particularly benefit from the distribution via multiple channels (Webb, 2002). The customers may also save on search costs or transaction costs by holding a multiple-product relationship with a single insurance firm. Wallace et al. (2004) observed that a multiple channel distribution strategy serves as an instrument by which to increase customers' satisfaction and customer loyalty, which is of particular importance in an increasingly competitive environment like the liberalized German insurance market.

Finally, the use of multiple channels enables insurance firms to reduce risks which can specifically arise with a single-channel distribution strategy. Multi-channel insurers are better able to react to a changing environment, e.g., changing consumer preferences or rising competition. The use of additional channels may prevent incumbents from losing market shares to new rivals which enter the market via specialized channels at low prices. Dutta et al. (1995) contended that the introduction of an additional channel may represent a safeguard against lock-in problems with existing channels and that multiple channels facilitate the firm's ability to evaluate the performance of the different channels. Kumar and Ruan (2006) found that the addition of a direct channel (an online channel or an exclusive agency channel) may help increase the level of support from existing independent retail channels (independent agencies or brokers).

There are also potential disadvantages to the use of multiple channels by life insurers. Cost disadvantages can arise because of the high investment costs necessary to establish an additional distribution channel and to coordinate between the channels (Easingwood and Storey, 1996). The insurer also runs the risk that newly established distribution channels will not be accepted by the customers or that customers will make use of new distribution channels (e.g., direct marketing channels) only to inform themselves, while using the established channels (e.g., exclusive agents) to purchase the product. This problem is also known as channel cannibalization: instead of increasing turnover and profits, additional channels simply redirect turnover from one channel to another (e.g., Dzienziol et al., 2002).

Direct insurers: Direct-distribution insurers have the advantage that they are able to provide their services at lower costs compared to insurance firms which use agents, bank branches and other third parties to distribute their products. Cost advantages result from the absence of commission costs, which leads to lower operating expenses (Opex). Moreover, they save the large fixed costs of establishing a distribution network through constructing their own branches or bank branches.[27] This cost advantage allows direct insurers to offer lower premiums. A potential disadvantage of this distribution system lies in the fact that the more complex insurance products are difficult to sell without personal advice by an intermediary or staff member at a branch office. As life insurance products tend to be complex, the growth of direct life insurance firms could be limited as a result of the missing personal contact between insurance firm and customers (e.g., SwissRe, 2000). Further, insurers which enter the market must incur high marketing costs for customer acquisition and the creation of a well known brand (e.g., Ennew and Waite, 2007). By making use of a new technology, most direct insurers are new entrants to the market. Limited growth in a highly competititve market combined with high investments for the establishment of the firm can prevent a new entrant from realizing possible economies of scale. However, scale effects are of major importance in the insurance industry because insurers face relatively large fixed costs in computer systems and financial capital, and because the industry operates on the basis of the law of large numbers: the larger the policy portolio of similar risks, the better the insurance firm is able to assess the risks and to lower risk volatility (e.g., Cummins and Rubio-Misas, 2006).

Independent agency insurers: In the U.S. insurance market, independent agents have higher expenses because of the structure of the relationship between the insurance company and the different types of agents: In contrast to dependent agents, independent agents own their individual client lists and have the right to policy renewal, so they directly contact the customer at the end of the contract period and decide which of the insurers represented will receive the renewal business. By contrast, with exclusive agents, it is the insurance company which decides on the renewal of an insurance policy. Therefore, typically, independent agent renewal commissions are higher than the commission level in exclusive distribution systems since the insurer must ensure that an independent agent acts in its sense and does not move the client to another insurer. Thus, insurers incur higher monitoring costs in case of dealing with independent agents (Barrese and Nelson, 1992). In the German insurance market, the independent agent does not own his or her client list, and it is the insurance firm which decides on the renewal of the contract (e.g., Grieß and Zinnert, 1997). Even so, independent agents usually receive high commission levels from the insurance firms to ensure that the

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[27] For a formal analysis, see the model of direct banking by Neuberger (2007), which can be applied to the case of direct insurers.

independent agent places the most profitable business with them (e.g., Scheiper, 1996; Zweifel and Eisen, 2003; Dahmen, 2004). However, to our knowledge, there is no study which analyzes costs incurred by different distribution channels for the German insurance market.

According to the literature, insurance brokers are able to compensate their high cost levels with a higher level of service quality compared to other distribution channels. The higher level of service quality can be analyzed from the insurers', as well as from the customers' point of view. From the insurers' perspective, the use of independent agents enables insurers to reduce transaction costs and to write more profitable business (Anderson et al., 1998). The lower transaction costs from independent agents occur because they face higher incentives to perform detailed risk analyses. (For more details, see Regan and Tennyson, 1996; Regan, 1997). From a customers' point of view, the higher quality from independent agents results from a reduction in search costs (Posey and Tennyson, 1998), a better market overview, and better monitoring of the insurer for, for example, appropriate coverages, low prices, and financial stability (Regan, 1997). Mayers and Smith (1981) and Barrese and Nelson (1992) also stated that independent agents are better able to deal with insurers when there is a conflict with the policyholders, as they can threaten to move the customer to another insurer. Venezia et al. (1999) stated that independent agents provide better claims services in case of a loss. These better claims services are also explained by the fact that independent agents can threaten to switch their clients to a different insurer. Because of their higher costs and ability to provide higher service quality, independent agency insurers tend to focus on complex, counseling-intensive insurance products and compensate for their higher costs with higher revenues which result from higher service quality (e.g., Berger et al., 1997). Thus, the use of independent agents by an insurance firm is justified, if the distribution via this channel is able to generate higher revenues resulting from a higher level of quality by the independent agents.

To explain the distribution structure and the coexistence of different distribution channels in the German life insurance industry we compare the performance of two different single-distribution channels with the multi-channel distribution approach. Insurers' performance is measured in terms of both costs and profits, while the latter implicitly incorporates aspects of service quality. Thus, our approach allows an analysis of the different distribution strategies' total economic performance, as we allow higher costs to be compensated for with higher prices/revenues resulting from higher service quality.

The performance comparison is carried out by testing two sets of hypotheses. To compare direct with multi-channel insurers, we derive the following hypotheses from our theoretical considerations:

H 1: Direct insurers are more cost efficient than multi-channel insurers.

The second single-channel distribution strategy - independent insurers - is compared to multi-channel insurers by testing the following hypotheses:

H 2.1: Compared to multi-channel insurers, independent agency insurers are less cost efficient because of the higher costs of the independent agency system.

H 2.2: By focussing on high quality services, independent agents insurers are able to realize higher revenues, which leads to similar or higher levels of profit efficiency.

If we find evidence for the presented hypotheses, specialized single-distribution strategies will be shown to be superior to broader multi-channel distribution systems; by focussing either on a cost or on a quality advantage, direct and independent agency insurers would outperform multi-channel distribution insurers. By contrast, if we must reject hypotheses 1 and 2.2, the advantages of a multi-channel distribution system outweigh its disadvantages; a broad multi-distribution strategy would then be superior to single-channel distribution strategies and would explain why specialized single-distribution channel insurers have not gained a larger market share.

3.3.2 Previous Evidence

The coexistence of different distribution systems has been the subject of several empirical studies. However, most of these studies focus on the comparison of exclusive-agency insurers versus independent-agency insurers. Joskow (1973) found that American insurers working with independent agents incurred much higher costs than did insurers using exclusive agents. Cummins and VanDerhei (1979) and Barrese and Nelson (1992) also found support for higher underwriting costs of independent agency insurers compared to an exclusive distribution system. However, none of these three studies compared the (average) profit levels of both systems. Barrese, Doerpinghaus, and Nelson (1995) incorporated a quality dimension into their analysis by using private passenger automobile insurance complaint data as a proxy for service quality. According to their study, American independent-agency insurers in the private passenger automobile insurance line provided higher service quality compared to exclusive-agency insurers. Berger et al. (1997) analyzed a sample of 472 U.S. insurers and concluded that exclusive agency insurers were more cost efficient, but this performance advantage disappeared when revenues are taken into account. Brockett et al. (2005) also found that U.S. property-liability independent agent insurers were more revenue efficient than a second group of exclusive-agent and direct insurers. Finally, Klumpes (2004) analyzed a sample of U.K. life insurance firms and estimated cost and profit efficiency levels. In contrast to Berger et al. (1997) he found that independent agency insurers were both less cost-efficient and less profit-efficient compared to dependent agency insurers. However, only Cummins (1999) included direct and multi-channel insurers in an analysis of the performance of different distribution systems in the U.S. life insurance industry for the period 1988-1995. He found that, compared to agent-based insurers, direct insurers were less cost efficient and revenue efficient, but technically more efficient and that multi-channel insurers tended to be more efficient.[28]

3.4 Methodology

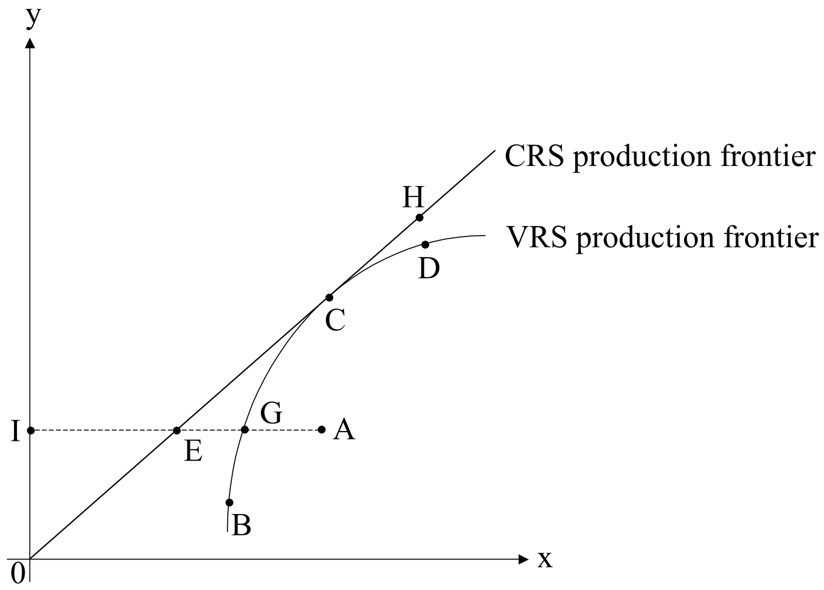
3.4.1 Frontier Efficiency Concepts

We apply modern frontier efficiency analysis to estimate cost and profit efficiency in the German life insurance industry. The methodology allows for the analysis of multiple input-output technologies. The performance of each firm is measured by comparing it to the efficient frontier of the industry, which is composed of the efficient firms in the reference set (e.g., the industry). Thus, one can obtain firm-specific efficiency measures relative to a "best practice" frontier. The measurement of productive efficiency goes back to Koopmans (1951), Debreu (1951), and Farrell (1957), who introduced the concept of technical efficiency as a firm's ability to produce a given output with a minimum of inputs (input-oriented approach) or to maximize its output with a given level of inputs (output-oriented approach).

[28] Cummins (1999) only compared insurers which rely exclusively on the agency system with those which mainly use the agency system, but also use at least one other distribution system. The success of multiple distribution channels was analyzed for the financial sector by Easingwood and Storey (1996). On the basis of a questionnaire sent to managers of financial products in the U.K. market, they concluded that the simultaneous combination of a high number of channels was associated with higher overall success of the firm. However, their analysis did not focus on insurance firms, and their results relied solely on the analysis of correlations between qualitative indices. They did not analyze cost and revenue structures of the firms or compared multi- and single-distribution channel strategies, but only analyzed the effect of an increasing number of channels within multi-distribution firms.

Figure 3.1 illustrates the concept of technical efficency for a one-input (x) one-output (y) case. Under constant returns to scale (CRS), Firm A's technical efficiency is defined as the ratio IE/IA.[29] The CRS assumption supposes that all firms are operating at optimal scale, i.e., at the point where average costs are at a minimum. For the calculation of efficiency scores, the assumption of CRS implies that all firms are compared to each other. Thus, an inefficient firm can be benchmarked against smaller or larger firms (e.g., Coelli et al., 2005). In figure 3.1, the CRS frontier is represented by the straight line 0CH.

Figure 3.1: Input-Oriented Technical Efficiency under CRS and VRS



Source: Own composition following Coelli et al. (2005), p. 59.

However, in reality, firms may not operate at optimal scale but deploy increasing (IRS) or decreasing returns to scale (DRS). Under IRS, a firm experiences diminishing average costs and under DRS, a firm is operating under increasing average costs. The variable returns to scale (VRS) frontier accounts for the possibility of both IRS and DRS. In figure 3.1, the VRS frontier is displayed by the line BCD. From B to C, the production technology is assumed to display IRS, whereas, from C to D, firms are assumed to exhibit DRS. At point C, firms are assumed to operate under CRS; consequently, point C belongs to both the CRS and the VRS

[29] For the purpose of simplification, technical efficiency is illustrated only in an input-oriented way in this figure. Under CRS, input- and output-oriented technical efficency scores do not differ, whereas under VRS, different efficiency scores are obtained, depending on the orientation of the model.

frontiers. The resulting VRS frontier envelops the observed firms more closely than does the CRS frontier; thus, the efficiency will be at least equal to those under the assumption of CRS. The VRS assumption implies that an inefficient firm is compared only to firms of comparable size (e.g., Banker, 1984). In figure 3.1, firm A's technical efficiency under VRS is measured by IG/IA. If there are firms in the industry which are not operating at optimal scale, efficiency measurement under CRS results in technical efficiency's being confounded by scale efficiency (SE). Scale efficiency is defined as the amount by which a firm's efficiency could be improved by moving to its optimal scale (e.g., Ray, 2004; Coelli et al., 2005) and is calculated by dividing the CRS efficiency score by the VRS efficiency score. The concept of scale efficiency decomposes the technical efficiency of a firm into pure technical efficiency and scale efficiency. In Figure 3.1, firm A's scale efficiency is defined by the ratio IE/IG.

To obtain qualitative information about returns to scale for individual observations, two additional assumptions on the underlying production technology can be added to the concept of CRS and VRS. Under the concept of non-increasing returns to scale (NIRS), a production technology is assumed to exhibit CRS on the first segment of the frontier and DRS on the second segment, as shown in figure 3.1, where the NIRS frontier is represented by the line 0CD. The term results from the assumption that firms do not exhibit increasing returns to scale (IRS) at any point of the frontier. In the calculation of efficiency, an inefficient firm is not benchmarked to larger firms but may be compared with smaller ones. The assumption of NIRS puts emphasis on larger firms, as these are assumed to operate under DRS (e.g., Cooper et al., 2006). By contrast, smaller firms are assumed to operate under CRS, which means that possible scale effects are not accounted for when calculating their technical efficiency. The opposite is supposed if non-decreasing returns to scale (NDRS) are assumed for the production technology. Under NDRS, the production technology exhibits IRS in the first segment, and CRS in the second segment of the frontier; this can be seen in figure 3.1's line BCH, which represents the NDRS frontier. Under NDRS, firms do not exhibt DRS at any point of the frontier. Thus, a production process can be scaled up, but not scaled down proportionally. Hence, the NDRS frontier puts emphasis on smaller firms, as these are assumed to operate under IRS, while larger firms are not allowed to exhibit scale ineffiencies.

Thus, efficiency scores will be lowest in the case of CRS compared to all other models, as the CRS frontier envelops the data least closely of all (e.g., Ferrier and Lovell, 1990). Ray (2004), p. 80 observed that "in this discussion of SE, VRS is the maintained assumption. The

CRS and NIRS frontiers are mere artifacts that permit us to examine different points on the VRS frontier."

The calculation of efficiency scores under NIRS and NDRS determines the nature of returns to scale under which a single firm is operating (Briec et al., 2000): Let $DF^I(x, y \mid CRS)$, $DF^I(x, y \mid VRS)$, $DF^I(x, y \mid NIRS)$ and $DF^I(x, y \mid NDRS)$ indicate technical input efficiency measures computed under CRS, VRS, NIRS, and NDRS.[30] A convex technology exhibits IRS if

$$DF^I(x, y \mid NDRS) = \max\left\{DF^I(x, y \mid NIRS),\ DF^I(x, y \mid NDRS)\right\}. \tag{3.1}$$

It exhibits DRS if

$$DF^I(x, y \mid NIRS) = \max\left\{DF^I(x, y \mid NIRS),\ DF^I(x, y \mid NDRS)\right\}. \tag{3.2}$$

It exhibits CRS if

$$DF^I(x, y \mid NDRS) = DF^I(x, y \mid NIRS) = \max\left\{DF^I(x, y \mid NIRS), DF^I(x, y \mid NDRS)\right\}. \tag{3.3}$$

Thus, if at any local point the technical input efficiency score under NDRS is larger than it is under NIRS, the technology shows IRS (equation (3.1)), and DRS are found if technical efficiency under NIRS is larger than it is under NDRS (equation (3.2)). Finally, a local point exhibits CRS if the efficiency scores under NIRS and NDRS do not differ (equation (3.3)).[31]

Farrell (1957) extended the concept of technical efficiency to a concept of allocative efficiency, which occurs when a firm is able to choose the cost-minimizing combination of inputs, given the factor prices; if it chooses the revenue-maximizing ouput combination, given the output prices; and finally, a firm is called allocative efficient if it chooses a combination of profit-maximizing output and input.

Taking into account input price information only, it is possible to determine a firm's cost efficiency (CE); a firm is fully cost efficient if it is able to produce a given output y_0 at minimum costs. If the production possibility set is defined as $T = \{(x; y) : x \text{ can produce } y\}$, where x and y represent input and output vectors, and the corresponding input requirement set for the given ouput y_0 is defined as $L\ (y_0) = \{(x : x \text{ can produce } y_0)\}$, then the cost-minimization problem of the firm can be expressed as

[30] The superscript I indicates that an input-oriented approach is chosen to measure technical efficiency.

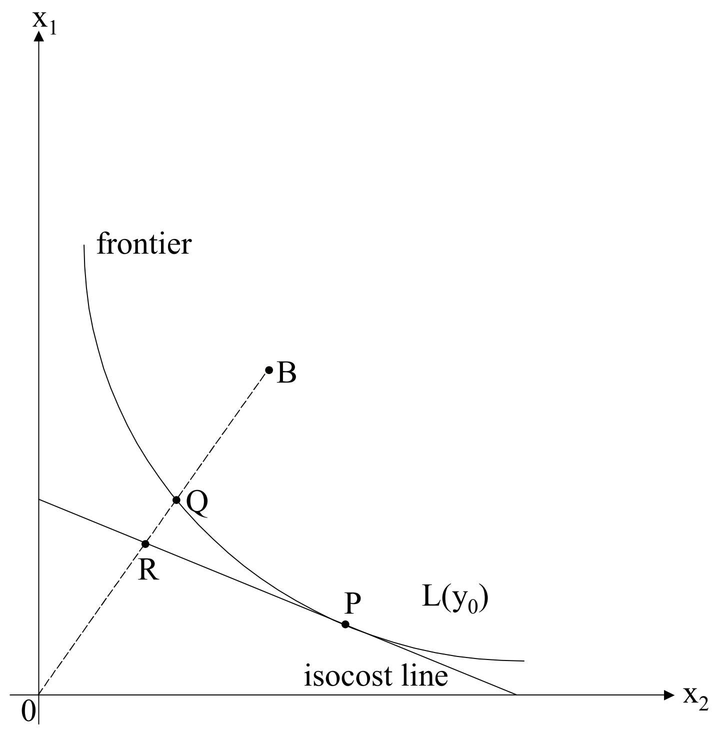
[31] The main advantage of the method presented by Briec et al. (2000) is that only two models (under the assumptions of NIRS and NDRS) must be computed to estimate the nature of returns to scale for every single observation point. However, the nature of returns to scale can also be obtained by other approaches, as has been shown by Färe et al. (1983), Banker et al. (1984) and Keerstens and Vanden Eeckaut (1999), among others.

$$\min C = \min w'x \text{ subject to } x \in L(y_0) \tag{3.4}$$

where w is a vector of input prices which correspond to the input vector, and the term w'x represents the inner product of the vectors w and x. The firm is assumed to take input prices as given; thus, it minimizes its costs by adjusting the input quantities.[32] The firm is cost efficient if and only if there is no other input vector x which may produce the given output level y_0 at lower cost.

The cost efficiency of a firm is defined by the ratio of minimum costs to actual costs for a given output vector. It ranges from 0 to 1, with a score of 1 representing a fully cost-efficient firm. Cost efficiency displays the product of allocative (AE) and technical (TE) efficiency; thus, a firm can be cost-efficient only if it is both allocatively and technically efficient (e.g., Ray, 2004). Figure 3.2 illustrates the concept of cost efficiency for the two-input (x_1 and x_2) one-output (y) case under the assumption of CRS. The production frontier represents all technically efficient firms, whereas the isocost line represents a given cost level. Firm B's cost efficiency can be determined by the product of TE (0Q/0B) and AE (0R/0Q), and equals 0R/0B. AE accounts for the fact that firm B could move from the technically efficient but allocatively inefficient point Q to point P, which is both technically and allocatively efficient.

Figure 3.2: Cost Efficiency in the Two Input – One Output Case



Source: Own composition following Coelli et al. (2005), p. 52.

32 This implies that cost efficiency is always determined under the assumption of an input-oriented model.

If output quantities are also regarded as choice variables, profit efficiency (PE) can be calculated.[33] Therefore, information about both input and output prices are needed. The firm's objective is to choose the profit-maximizing input and output quantities, given the input and output prices, so it faces the constraint that the chosen input-output combination must represent a feasible production plan. The profit-maximizing problem of a firm can be expressed by:

$$\max \Pi = p'y - w'x \text{ subject to } (x,y) \in T, \qquad (3.5)$$

where all variables are as presented before, p represents the vector of output prices, and the term p'y represents the inner product of the vectors p and y.

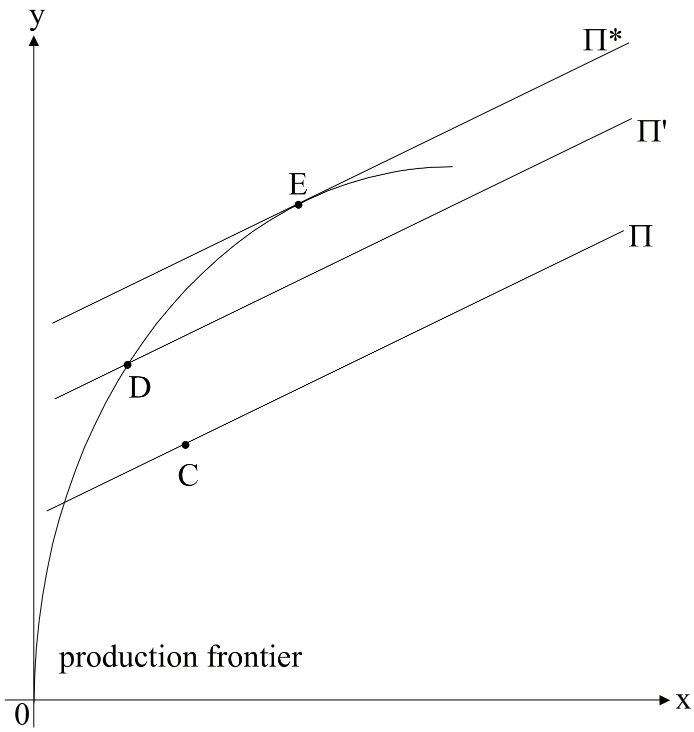
Profit efficiency is then defined as the ratio between a firm's actual profits and the maximum attainable profits, given the input and output prices. A fully profit efficient firm shows a profit efficiency of 1. Just as profits can be negative, profit efficiency is not bounded by 0 at the lower end, but can turn negative (zero) if profits are negative (zero).[34] Further, the profit efficiency measure is undefined if the maximum attainable profit in an industry is negative (e.g., Banker and Maindiratta, 1988; Cooper et al., 2006). Figure 3.3 illustrates the concept of ratio-based profit efficiency for the one-input (x) one-output (y) case, under the assumption of VRS (PE^{VRS}). Both the efficient production frontier and different isoprofit lines (Π) are illustrated. Each isoprofit line represents an identical profit level, with Π* corresponding to the highest illustrated profit level and Π corresponding to the lowest. The highest isoprofit line Π* is determined by the tangency of the isoprofit line with the production function, thus E corresponds to the optimal input-output bundle. The overall profit

[33] It is also possible to calculate revenue efficiency by taking into consideration output quantities, output prices, and input quantities. In the case of revenue efficiency, firms try to maximize revenues by choosing the optimal output quantities, given the input prices and input quantities. Thus, revenue efficiency is calculated based on an output-oriented approach (e.g., Ray, 2004; Coelli et al., 2005).

[34] A variety of solutions for the problem of negative profit efficiency has been developed: Some authors (e.g., Banker and Maindiratta, 1988) suggested eliminating firms which exhibit negative profits before calculating efficiency scores. Others (e.g., De Young and Hasan, 1998) added a small positive number to a firm's actual profits (losses) to ensure profits which at least equal zero. We decided not to remove firms from the sample which exhibit negative profits, as it is possible that firms incur short-term losses but are able to establish themselves in the market in the long run. This is especially true for young firms which incur high initial investments. Our sample contains a number of firms which entered the market after the liberalization of the German insurance market in 1994. We did not add a small positive number to negative profits, as our primary focus is not on the profit efficiency scores of single firms, but rather on the average profit efficiency for different groups of insurers. As we only found very few firms showing only small negative PE scores with none of these firms showing negative profit efficiency scores over the whole observation period, the impact on the average profit efficiency scores is very small.

efficiency of firm C is given by Π/ Π* and can be decomposed into technical profit efficiency (Π/ Π') and allocative profit efficiency. Π' represents the profit at the technically efficient production point D, and Π* the maximum attainable profit. The allocative profit efficiency would then be Π'/ Π*. Overall profit efficiency is the product of technical and allocative profit efficiency.

Figure 3.3: Profit Efficiency in the One Input – One Output Case



Source: Own composition following Ray (2004), p. 229.

3.4.2 Estimation Methodology – Data Envelopment Analysis

We estimate firm-specific efficiency using non-parametric DEA. Using DEA, an a priori specification of the underlying production function is not needed because the efficient best practice frontier is estimated by solving linear programming models to envelope the observed data as tightly as possible (Charnes et al., 1978). It requires only convexity of the production possibility set and disposability of the inputs and outputs. This makes DEA especially useful when dealing with service industries, as knowledge about the sector's production technology is usually limited. An alternative to DEA is an econometric approach, which requires specifying a functional form for the cost, profit or production frontiers. It is hypothesized that the function error term consists of an inefficiency component and a purely random component, so efficiency is measured by separating the efficiency component from the overall error term. In contrast to an econometric approach, DEA measures all deviations from the efficient frontier as inefficiency. Thus, a deviation from the frontier that is due to purely random shocks would not be detected by DEA (for an overview, see, e.g., Kumbakhar and Lovell, 2000).

Standard cost efficiency is estimated as follows: Using data on K inputs and M outputs for each of the firms (i = 1,...,N), the i^th^ firm uses an input vector x_{ki} (k = 1,…K) to produce an output vector y_{m0} (m = 1,…,M). First, the following linear programming problem (LP) is solved:

$$C_i^* = \underset{\lambda, x_k}{\mathrm{Min}} \sum_{k=1}^{K} w_{ki} x_{ki}$$

$$\text{s.t.} \quad \sum_{i=1}^{N} \lambda_i \, x_{ki} \le x_k$$

$$\sum_{i=1}^{N} \lambda_i \, y_{ki} \ge y_{m0} \qquad (3.6)$$

$$\lambda_i \ge 0.$$

Further, w_{ki} is an input price vector for the i^{th} firm, which corresponds to the input vector $x_{ki.}$

Second, the cost efficiency of the i^{th} firm is calculated as the ratio of minimum cost to observed cost, with x^*_{ki} being the cost-minimizing input vector for the i^{th} firm, which is obtained by the LP presented in equation (3.6) (e.g., Färe et al., 1994).

$$CE = \frac{\sum_{k=1}^{K} w_{ki} x_{ki}^*}{\sum_{k=1}^{K} w_{ki} x_{ki}}; 0 \le CE \le 1. \qquad (3.7)$$

The measure of cost efficiency is bounded between 0 and 1. A value of 1 represents a fully cost-efficient firm; 1-CE represents the amount by which the firm could reduce its costs and still produce at least the same amount of output.

The LP approach in equation (3.6) calculates cost efficiency under the assumption of CRS (CE^{CRS}). To calculate cost efficiency under VRS (CE^{VRS}), the convexity constraint $\sum_{i=1}^{N} \lambda_i = 1$ is added (Banker et al., 1984). Färe and Grosskopf (1985) showed that scale efficiency can also be determined in line with cost efficiency: Analogous to the calculation of scale efficiency in case of TE, scale efficiency in the model of cost efficiency is also determined by dividing CE^{CRS}/CE^{VRS}, given that all firms face identical input prices. Accounting for possible economies of scale is of major importance in insurance industry studies, as was noted in section 3.2.

To determine the nature of returns to scale, cost efficiency is also estimated under NIRS and NDRS, following the approach by Briec et al. (2000). To calculate NIRS, the constraint $\sum_{i=1}^{N} \lambda_i \leq 1$ must be added to equation (3.6), whereas NDRS are assumed by adding $\sum_{i=1}^{N} \lambda_i \geq 1$ (e.g. Zhu, 2003; Ray, 2004).

In the insurance sector, input and output quantities are typically reported using a monetary dimension. Further, the definition and calculation of input and output prices is rather difficult and the subject of controversy in the literature (see section 5 for a more detailed discussion of this problem). Therefore, we follow Tone (2002), Tone and Sahoo (2005) and Cooper et al. (2006) and calculate cost efficiency by replacing the input vector x_{ki} in the above LP by a vector $\overline{x}_{ki}$ with $\overline{x}_{ki}$ representing the monetary input quantities, i.e., costs. This approach further allows us to model input prices w_{ki} as equal to unity for all selected inputs.[35]

In the second step, profit efficiency is estimated. The profit maximization LP is solved as follows:

$$
\begin{aligned}
P_i^* = & \operatorname*{Max}_{\lambda, x_k, y_m} \sum_{m=1}^{M} p_{mi} y_{mi} - \sum_{k=1}^{K} w_{ki} x_{ki} \\
\text{s.t.} \quad & \sum_{i=1}^{N} \lambda_i \, x_{ki} \leq x_k \\
& \sum_{i=1}^{N} \lambda_i \, y_{mi} \geq y_m \\
& \lambda_i \geq 0 \\
& \sum_{i=1}^{N} \lambda_i = 1.
\end{aligned}
\tag{3.8}
$$

[35] This approach was already suggested by Färe and Grosskopf (1985), who showed that cost efficiency can be determined using DEA by minimizing costs, given output quantities, without differentiating between input quantities and input prices. Tone (2002), Tone and Sahoo (2005) and Cooper et al. (2006) called their approach *new cost efficiency*. Their focus differs from ours, as they accounted for different input prices faced by the firms by considering $\overline{x}_{ki}$. In our opinion, this approach may also be used if input prices are not or only partially available, but if information about costs is present, as in our case. Although technically allocative efficiency can be derived by dividing cost efficiency and technical efficiency scores, the resulting score should only reflect input slacks which are not accounted for in the case of technical efficiency (e.g., Ferrier and Lovell, 1990). In reality, the resulting efficiency scores contain both technical and allocative inefficiencies, as the firm's decision about the optimal use of input factors, depending on the given input prices, is already contained in the cost information. We do not derive firm-specific allocative inefficiencies, as the differentiation between them is of only minor importance for the purpose of our study. Recently, Banker et al. (2007) derived a consistent estimator of aggregate technical and allocative efficiency by using aggregate cost and revenue data. They also showed how technical and allocative efficiency can be disentangled in this case.

All variables are as presented before, P^*_i represents the maximum profit of firm i and p_{mi} is vector of output prices for the i^{th} firm. A measure of profit efficiency can be obtained by calculating the ratio of observed profit to maximum (potential) profit.

$$PE = \frac{\sum_{m=1}^{M} p_{mi} y_{mi} - \sum_{k=1}^{K} w_{ki} x_{ki}}{\sum_{m=1}^{M} p_{mi} y^*_{mi} - \sum_{k=1}^{K} w_{ki} x^*_{ki}}; -\infty \leq PE \leq 1, \tag{3.9}$$

where y^*_{mi} is the revenue-maximizing vector of output quantities for the i^{th} firm. Given input and and output prices, x^*_{ki} and y^*_{mi} are calculated by the LP presented in equation (3.8) (e.g., Zhu, 2003; Ray, 2004), so that $-\infty \leq PE \leq 1$ describes the maximum amount by which the profits of an inefficient firm could be increased before it achieves full profit efficiency. Profit efficiency is estimated under the assumption of VRS (PE^{VRS}) because, under the assumption of CRS, maximum profit would be zero or undefined (e.g., Färe et al., 1994; Ray, 2004). Thus, scale efficiency is calculated only in the case of cost efficiency, but we are still able to determine the nature of returns to scale of a profit-inefficient firm. To calculate NIRS, the constraint $\sum_{i=1}^{N} \lambda_i \leq 1$ is added to equation (3.8), whereas NDRS are assumed by adding $\sum_{i=1}^{N} \lambda_i \geq 1$ (e.g., Zhu, 2003).

Again, we follow Cooper et al. (2006) and calculate the “new” profit efficiency, since data about output prices is limited but information about revenues, which represent the product of output quantities and prices, is available. (See section 3.4 for a more detailed discussion.) For this calculation, the output vector y_{mi} is replaced by the vector $\overline{y}_{mi}$, where $\overline{y}_{mi}$ represents the revenues of firm i. This allows us to model output prices which equal 1. Also, the input vector x_{ki} is replaced by a vector $\overline{x}_{ki}$ with $\overline{x}_{ki}$ representing the monetary input quantities, i.e., the costs. Finally, input prices are assumed to equal 1.[36]

[36] The fact that PE cannot be calculated under the assumption of CRS leads to the assumption of imperfect markets, as perfect competition would lead to a situation in which all firms operate under CRS. Although, technically, all firms face the same input and output prices of 1, our PE model allows for imperfect competition, which would be reflected in different output prices resulting from product differentiation among firms. The different output prices would be contained in the revenues. Again, the resulting efficiency scores are not differentiated in regard to allocative and technical inefficiencies, as this is not important for the purpose of this study.

3.5 Dataset and Variables

3.5.1 Dataset

The data used in this study are taken from periodically published insurance industry reports and insurers' income statements for the years 1997-2005 (Hoppenstedt, 1999-2007). However, Hoppenstedt registers every licensed insurance firm in Germany, so the database contains also information about firms that do not actively participate in the insurance market. We eliminated firms which had not delivered any information at all, or which showed negative obervations for inputs or outputs. In addition, we removed firms operating only in very specialized product niches, offering products only to a very specialized customer base (e.g., civil cervants, doctors) or offering only single, specialized insurance products (e.g., exclusively term-life insurance).[37] These firms were eliminated as they are not representative of the industry as a whole. In the end, our data set accounts for approximately 90 percent of the total premium income of the industry.

The German life insurance industry is characterized by a large heterogeneity among the firms, so we corrected for outliers in the sample by applying the outlier correction model suggested by Wilson (1993). We found that, in each year, the firms detected as outliers were among the largest in the sample.[38]

3.5.2 Variables

Using DEA requires identifying the relevant inputs and outputs of an insurance firm. However, a review of the literature does not show clear consensus on a single input/output specification (e.g., Cummins and Weiss, 2000). While the efficiency of manufacturing firms can be calculated easily, as these firms use physical resources to produce tangible, complete products as outputs, the selection of variables to represent inputs and outputs is more difficult for service firms, as input prices are often implicit and many outputs are intangible.

In the existing literature, the inputs and outputs of insurance firms has been measured primarily using one of three approaches: the asset (intermediation) approach, the user-cost

[37] There is also one life insurer in the German market which solely distributes its products via bank offices (CiV, which belongs to Citi Bank and uses only the bank's offices for the distribution of its products). Further, Aachener und Münchener Lebensversicherung decided in 2005 to sell its products solely via exclusive agents. We excluded CiV from the sample because it is the only insurer that uses only bank offices for distribution. Aachener und Münchener Lebensversicherung had already been removed from the sample for 2005 because it was an outlier.

[38] The results of the efficiency estimations differ only slightly if the detected outliers are excluded from the sample, though, and all of the qualitative results of the study remain unchanged.

approach, and the value-added approach (e.g., Berger and Humphrey, 1992). The asset approach treats insurance firms as pure financial intermediaries. According to this approach, insurance firms act like other financial intermediaries – e.g., banks – and borrow funds from their customers, which are invested and transformed into assets. Interest payments are paid out to cover the time value of the funds used. Applying the asset approach would mean that only the intermediation services provided by life insurance firms are taken into account and important functions of life insurers, like risk-pooling and risk-bearing, would be disregarded. Thus, the asset approach seems inappropriate for measuring the real output services by life insurance firms.

The user-cost approach, developed by Hancock (1985), determines whether a financial product is an input or an output by analyzing whether its net contribution to the revenues of an insurance firm is positive or negative. A product is considered an output if its financial return exceeds the opportunity costs of funds or if the financial costs of a liability are lower than the opportunity costs; otherwise, the product is classified an input. This method requires precise information on product revenues and opportunity costs, but this kind of data is nearly impossible to obtain for an entire industry, so this approach is not appropriate for the current study.

The value-added approach considers all asset and liability categories to have some output characteristics. Those categories which have substantial value-added are used as the important outputs, and the remaining categories are treated as rather unimportant outputs, intermediate products, or inputs. An important advantage of this approach, compared to the user-cost approach, is that the value-added approach uses operating cost data, rather than determining the costs implicitly or using opportunity costs. Thus, the value-added approach is considered to be the most appropriate method for measuring the output of financial firms and has been widely used in recent insurance studies.

In using the value-added approach, the services provided by insurers are defined before suitable output proxies are chosen. The services provided by insurers can be split up in three major groups:

1. Risk-bearing/risk-pooling services: Life insurers collect premiums and annuity considerations from their customers and distribute a certain share or part of the premiums to those policyholders who incur a loss. Thus, insurers provide a mechanism which makes it possible for consumers and businesses exposed to possible losses to engage in risk reduction through pooling. In life insurance, the

main risks are the risk of death (endowment insurance) and the risk of longevity (annuities). The actuarial, underwriting, and related expenses incurred in operating the risk pool represent the major components of the value added.

2. "Real" financial services related to insured losses: In life insurance, the primary "real" services provided by insurers are financial planning and counseling for individuals and pension and benefit plan administration for businesses.
3. Intermediation services: Intermediation services are of special importance in life insurance because most companies sell asset-accumulation products. Funds (premiums) are collected in advance of paying benefits and are held in reserve. Until claims are paid, the insurer uses them to purchase a portfolio of assets, and the net interest margin between the rate of return earned on assets and the rate credited to policyholders represents the value added from the intermediation function.

Some efficiency studies have used premiums to measure output. This is inappropriate, as premiums represent revenues of an insurance firm instead of output (Yuengert, 1993).[39] Following the value-added approach, then, the output of a life insurance company is defined in our study as follows:

We approximate the risk-bearing function by using *incurred benefits net of reinsurance*. Incurred benefits represent payments received by policyholders in the current year. They can be seen as proxies for the risk-bearing/risk-pooling function because they measure the amount of funds distributed to the policyholders as compensation for incurred losses. The funds received by insurers that are not needed for benefit payments and expenses are added to policyholder reserves. Thus, *additions to reserves* is a suitable proxy for the intermediation function of the insurer. Finally, we include *bonuses and rebates* into our output measure because these funds benefit the policyholders. By choosing incurred benefits net of reinsurance and the additions to reserves as output proxies, we follow the majority of the life insurance studies (e.g., Meador et al., 1997; Cummins and Zi, 1998; Cummins, Weiss and Zi, 1999; Fenn at al., 2008).[40] All three output measures are correlated with real services provided

[39] Another approach is to use physical output measures, such as number of policies. Unfortunately, there is only limited data available for these kinds of physical measures.

[40] We tested for the influence of the output measure bonuses and rebates by leaving this measure out and re-estimating cost and profit efficiency levels. Our results proved to be robust and did not differ significantly between both models.

by life insurers. Because of limited data availability, it is not possible to split up the output measures provided by the life insurance firms according to the different life insurance lines.

Life insurers' revenue is measured by the *sum of premium and investment income* (e.g., Cummins and Weiss, 2000; Fenn et al., 2008). Net premium income is measured by the sum of gross written premiums, less ceded reinsurance premiums, less the change in the provision for unearned premiums.

Insurers' inputs can be classified into three principal groups: labor, business services and materials, and capital. In most cases, physical measures for these inputs (e.g., the number of employees) are not available, but there is information about the costs an insurance firm incurs for the use of the inputs. They are already valuated by the corresponding input prices, so they represent the product of input quantities and prices. Using the new cost/new profit efficiency approach, as suggested by Tone (2002), Tone and Sahoo (2005), and Cooper et al. (2006), allows us to take cost measures into account directly. This approach shows the advantage that the derivation of input quantities and suitable input prices, which is rather difficult in the case of insurance firms, is not necessary. Most studies derive input quantities by dividing cost values by a uniform price/wage index over all firms. Compared to our approach, this approach leads to the same cost efficiency values (Färe and Grosskopf, 1985). Technically, input prices are set to 1 by convention (e.g., Mountain, 1999; Edvardsen et al., 2006; Paradi, 2006).

To measure insurers' costs, we choose *acquisition and administration expenses*, which sum up to equal *operating expenses*, as a proxy for the insurers' inputs for labor and business services (e.g., Berger et al., 1997; Cummins and Zi, 1998) since administration and acquisition expenses contain the insurers' expenses for labor and business services. This shows the advantage of our approach, since it would not be possible to derive separate input quantities for labor and business services.

The consideration of financial capital is also important in the case of insurance firms.[41] Insurance studies frequently use financial equity capital but seldom use financial debt.[42] Equity capital is used as an input because insurance is viewed as risky debt (e.g., Cummins

[41] Some studies also include physical capital as an input measure (e.g., Meador et al., 1997) but, in general, the amount of physical capital used by insurance firms is rather small. We checked for the influence of physical capital by including *capital expenses* into our analysis, but it had little influence on our results. To avoid an increase in the number of variables used in our analysis, then, capital expenses were left out of the analysis.

[42] Financial debt is used less often since insurers' reserves have both input and output characteristics. It is much more common to treat insurers' reserves (or the corresponding additions to reserves) as an output following the value-added approach, as has been done in this study.

and Danzon, 1997). According to this approach, insurance premiums are discounted in the market to account for the insurer's default risk. Thus, better-capitalized insurers should be able to realize higher prices for their products, compared to less-capitalized insurers, all else being equal, because a higher amount of capital increases the probability that unexpectedly high losses will be paid (Cummins and Weiss, 2000).

This study follows the majority of extant insurance studies by using *statutory policyholders' surplus* as a consideration for financial equity capital. To measure the cost of equity, financial equity capital should be valuated by the firm-specific price for equity capital (for an overview of the different approaches to measure the cost of equity see Cummins and Weiss, 2000). Because of limited data availability and the small influence of the different approaches on the efficiency results found in other studies, we assume identical prices for equity capital over all firms in a given year. Another approach would be the so-called three-tier approach, which measures the cost of capital based on tier ratings. In this approach, insurance firms are divided into three tiers according to their ratings, where the lowest capital costs are assigned to the insurance firms with the highest rating. Compared to the average return on book value approach, the three-tier approach does not materially change the results (Cummins et al., 1999). An application of the three-tier approach to the German life insurance market proves difficult, as rating scores are only available for a small number of the German life insurers.To approximate the price for equity capital in the industry, we calculate the average return on the book value of equity for the industry in a given year. Similar approaches can be found in the literature, e.g., Fenn et al. (2008) used a rate of interest variable from long-term government bond rates to proxy the price of capital. Cummins and Rubio-Misas (2006) proxied the price of equity capital by the rate of total return of the most important Spanish Stock Exchange for every year in their observation period. As the rate of total return of the most important German Stock Exchange (DAX) showed negative values in some of the observation years due to the crash of the stock markets in the year 2000, we prefer to use the average return on the book value of equity as a proxy for the price of equity. The return on the book value of equity has been used before by Cummins and Weiss (1993), and Cummins and Sommer (1996). The latter noted that the use of market values instead of book values in the calculation of the rate of return would be preferable, but is limited due to the small number of insurers with publicly traded equity. This holds especially true for the German market, where only about 20 percent of the stock insurance firms are listed on the stock exchange (Elgeti and Maurer, 2000), and there is a significant number of mutual and public-owned insurance firms.

Equity costs are finally obtained by valuating statutory policyholders' surplus with the price for equity capital in this year.

Summarizing, we measure insurers' output by the sum of incurred benefits net of reinsurance, additions to reserves, and bonuses and rebates. Costs are measured by the sum of acquisition and administration expenses, and equity costs. Revenues are the sum of net premium income and investment income. Table A 2 in the Appendix presents summary statistics for the variables used in the analysis as described above for every year of the observation period.

The results show a large dispersion in all the variables between the smallest and largest firms in the sample, as well as among the three analyzed groups of insurers. Direct insurers show the smallest average values in terms of *operating expenses*, *output*, *premiums*, and *investment income* in the sample.[43] In terms of *equity costs*, independent agency insurers show slightly lower values for some years, compared to direct insurers. In general, however, independent agent insurers show higher cost, output and revenue levels. The largest group is the multi-channel insurers, which showed an average of 3.48 times larger output, compared to the direct insurers, and 2.58 times larger output compared to independent agency insurers in 1997. By 2005, the differences in output terms had decreased slightly. The differences between these groups are also apparent in terms of costs and revenues.

3.6 Results

We begin with the analysis of cost efficiency, profit efficiency and scale economies as well as the discussion of returns to scale for the whole industry. We then turn to the comparison of cost and profit efficiency levels for the different groups of insurers.

3.6.1 Average Efficiency Levels and Returns to Scale

As presented in section 3.3, scale efficiency results are derived from the cost efficiency estimations with CRS and VRS. Table 3.1 shows the average cost efficiency under CRS (CE^{CRS}) and VRS (CE^{VRS}), as well as the scale efficiency (SE) and profit efficiency scores (PE^{VRS}). Mean values are presented by year for all insurers and by total output size quartiles. We first focus on efficiency results for the entire sample, then discuss the results for the single size quartiles. Since efficiency scores were estimated separately for every year in the

[43] The only exceptions are the years 2003 and 2004: In 2003, direct insurers show slightly higher mean value for *premium income* as compared to independent agent insurers; and in 2004, they show slighlty higher average *output* and *investment income*.

observation period, we can draw conclusions about the development of efficiency between groups during the observation period. Because firms exited and entered the market during the observation period, the annual subsamples do not include the same number of observations each year. Thus, the specific efficiency scores for each year cannot be compared individually to one another. However, we can analyze the development of the differences in cost and profit efficiency levels between the different groups over time.

The results show that CE^{CRS} ranged between 0.27 and 0.46 during the observation period. CE^{VRS} ranged between 0.40 and 0.53, and PE^{VRS} ranged from 0.58 to 0.63. Because of the discrepancy between CE^{CRS} and CE^{VRS}, it is important to analyze scale efficiency to determine how firms can improve their efficiency by adjusting their size. Scale efficiency ranges between 0.73 and 0.90 on average, meaning that firms could improve their efficiency by 10-27 percent by moving to the optimal size.

Table 3.1: Average Cost, Scale and Profit Efficiency by Size Quartiles, 1997-2005

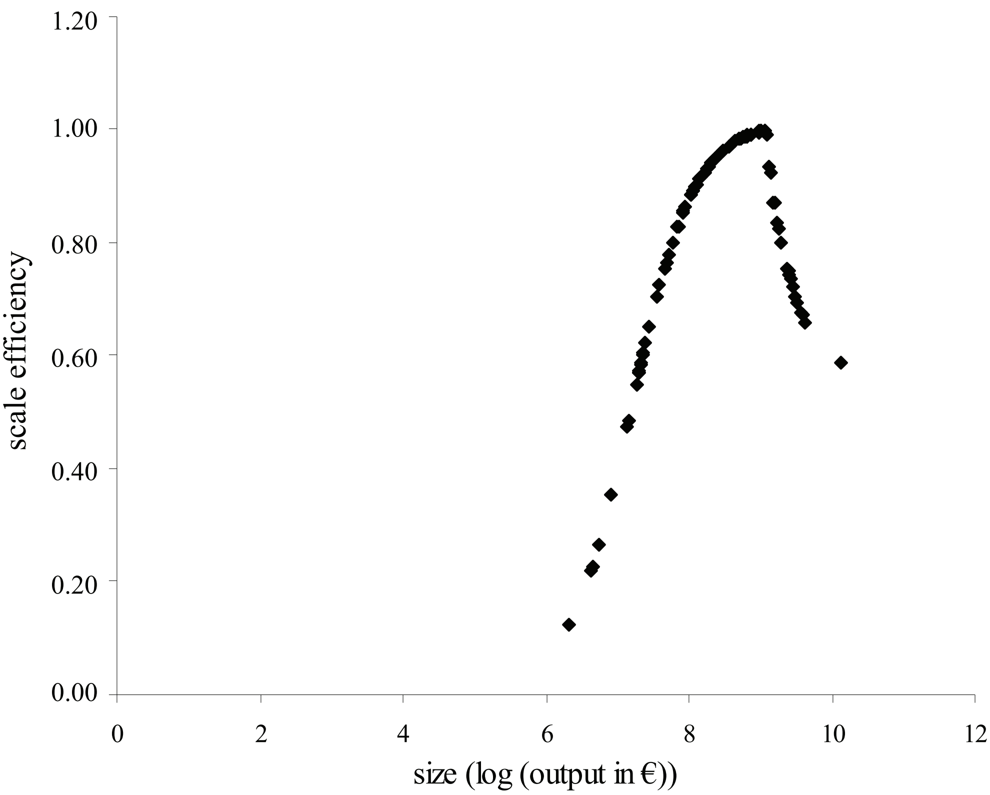
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Quartile 1	CE^{CRS}	0.1548	0.1577	0.1652	0.1965	0.2569	0.2618	0.2980	0.2698	0.2398
	CE^{VRS}	0.4183	0.3916	0.3874	0.3910	0.4428	0.3950	0.4569	0.4327	0.4689
	SE	0.4224	0.4357	0.4821	0.5363	0.5798	0.6613	0.6838	0.6563	0.5592
	PE^{VRS}	0.5856	0.3804	0.4148	0.4715	0.4536	0.4599	0.5166	0.4828	0.5112
Quartile 2	CE^{CRS}	0.2822	0.2800	0.2383	0.3137	0.3527	0.4354	0.4547	0.4060	0.4532
	CE^{VRS}	0.3329	0.3269	0.2706	0.3481	0.3647	0.4515	0.4907	0.4392	0.4616
	SE	0.8476	0.8498	0.8818	0.8495	0.9595	0.9632	0.9278	0.9277	0.9838
	PE^{VRS}	0.6631	0.4964	0.4727	0.4663	0.4097	0.5172	0.5333	0.5164	0.5273
Quartile 3	CE^{CRS}	0.3491	0.3673	0.3006	0.4296	0.4114	0.4624	0.5385	0.4603	0.4461
	CE^{VRS}	0.3583	0.3765	0.3071	0.4366	0.4366	0.4662	0.5483	0.4655	0.4593
	SE	0.9710	0.9737	0.9763	0.9820	0.9440	0.9915	0.9807	0.9878	0.9726
	PE^{VRS}	0.6526	0.6368	0.6476	0.6234	0.6128	0.6912	0.6829	0.6172	0.5925
Quartile 4	CE^{CRS}	0.4858	0.4382	0.3586	0.5254	0.4599	0.4911	0.5631	0.4462	0.4743
	CE^{VRS}	0.6674	0.6514	0.6402	0.6638	0.5685	0.5164	0.6125	0.5899	0.6111
	SE	0.6926	0.7322	0.6098	0.7976	0.8402	0.9692	0.9453	0.7679	0.7871
	PE^{VRS}	0.4859	0.8410	0.8352	0.8368	0.8313	0.7836	0.7833	0.7855	0.7553
Total	CE^{CRS}	0.2958	0.3108	0.2660	0.3645	0.3688	0.4127	0.4636	0.3940	0.4033
	CE^{VRS}	0.4359	0.4366	0.4003	0.4575	0.4530	0.4573	0.5271	0.4812	0.5002
	SE	0.7288	0.7479	0.7401	0.8027	0.8278	0.8963	0.8844	0.8327	0.8256
	PE^{VRS}	0.6004	0.5886	0.5932	0.5968	0.5753	0.6130	0.6290	0.5990	0.5966

Note: Estimated with “DEA Excel Solver”.

Source: Own estimations.

Figure 3.4 shows that, for German insurers, scale efficiency increases with firm size: the figure presents a scatter plot of scale efficiency scores against the logarithm of total output, which measures the size of the insurance firms for the year 2000.[44] Scale efficiency increases up to an output size of approximately 1.18 billion €, where firms show a scale efficiency of 1 (i.e., where they operate at optimal size). For firms larger than 1.18 billion €, scale efficiency decreases again.

Figure 3.4: Scale Efficiency versus Size, Year 2000



Source: Own calculations.

An analysis of the nature of returns to scale for every firm reveals that all firms up to 1.18 billion € show increasing returns to scale, while larger firms show decreasing returns to scale. These results are confirmed for the whole observation period. Table 3.2 illustrates the number of insurers operating under increasing, constant, and decreasing returns to scale (in percent) for every year by size quartiles, where firm size increases from quartile 1 to quartile 4. The results show that increasing returns to scale apply to the majority of the German life insurance firms, with only a few firms operating under constant or decreasing returns to scale.

[44] Because of space limitations, Figure 3.4 presents the scatter plot only for 2000, but the results are consistent and stable over the whole observation period.

Table 3.2: Returns to Scale by Size Quartiles, 1997-2005

		1997	1998	1999	2000	2001	2002	2003	2004	2005
Quartile 1	% IRS	100	100	100	100	100	100	100	100	100
	% CRS	0	0	0	0	0	0	0	0	0
	% DRS	0	0	0	0	0	0	0	0	0
Quartile 2	% IRS	100	100	100	100	85.0	100	100	100	100
	% CRS	0	0	0	0	5.0	0	0	0	0
	% DRS	0	0	0	0	10.0	0	0	0	0
Quartile 3	% IRS	100	100	100	100	0	100	100	100	90.0
	% CRS	0	0	0	0	0	0	0	0	5.0
	% DRS	0	0	0	0	100	0	0	0	5.0
Quartile 4	% IRS	0	21.7	8.7	4.8	0	80.0	80.0	5.0	0
	% CRS	5.6	4.3	4.3	4.8	0	5.0	5.0	5.0	0
	% DRS	94.4	73.9	87.0	90.5	100	15.0	15.0	90.0	100
Total	% IRS	78.3	80.4	77.4	77.9	46.9	95.0	95.0	76.5	72.5
	% CRS	1.2	1.1	1.1	1.1	1.2	1.3	1.3	10.2	1.3
	% DRS	20.5	18.5	21.5	21.8	51.9	3.8	3.8	22.2	26.3

Note: Estimated with “DEA Excel Solver”.

Source: Own estimations.

Over the whole observation period, only the largest 20 percent or so show decreasing returns to scale on average.[45] With regards to the underlying technology, the maintained hypothesis should be VRS.

An analysis of the average efficiency scores and returns to scale determination for the single size quartiles underscores these results. The results in table 3.1 show a positive relationship between cost and profit efficiency levels and size quartile, with larger firms being more cost and profit efficient. This relationship holds true for the whole observation period with only few exceptions.

Scale efficiency also increases from quartile 1 to quartile 3, and then decreases in quartile 4 (with the only exceptions in 2001 and 2005, where it already decreases in the third quartile). The reason for this decline is that the majority of the firms in quartile 4 exhibit decreasing returns to scale, i.e., they have exceeded their optimal size. These results are also confirmed by the nature of returns to scale by quartiles, wherein all firms in the two smallest quartiles (1 and 2) show increasing returns to scale, and the majority of firms in quartile 3 also represent increasing returns to scale, with the only exception being year 2001. Constant or decreasing returns to scale can be found only in quartiles 3 and 4, while the majority of the firms showing decreasing returns to scale belong to quartile 4.

[45] The only exceptions are the years 2001-2003: In 2001, the majority of the firms showed decreasing returns to scale, while in 2002 and 2003 the number of firms showing decreasing returns to scale is very small (3.8 percent). The results are broadly consistent for cost and profit efficiency estimations. Firms reach their optimal size at a similar size in the case of profit efficiency, and the number of firms operating under DRS slightly increases.

3.6.2 Cost and Profit Efficiency Levels by Distribution Systems

Tables 3.3 and 3.4 report our results on the groupwise comparison of average cost, scale, and profit efficiency scores for the three different groups of insurers we analyzed. We tested the groups of direct and independent agency insurers against the group of multi-channel insurers to compare the performance of the two single-distribution channel approaches with the multi-channel approach.

To compare the mean efficiency scores of different subgroups in the sample, we employ the nonparametric Mann-Whitney-U test.[46] We start with the comparison of direct and multi-channel insurers before turning to the independent agency insurers.

Surprisingly enough, direct insurers show lower CE^{CRS} levels compared to multi-channel insurers. The differences between both groups are significant until the year 2000. The reason for the large differences in CE^{CRS} can be attributed to scale advantages: Direct insurers show much lower scale efficiency levels in all years, with significant differences in five years. Further, our analysis shows that all direct insurers show increasing returns to scale over the whole observation period (with the only exception in 2005), so all of them are operating under decreasing average costs and none has reached its optimal size. Hence, the analysis of CE^{VRS} shows that the differences in cost efficiency between the groups disappear: from year 2001 on, direct insurers even show slightly higher efficiency scores compared to multi-channel insurers. Differences in PE^{VRS} between both groups are rather small and insignificant, with the exception of the year 1998. As profit efficiency is only estimated under the assumption of VRS, the relationship between both groups in terms of CE^{VRS} translates into profit efficiency. Thus, there seem to be no systematic differences in the revenue efficiency of both groups.

[46] As a robustness check, we also applied a Kolmogorov-Smirnov type test to test for differences between the groups (Banker, 1993). With few exceptions, the results are identical to the Mann-Whitney-U test results, and all qualitative results remain the same.

Table 3.3: Average Cost and Scale Efficiency by Groups, 1997-2005

	Multi-Channel insurers			Direct insurers			Independent agent insurers		
	CE^{CRS} (SD)	CE^{VRS} (SD)	SE (SD)	CE^{CRS} (SD)	CE^{VRS} (SD)	SE (SD)	CE^{CRS} (SD)	CE^{VRS} (SD)	SE (SD)
1997	0.3210	0.4436	0.7736	0.2383*	0.4790	0.4895*	0.1857*	0.3475	0.6577*
	(0.1269)	(0.2213)	(0.2069)	(0.3085)	(0.3234)	(0.4190)	(0.1289)	(0.2634)	(0.3198)
1998	0.3480	0.4610	0.8011	0.2185*	0.4178	0.4785*	0.1813*	0.3136*	0.6884
	(0.2858)	(0.2270)	(0.1967)	(0.2859)	(0.2781)	(0.3974)	(0.1247)	(0.2564)	(0.2739)
1999	0.2854	0.4141	0.7692	0.2504*	0.4342	0.5562*	0.1648*	0.2906*	0.7210
	(0.1057)	(0.2190)	(0.2238)	(0.2873)	(0.3073)	(0.3579)	(0.1009)	(0.2520)	(0.2705)
2000	0.4089	0.4905	0.8416	0.3021*	0.4548	0.6125*	0.1755*	0.2810*	0.7509
	(0.1960)	(0.2384)	(0.1431)	(0.2921)	(0.2860)	(0.3309)	(0.1499)	(0.2730)	(0.2600)
2001	0.3972	0.4738	0.8603	0.3807	0.5753	0.6397	0.1997*	0.2467*	0.7810
	(0.1827)	(0.2216)	(0.1697)	(0.3178)	(0.3226)	(0.3799)	(0.1380)	(0.1441)	(0.2296)
2002	0.4491	0.4838	0.9288	0.4012	0.5376	0.7473*	0.2009*	0.2232*	0.8322*
	(0.1863)	(0.2018)	(0.1586)	(0.2611)	(0.3056)	(0.2990)	(0.1594)	(0.1565)	(0.1989)
2003	0.4889	0.5437	0.9071	0.5104	0.6631	0.7731	0.2868*	0.3255*	0.8514
	(0.1965)	(0.2140)	(0.1343)	(0.2637)	(0.2728)	(0.2725)	(0.1739)	(0.1602)	(0.1667)
2004	0.4123	0.4981	0.8477	0.4380	0.5820	0.7141	0.2410*	0.2860*	0.8467
	(0.1690)	(0.2166)	(0.1377)	(0.2976)	(0.2705)	(0.3371)	(0.1100)	(0.1104)	(0.1589)
2005	0.4324	0.5154	0.8607	0.3642	0.5568	0.6525	0.2679*	0.3525*	0.7884
	(0.2000)	(0.2443)	(0.1484)	(0.2616)	(0.2296)	(0.3601)	(0.1196)	(0.1633)	(0.2373)

Note: *: Differences between efficiency scores are statistically significant between groups according to the Mann-Whitney-U-test. Multi-Channel insurers were tested against direct and independent agent insurers, respectively. Detailed test results are available from the author on request; Estimated with "DEA Excel Solver".

Source: Own estimations

Table 3.4: Average Profit Efficiency Scores by Groups, 1997-2005

	Multi-Channel insurers	**Direct insurers**	**Independent agent insurers**
	PE^{VRS} (SD)	PE^{VRS} (SD)	PE^{VRS} (SD)
1997	0.5888 (0.2835)	0.5617 (0.3437)	0.7099 (0.2521)
1998	0.6396 (0.2605)	0.4048* (0.3974)	0.4643 (0.3887)
1999	0.6307 (0.2633)	0.4764 (0.3618)	0.4681 (0.4082)
2000	0.6390 (0.2733)	0.5711 (0.3840)	0.3896* (0.3603)
2001	0.6088 (0.2734)	0.6470 (0.4106)	0.3341* (0.2684)
2002	0.6469 (0.2437)	0.6567 (0.3664)	0.3664* (0.2975)
2003	0.6565 (0.2552)	0.7883 (0.2608)	0.3494* (0.2516)
2004	0.6164 (0.2495)	0.6735 (0.3932)	0.4243* (0.2198)
2005	0.6274 (0.2702)	0.6189 (0.3661)	0.3897* (0.1925)

*: Differences between efficiency scores are statistically significant between groups according to the Mann-Whitney-U-test. Multi-Channel insurers were tested against direct and independent agent insurers, respectively. Detailed test results are available from the author on request; Estimated with “DEA Excel Solver”.

Source: Own estimations.

From our results, we conclude that hypothesis 1 has to be rejected: Direct insurers do not show the expected cost advantage compared to multi-channel insurers. This seems to be due to the low scale efficiency direct insurers show, which does not permit them to realize their cost advantages. Though direct insurers are able to recoup some of their cost disadvantages over time, they have not yet reached a sufficient firm size to realize their theoretical cost advantages compared to multi-channel insurers.

We explain the limited growth of direct insurers as resulting from two factors. First, the nature of life insurance products is complex, so life insurance products are regarded as comparatively counseling-intensive products. Since direct insurers do not provide their customers with personal advice, customers could rather rely on multi-channel insurers for life insurance products and use direct insurers primarily for the purchase of more standardized products. In the case of life insurance products, term life insurance is an example of a more standardized, less complex insurance product. Actually, our data set shows that the share of term life insurance policies in direct insurers' portfolios is larger, on average, compared to multi-channel insurers' portfolios. Further, a direct insurer has been the market leader for term life insurance products since 1994 (AMB Generali, 2006). A second reason for the limited growth of direct insurers could be that multi-channel insurers are increasingly adopting direct distribution as an additional distribution channel. Thus, customers who are willing to use direct distribution channels do not necessarily need to switch to a direct insurer (Krah, 2006). This underscores the importance of reputation in insurance markets; because insurance products are credence or trust goods and direct insurers are mainly young firms which were founded after the liberalization of the market. In contrast to established multi-channel insurers, they have not been able to build up a long-term reputation. Thus, customers could prefer to use additional channels of an established multi-channel insurer instead of switching to a direct insurer (Ennew and Waite, 2007).

The comparison of multi-channel insurers and independent-agency insurers shows that independent-agency insurers have lower cost efficiency, under both CRS and VRS assumptions. The differences between both groups are significant over the whole observation period, both under CRS and VRS.[47] From this, we conclude that our hypothesis 2.1 cannot be rejected: Independent agents insurers are less cost-efficient compared to multi-channel insurers, thus, we find evidence for higher costs which are incurred by the services of independent agents in the German insurance market. Concerning the scale efficiency scores, independent agency insurers also show lower scores compared to multi-channel insurers, but the differences are much smaller than they are in the case of direct insurers, and they are significant only for some years within the observation period.

With regard to profit efficiency, agent-based insurers are not able to recoup their disadvantage in terms of cost inefficiency, so they show lower average profit efficiency over the whole observation period and, from 2000 on, the differences are statistically significant.[48] Thus, we have to reject hypothesis 2.2: Compared to multi-channel insurers, independent agency insurers are not able to recoup their higher costs by corresponding higher revenues,

[47] The only exception being the differences in CE^{VRS} in 1997.

[48] The only exception is found in 1997, where independent agent insurers show a higher PE^{VRS} score, though the difference is not significant.

which would lead to similar profit efficiency levels between either group or even higher profit efficiency levels of independent agency insurers.

However, our result does not imply that independent agency insurers would not be able to provide their customers with higher service quality; it states only that the specialized distribution system of independent agent insurers does not seem to be superior, either in terms of costs or in terms of revenues, to distribution via multiple channels. The differences in profit efficiency between both groups have increased since the beginning of the observation period, which could indicate that independent-agency insurers have lost part of their customer base over time because of the increasing importance of distribution by independent agents for multi-channel insurers. Thus, insurance customers who want to make use of the services of independent agents are no longer limited to the product range of insurance firms that work exclusively with independent agents but increasingly have the opportunity to purchase products from multi-channel insurers.

Our analysis shows that specialized single-channel distribution insurers are not superior to multi-channel insurers. The results give evidence that direct insurers are not able to realize their expected cost advantage over multi-channel insurers. Also, independent-agency insurers are unable to take advantage of their hypothesized service superiority. Thus, the distribution of life insurance products via multiple channels seems to be superior to specialized single-distribution channels, as none of the specialized insurers shows a performance advantage.

3.7 Conclusions

Our analysis of the performance of single-channel distribution and multi-channel distribution firms in the German life insurance helps to explain the structure of the industries' distribution systems, where the distribution of life insurance products is dominated by multi-channel distribution firms, while specialized single-distribution insurers have only small market shares. Second, our paper gives insight into cost and profit efficiency levels among German life insurance firms during the period 1997-2005, and delivers information about scale economies in the German life insurance industry.

Applying an empirical framework developed by Berger et al. (1997), we estimate cost and profit efficiency for three groups of life insurance firms with different distribution systems – multi-channel insurers, direct insurers, and independent agent insurers – from a sample of German life insurers. Testing two hypotheses, we find economic evidence for the coexistence of the different distribution systems, which is the absence of performance advantages of specialized insurers.

According to economic theory, direct insurers should show higher cost efficiency compared to multiple channel insurers because of their theoretical cost advantages (hypothesis 1). Independent agent insurers should focus on high quality services and by this, realize higher revenues compared to multi-channel insurers (hypothesis 2.2). However, our results show that both hypotheses have to be rejected, since specialized single-channel insurers do not outperform multi-channel insurers in terms of either cost and profit efficiency and, thus, do not represent a superior distribution system. This result explains why their market share has remained small despite the increasing importance of direct distribution and the increasing use of independent agent insurers in the German life insurance market.

Our results also explain the development in the distribution systems of the German life insurance industry after its liberalization. As had been expected, the dominance of exclusive agents which prevailed in the German life insurance industry until the 1994 liberalization has been declining in favor of distribution via direct channels and independent agents. However, specialized direct insurers and independent agent insurers have not been the primary beneficiaries of this development; instead, it is the multi-channel insurers which have succeeded in incorporating additional channels into their distribution systems (e.g., Krah, 2006). Thus, one might conclude that distribution via multiple channels is superior to specialized distribution systems in the life insurance industry. Similar results are found for the U.K. life insurance industry, where the traditional single-channel distribution via independent agents is declining in favor of multi-channel distribution strategies (Gentle, 2007), and for the banking industry, where multi-channel distribution also dominates the single-channel approach (Economist, 2000).

Further, our work is able to give insight into cost, profit, and scale efficiency levels in the German life insurance industry. With regards to cost efficiency, we obtain mean values which range from 0.26 and 0.46 (CE^{CRS}) and 0.40 and 0.53 (CE^{VRS}). These scores are in line with the existing DEA efficiency studies on cost efficiency on German life insurance markets: For the period 2002 to 2005, Ubl and Diboky (2007) reported CE^{CRS} estimates for the German life insurance market, ranging from 0.35 to 0.39, which is similar to our results.[49] Mahlberg and Url (2007) referred an average cost efficiency under NIRS of 0.46 for a sample of German

[49] For comparable results for the U.S. life insurance industry see Cummins and Zi (1998) and Cummins et al. (1999).

insurance firms during the observation period of 1991-2001. Their results can only be compared to ours with reservation, as their sample covers property-liability, health, and life insurance firms. Finally, Hussels and Ward (2004) also estimated cost efficiency levels which are comparable to our results, both under constant and VRS. The profit efficiency we estimated ranges from 0.58 to 0.63. To our knowledge, there is no study which has analyzed DEA profit efficiency for the German life insurance industry so far.[50]

We further find that most German life insurance firms operate under increasing returns to scale. This holds true for the whole observation period. These results are in line with the previous studies on returns to scale in life insurance industries which find an inverse relationship between size and the percentage of firms operating under increasing returns to scale and a direct relationship between size and the proportion of firms operating with decreasing returns to scale (Cummins and Weiss, 2000). Our findings support also results from two recent studies: Bikker and van Leuvensteijn (2005) found that Dutch life insurance industries, on average, enjoy scale economies. Fenn et al. (2008) concluded that European insurance firms of all types seem to be operating under decreasing costs, i.e. under increasing returns to scale. This holds especially true for life insurance firms. Mahlberg and Url (2007) found that NIRS prevail in the German insurance industry which would mean that insurance firms either operate under increasing or constant costs. Their result contrasts to Fenn et. al (2008), as well as to ours which may be due to the fact that their sample contains life, property-liability, and health insurance firms.

To sum up, our work represents a twofold contribution to the existing literature. It contributes to the previous research on the coexistence of different distribution systems in insurance industry which had been limited, to a large extent, to the comparison of exclusive agent versus independent agent insurers so far. Further, it gives insight into cost, profit, and scale efficiency levels of the German life insurance industry during the post-liberalization period 1997-2005.

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[50] Berger et al. (2000) used a Distribution Free Approach (DFA) to estimate efficiency for U.S. life insurance firms for the period 1988-1992, and reported rather low profit efficiency scores; the average profit efficiency score was only 0.26. Though, the results should only be compared with caution, as DFA efficiency scores are usually lower compared to DEA results (Cummins and Zi, 1998). Paradi (2006) used a DEA approach and reported average PE^{VRS} of 0.567 for a sample of Canadian life and health insurance firms for the year 1998. Thus his results are similar to ours. However, a comparison of results from different studies which vary concerning the data set used, the time period which is analyzed, and the choice of variables should be treated cautiously.

4 The Effects of Liberalization and Deregulation on the Performance of Financial Institutions: The Case of the German Life Insurance Market

4.1 Introduction

In 1994, European life insurance markets were liberalized by the Third Life Insurance Directive. Since then, insurance firms have been able to operate freely throughout the member states, either by establishing their own branches and agencies throughout the European Union, or by direct cross-border trade. Market consolidation has increased as a consequence of intense (cross-border) M&A activities, and the main part of the existing product and price regulations were abolished. By this, the European Union aims to enhance the efficiency of the national insurance markets through increased competition and consolidation. As a result, insurance customers should benefit from an increased product variety at more competitive prices.

As a consequence of the Third Life Insurance Directive, the German insurance market has undergone major changes in the past decade. Before European market liberalization, the market was characterized by severe price and product regulation, which allowed inefficient insurers to stay in the market. Competition was also highly limited because of regulations that restricted foreign insurance firms' access to the market. The stepwise liberalization of the market which resulted in a changed regulatory regime and an increased level of competition was accompanied by two other factors that have strongly affected the insurance environment. First, technological progress in information technologies has led to considerable changes in internal administrative and communication processes and has strongly influenced the structure and choice of distribution channels in most insurance firms. Most significantly, electronic distribution channels have simplified direct contact with the customer without the involvement of intermediaries. Second, changes in the statutory pension systems have resulted in increased demand for private and occupational old-age provision. This development is backed by state-run promotion of certain old-age provision products, with life insurance firms facing strong competition by banks in this field.

This study analyzes whether the aims of the liberalization process have been achieved in the German life insurance market, i.e., whether increased competition as a consequence of the liberalization has resulted in better market performance. To accomplish this analysis, we analyze possible effects of the liberalization process on market performance by applying the revised SCP paradigm. The traditional SCP paradigm addresses the relationship between market structure and performance via the conduct of the firms in an industry (e.g., Mason, 1949, and Bain, 1951). The revised SCP paradigm also accounts for possible feedback effects of market performance on the structure and conduct of firms (e.g., Demsetz, 1973) so, in this study, it is used to analyze the effects of liberalization and the corresponding changes in the regulatory regime. Market performance is analyzed by measuring the total factor productivity (TFP) change of the industry, which is composed of technical change and changes in (technical) cost and scale efficiency. We also measure profit efficiency change in the industry after market liberalization.

If market liberalization has been successful, cost and profit efficiency will have increased as competition forces firms to reduce costs and to realize unused profit potentials. An increase in profit efficiency might also result from firms' undertaking innovations in services and products which raise costs but also lead to higher prices and profits, even though cost efficiency decreases. Increased competition may also induce firms to exploit formerly unused scale economies by moving to the most productive production size, i.e., the point of minimum average costs. It is also important to analyze changes in scale efficiency, as an increased scale efficiency and market consolidation may reduce competition. Thus, in a second step, cost and profit efficiency might decrease as a feedback effect. Finally, an analysis of market performance would not be complete without taking into account technical change; it is expected that increased competition provides incentives for firms to adopt new technologies and increase productivity, so we expect positive technical change in the industry. This is supported by a technology-pull effect resulting from important innovations in information technologies. Analysis of both the effects of efficiency and technical change provides evidence of the main drivers of TFP growth after market liberalization.

Previous evidence from the German industry is limited. Hussels and Ward (2004) analyzed cost efficiency and technical change using a small sample of German life insurance firms over the period 1991-2002, applying a non-parametric Malmquist DEA analysis to a randomly chosen, balanced panel of 31 German life insurers which persisted in the industry over the entire period. However, they neglected the possible effects of firms which entered or exited the market as a consequence of the liberalization of the market. In addition, the random choice of insurance firms in the sample may have resulted in biased data. Mahlberg and Url (2007) conducted a non-parametric Malmquist DEA for the whole German insurance industry using a balanced panel containing only firms which remained in the sample over the whole observation period 1991-2002.

Our data set contains information about the German life insurance industry for the years 1995-2002. We use an unbalanced panel in order to account for possible effects on market performance resulting from firms' entering or exiting the market during the observation period and extend the research by incorporating profit efficiency change into the analysis, which has not been done by previous studies. It is important to account for changes in profit efficiency, in addition to changes in cost efficiency, because, as a consequence of the liberalization process, life insurance firms have innovated by creating new products and services. These innovations may raise costs, but they may also lead to increased revenues. In contrast to cost efficiency measurement, which takes only the cost side into account, profit efficiency measurement also considers firms' revenues and, thus, allows a more complete analysis of changes in market performance (e.g., Berger and Mester, 2003). Thus, this paper provides new and extended evidence on the effects of liberalization in the German life insurance industry.

To obtain measures of cost efficiency, scale efficiency, and technical change, we use a stochastic distance frontier panel approach recently developed by Greene (2005) to disentangle inefficiency and firm-specific heterogeneity. Profit efficiency is derived by applying a novel approach developed by Kumbakhar (2006), which accounts for possible price-setting power of the firms. In contrast to the standard profit function, where firms take output prices as given, the non-standard profit function takes account of the increasing product competition in the market that may enable firms temporarily to achieve price-setting power.

The paper is structured as follows. Section 4.2 gives an overview of past and present regulation of the German life insurance market. Section 4.3 derives the hypotheses to be tested in the study and gives an overview of previous evidence on the effects of market liberalization and deregulation on insurance markets. Section 4.4 presents the methodology. The data set and the chosen variables are described in section 4.5. Section 4.6 presents the results of the SFA, and the measurement of changes in TFP growth and efficiency, and section 4.7 concludes the study.

4.2 The Regulatory Regime in the German Life Insurance Industry

An overview of the regulatory regime in the German life insurance industry begins in section 4.2.1 with a discussion of the situation before the liberalization of the market. Section 4.2.2 presents the European liberalization process, and section 4.2.3 overviews the current regulation of the German life insurance industry.

4.2.1 The Regulation of the Industry before 1994

There are several reasons why most countries regulate their insurance industry (Vollbrecht, 2001). Perhaps most important is that many insurance policies are long-term contracts, and the insurance customer is a conditional creditor to the insurance company in case of a loss. Because of the high complexity of insurance products, there are high information asymmetries between customer and the insurer, which prevent the insured from supervising and monitoring the insurance firms (e.g., van den Berghe, 1991). Thus, global supervision of insurance firms by a regulatory agency is more efficient than a separate check by each customer, which would lead to prohibitively high individual costs (Kunreuther et al., 1983). Another reason is based on the risk of insolvency of an insurance firm, which would cause policy holders to lose their conditional claims or prevent harmed third parties from being compensated. Supervision of insurance firms' solvency is generally accepted as a way to avoid these kinds of social costs. Although the regulatory systems in the member states generally had regulatory agencies that supervised insurance firms and monitored their solvency, these systems differed significantly in other ways before the adoption of the European insurance directives. European insurance markets had two different concepts of insurance regulation and supervision: On one hand, countries like the United Kingdom, the Netherlands, and Ireland relied on a regulatory system resembling the regulation later imposed by the European Union, which centered on licensing of insurance firms in connection with the supervision of financial solvency of the firms (formal supervision); on the other hand, the German insurance market, together with the Austrian and the Swiss insurance markets, was characterized by a strict regime of material supervision (van den Berghe, 1991). While formal supervision centers on minimizing the costs associated with a possible insolvency of an insurance firm, the material supervisory system tries to prevent any insolvency.[51]

[51] For a more detailed overview of motivations for insurance regulation, different regulatory systems, and theories, see Zweifel and Eisen (2003), chapter 8.

The German regulatory concept encompassed all elements of the supervisory system which prevailed in the United Kingdom, the Netherlands, and Ireland, but extended the regulation to a prior approval system in which every tariff and every product had to be accepted before the insurance firm could conduct its business (e.g., Everson, 1996). The entry of a new insurance firm into the market was subject to various requirements. For example, the prospective entrant had to submit a business plan containing detailed information about the contract conditions, premiums, expected costs, and revenues, and the amount of provided reserves. In addition, contract conditions were largely harmonized, as new contract types had to be submitted to the regulatory agency, and some contract elements were standardized. Price competition was highly restricted, as premiums were regulated according to a cost-plus price regulation. Based on a standardized calculation of expected loss common for all insurers, insurers could calculate their premiums by adding to them an amount unique to themselves that depended on the insurer's costs. To facilitate standardized calculation, German insurers were partly exempted from competition law by article 102 of the German Law Against Restraints on Competition (*Gesetz gegen Wettbewerbsbeschränkungen*), which allowed the insurance firms with the objective of joint product and rate agreements to form cartels (Hollenders, 1985).

As a consequence of the prescribed minimum price levels, German life insurers pursued a revenue-maximizing, rather than a profit-maximizing objective, focusing on increasing their sales strength to maximize their turnover. Because price competition was restricted, insurance firms competed for new business by increasing selling and advertising costs and based competition mainly on service (e.g., Hess and Trauth, 1998; Rees and Kessner, 1999). Thus, German life insurers engaged heavily in selling activities by large, exclusive sales forces, the most important distribution channel in life insurance, keeping independent agents and direct sale to a minor role. Because of restrictions on product and price competition, insurance customers were not interested in using independent agents or insurance brokers to compare several offers from different insurers (Finsinger, 1992; Finsinger and Schmid, 1993, 1994). Further, price-regulation limited the possibility of direct insurers' offering low ex ante premium levels. Commissions paid to agents were restricted to 11 percent of the premiums, and total marketing expenditures could not exceed 30 percent of total premiums. Finally, German life insurers were also profit-regulated, as 90 percent of any amount of insurers' profits which exceeded 3 percent of premium income had to be redistributed to policyholders and shareholders (e.g., Rees and Kessner, 1999). Thus, ex post price competition was possible but, from the customers' point of view, it was difficult to obtain a market overview over rebates. For their part, German life insurers were limited in their investment activities and in the types and amounts of assets they could hold; as a consequence, insurers held a substantial amount of fixed-interest assets.

4.2.2. The European Liberalization and Deregulation Process

The European Union aims at the establishment of a Single Market for Financial Services because integrating Europe's financial markets should foster competition between financial firms and lead to higher efficiency in these markets, and customers should benefit from an increasing variety of financial products at more competitive prices (e.g., Hogan, 1995).[52] Three life insurance directives were issued between 1973 and 1992 to enforce these principles. The First Directive on Life Insurance (79/267/EEC) (ECC, 1979) allowed life insurance firms to open subsidiaries, branch offices or agencies in every EU member state (freedom of establishment). Because of large differences in regulatory regimes, cross-border activities had remained small; at the end of 1988, cross-border life insurance activities among the member states amounted to less than 1 percent of total life insurance business (Sterczynski, 2003). Still, the concept of host country control prevailed after the First Directive, and the regulatory agency of the host country remained responsible for supervising the foreign insurance firms (e.g., Thimm, 1999; Hess and Trauth, 1998). The Second Life Insurance Directive (90/619/EEC) (ECC, 1990) established freedom of services, which made it possible to carry on insurance business in foreign member states without having a fixed subsidiary or branch office. The host country principle remained for private mass risks, impeding intensive cross-country activities. Only in cases in which the insurance customer took the initiative to buy an insurance contract from an insurance firm in a foreign member state, the home country of the insurer remained responsible for its regulation (e.g., Chrystal and Coughlin, 1992). Finally, the Third Directive on Life Insurance (92/96/EEC) (ECC, 1992a) completed the freedom of establishment and services.[53] The directive abolished price and product regulation in those member countries where these elements of material regulation still existed (e.g., Germany) and made price competition possible, as minimum price levels

[52] For a more detailed overview of the process of creating a EU Single Market for Financial Services, see the Financial Services Action Plan 1999-2005 (European Commission, 1999), and the White Paper on Financial Services Policy (2005-2010) (European Commission, 2005). The former describes the foundations of the creation of the single market for financial services (including banking, insurance, and pension funds services), and the latter describes the objectives in this area of financial services policy for the period extending to 2010.

[53] Today, the First, Second, and Third Directives on Life Insurance are no longer in force but have been repealed and replaced by a single directive (2002/83/EC) (EC, 2002a).

were no longer prescribed (Schmidt, 2002). The Third Directive also removed restrictions on distribution and marketing expenditures.

Liberalization restricts host country supervision to solvency supervision, giving over all remaining fields of supervision to home country supervision. Life insurance firms need only a single license, issued by the regulatory agency of their home country, to operate throughout the European Union, either under the principles of freedom of establishment or under the principle of freedom of services. However, if a subsidiary is established in a foreign country, the host country principle remains. Finally, the principle of minimum harmonization was established, requiring insurance firms to meet the minimum principles established in the Third Directive. The national regulatory agency is free to impose more stringent standards on its domestic insurance firms, but foreign insurers must be allowed to conduct their business according to the minimum principles (e.g., Hogan, 1995).

4.2.3 Current Regulation

Despite the liberalization process, which was completed by the Third European Directives, the insurance business in Germany is still limited, to an extent, by the remaining regulatory requirements regarding the amount of technical liability and solvency capital. To date, it remains the main objective of insurance regulation to provide the insurance company with a high level of credibility as a firm able to meet its actual and future (contingent) obligations by reducing the insolvency risk of an insurance firm. The supervision by the Federal Financial Supervisory Authority (Bafin) can be divided into two major parts: the official authorization of an insurance firm by the regulatory body and the permanent supervision of its financial stability.[54] For the initial authorization, the supervisory agency examines every legal entity wishing to conduct insurance business, irrespective of its affiliation to a larger group or its holdings (e.g., Will, 1997). The permanent supervision covers four main areas: establishment of sufficient technical provisions, solvency requirements, investment restrictions, and stress tests.

Technical provisions serve as liability reserves and are designed to capture uncertain future liabilities arising from the insurer's underwriting activities. In life insurance, the actuarial reserves (*Deckungsrückstellung*) represent the most important technical provision. Current regulation imposes two principles concerning the actuarial reserves of life insurance firms:

[54] The Bafin was established in 2002 and performs the functions of the former supervisory authorities for banking (*Bundesaufsichtsamt für das Kreditwesen*), securities (*Bundesaufsichtsamt für den Wertpapierhandel*), and insurance (*Bundesaufsichtsamt für das Versicherungswesen*).

their volume must be based on prudent prospective actuarial valuations, and their adequacy must be certified by an appointed actuary. The second principle is an additional feature of life and health insurance regulation, since most insurance contracts in these insurance lines are long-term (e.g., Will, 1997; Maurer and Somowa, 2007). Since the adoption of the Third Directives, there is no direct price regulation for any insurance line in the German insurance market; however, the insurance firms are limited in the calculation of their premiums by the regulatory requirements regarding the establishment of sufficient liability reserves and solvency capital. In the life insurance lines, the calculation of premiums is therefore verified by an appointed actuary (e.g., Rabe, 1997).

As for solvency requirements, life insurance regulation is based on European Community Directives from 1979 and 2002 (Directive 2002/83/EC – the "Solvency I" project).[55] The regulatory aim is to determine the risk-adjusted adequate level of solvency capital by using a two-step procedure. First, the required solvency capital is estimated; required solvency capital for life insurers consists of a 4 percent fraction of the mathematical provisions (to cover investment risks), a 1 percent fraction of the technical provisions (to cover the risks of policies, whereby the insurer carries no investment risk), and a 0.3 percent fraction of the capital at risk. Second, the required capital is compared to the actual amount of insurer's solvency capital. This consists of solvency capital A, encompassing equity capital, participating certificates, and subordinated debt as stated in the balance sheet; solvency capital B, the profit reserves; and solvency capital C, hidden reserves and estimated future profits. The solvency requirements are met if the available capital exceeds the required solvency capital; otherwise, the regulatory agency may establish a plan for recovering solvency or may even prohibit underwriting of new business. To ensure the proper supervision of insurance firms, insurers are obliged to report the required and available solvency capital quarterly to the regulatory agency.

Investment restrictions are the third aspect of insurance supervision. Insurers' investments are regulated because some of insurers' funds belong to the insurance customers but are managed by the insurer until the expiration or cancelation of the insurance contract. Insurers

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[55] The Solvency I framework is currently being modified within the so-called "Solvency II" framework. Solvency II follows the example of the New Basel Capital Accord (Basel II) from 2001, which regulates banking supervision. Similar to Basel II, Solvency II is based on a three-tier-approach: It aims at a risk-based supervision of insurance firms, taking into account the growing heterogeneity of risks, the increasing integration of banking and insurance services, and the supervision of insurance groups. Solvency II has not yet been implemented, so a closer analysis of this framework is not offered here.

can have two types of funds – free and tied. Tied funds are all assets covering the technical provision (i.e., the loss reserve, aging reserve, funding reserve, and unearned premium reserve), and are subject to regulation. All remaining assets are free funds. The regulatory agency defines qualitative and quantitative investment principles to protect the invested "tied" funds. Quantitative standards concerning the diversification of the invested funds allow, for example, no more than 35 percent of the tied assets to be invested in stocks. In 2004, new types of assets, like asset-backed securities and hedge funds, were included in the list of authorized assets according to the Investment Directive (EC, 2004) in response to the changing financial product markets.

Stress tests are the last part of the current regulatory regime. Established in 2003, stress tests are used to analyze the company's risks in a detailed way by considering the level of market risk, credit risk, foreign exchange risk, operational risk, legislative risk and liquidity risk to estimate the impact of external changes on the financial stability of the insurance firm. Further, foreign exchange, operational, and legislative risks are also considered. The stress tests assume that certain developments of capital markets are possible and determine whether the insurance company would be able to meet its contractual obligations without taking countermeasures in a simulated crisis situation.

To sum up, the regulation and supervision of German life insurance firms has changed from a very strict material regulation before 1994 to a very detailed but less intrusive regulation centering on the supervision of insurance firms and preventing insurers' insolvency. The next section describes how these changes in regulatory regime together with the liberalization of the market may affect the industry's structure, firms' conduct and market performance.

4.3 Theoretical Background and Previous Evidence

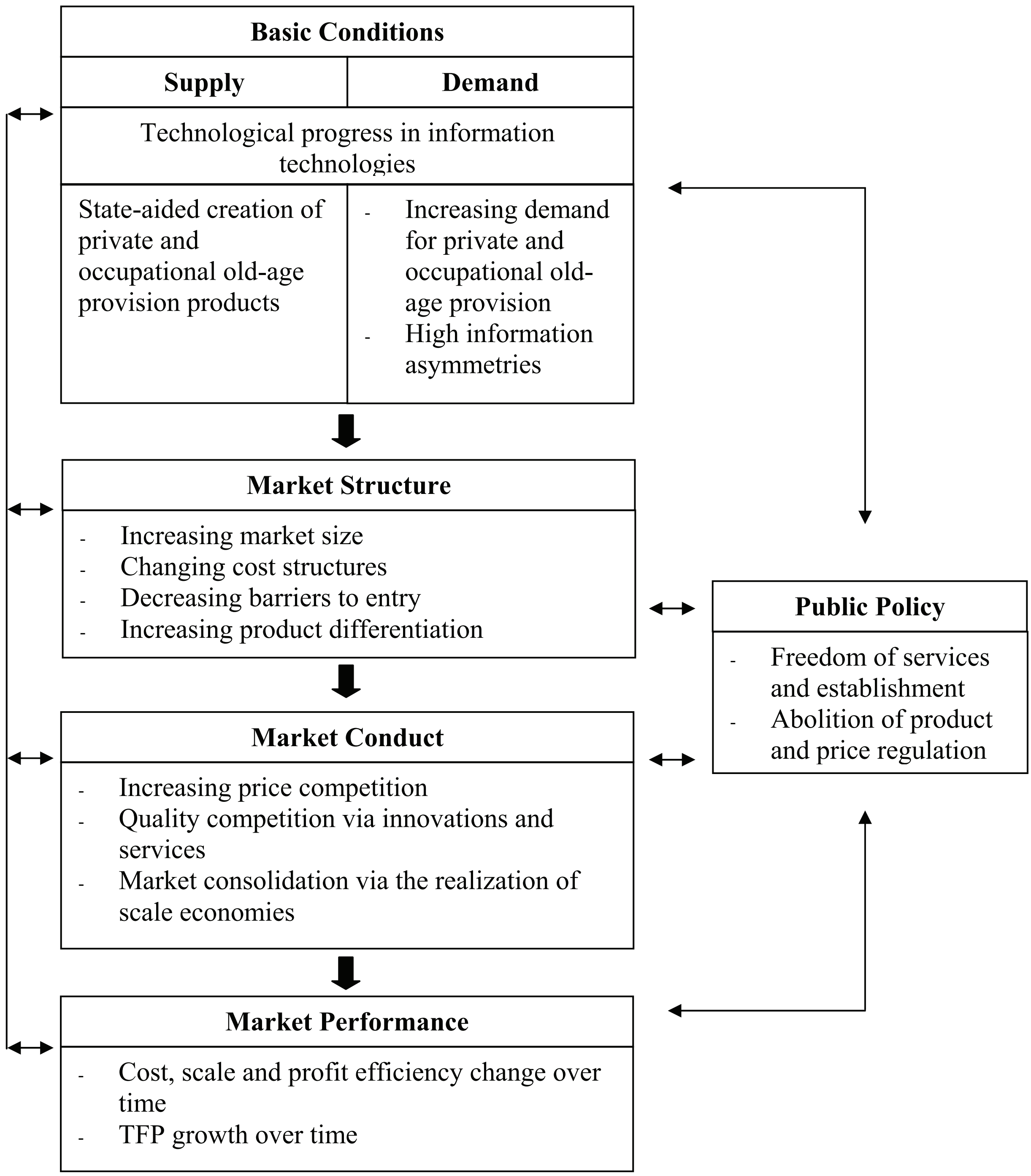
In this section, the regulatory changes connected with the liberalization of the European insurance markets are analyzed within the framework of the SCP paradigm (e.g., Mason, 1949; Bain, 1951). The revised SCP paradigm takes account of the fact that all variables are endogenous as a result of interactions between market structure, conduct, and performance (e.g., Demsetz, 1973). In section 4.3.1, the paradigm is applied to insurance markets to describe and analyze the possible effects of changed regulations on the structure, the conduct, and particularly the performance of the German life insurance market. Section 4.3.2 derives our hypotheses concerning the evolution of cost and profit efficiency in the market, as well as changes in technical and scale efficiency. Section 4.3.3 gives an overview of existing literature on the effects of market liberalization on insurance markets.

4.3.1 Effects of Liberalization and Deregulation within the (Revised) SCP-Paradigm

The traditional SCP paradigm addresses the relationship between market structure and performance via the conduct of the firms in an industry, where the *performance* of a market depends on the *conduct* of the market participants. Conduct, in turn, depends on the *market structure*, which is affected by *the basic conditions* of the industry and the prevailing *public policy* regime. The SCP paradigm can be used to analyze the effects of liberalization and the corresponding changes in the regulatory regime on market performance in the German life insurance industry. Possible feedback effects of market performance on the structure and conduct of firms are accounted for by the revised SCP paradigm. Figure 4.1 presents the structure of the revised SCP paradigm for the German life insurance market.[56]

[56] Only those aspects relevant to this study have been included in the SCP framework in figure 4.1. Thus, the figure makes no claim to be complete but serves as a guideline for the following analysis. For a more detailed description of the revised SCP paradigm, see, e.g., Scherer and Ross (1990) and Schwalbach (1994). For an application to banking markets, see Neuberger (1998).

Figure 4.1: Revised SCP Paradigm – Possible Effects of Market Liberalization



Source: Own composition following Neuberger (1998), p. 99.

Public policy includes the main actions of the liberalization process in the German market: implementation of the principles of freedom of services and establishment and the abolition of price and product regulation.

The *basic conditions* of the market changed during the period of interest for this study (1995-2002), particularly because important technological changes occurred in the field of information technology, which led to changed supply and demand conditions in insurance markets (e.g., Cummins et al., 1999). Insurance firms implemented new technologies for pricing, underwriting, policyholder services and distribution. Operating procedures and the communication channels within the company also changed as a consequence of technical change in information technologies (e.g., Köhne and Kopp, 2007). On the demand side, because of the internet, customers became increasingly able to inform themselves about insurance products and to purchase their products online. (For a detailed analysis of this process, see chapter 3.)

Another basic condition which influences the demand side is that insurance markets are characterized by large information asymmetries and high complexity, so insurance customers face difficulties in assessing the content and quality of insurance products and the financial stability and solvency of insurers.[57] These information asymmetries are of special importance in life insurance markets, as most life insurance products are both highly complex and long-term (e.g., Finsinger et al., 1985). As a consequence, trust and reputation of firms play an important role in insurance markets, and customers often prefer to purchase their products from established, well known suppliers (e.g., Beckmann et al., 2002). The high information asymmetries also help to explain the importance of distribution channel choice for insurance firms: In most cases, especially for long-term and complex life insurance products, insurance services are still provided by intermediaries (insurance agents or brokers) who help the customer to assess and choose suitable products. The supply and the demand side of life insurance products have also been affected by changes in the statutory pension systems (e.g., Maurer and Somova, 2007), and by newly created opportunities for employees to contribute to pension plans (e.g., Boléat, 1995; van den Berghe, 2001).

Market liberalization has had an important effect on the *market structure*. First, the size of the market has changed as a consequence of the establishment of freedom of services and

[57] The information asymmetries in insurance markets are two-sided, as insurance firms also face difficulties in evaluating the individual risk of potential insurance customers (e.g., Finsinger et al., 1985). Though, possible information asymmetries to the burden of the insurer are not in the focus of this study, and are not further considered in the following.

establishment. German life insurers now face potential competition from the whole European market, although competition by foreign insurers occurs mainly via M&A activities and only to a lesser extent via direct cross-border trade or the establishment of agencies (Beckmann et al., 2002). Farny (2002) pointed out that M&A activities by foreign insurers are not a direct consequence of market liberalization, as they were already possible before 1994; however, these activities have certainly increased since then.

Second, entry barriers to the market may have decreased because technological progress in information technology has eliminated the need for a large sales force and eased market entry for new direct insurers which offer their products exclusively via the internet. Still, certain barriers to entry persist because of remaining differences in regulation (e.g., differing tax regimes) and the large, exclusive sales forces still common in the German life insurance market. These may represent a barrier to entry to foreign insurers, as building up an own sales force would be very costly (e.g., Farny, 1989; Regan and Tennyson, 2000). Further barriers to entry may be due to economies of scale or reputation (or lack thereof). For example, the actual market share via direct distribution in life insurance markets remains small despite of technological progress (see chapter 3). The overall effect is that potential competition has increased as a consequence of market liberalization, but that effect is still limited because of customer loyalty to domestic, well established insurers and because of the large sales forces of domestic insurance firms (e.g., van den Berghe, 2001; Schmidt, 2002).

Third, cost structures have changed because technological changes allow insurance services to be provided at lower costs (e.g., Heinemann and Jopp, 2002) and because the abolition of price regulation provides incentives for insurance firms to minimize their costs (Rees and Kessner, 1999; Kessner, 2001). The market after liberalization is also characterized by increased product differentiation, since the abolition of ex ante product approvals has made room for an increasing variety of life insurance products. This development is supported by an increasing demand for private and occupational old-age provision and by new insurance products offering private old-age provision. In the German market, the so-called Riester pension reform (established in 2002) and the Rürup pension plans (established in 2004) are thought to encourage private old-age provisions by enabling individuals to invest part of their income into individual pension accounts. The investment occurs on a pretax basis and is subsidized by the government. (For more details, see Maurer and Somova, 2007.)

As a consequence*, market conduct* has also been affected. The abolition of price regulation may have increased price competition in certain insurance lines, particularly standardized life insurance products, like term life insurance. Since price competition is more likely in standardized, less complex insurance lines, insurance customers are better able to compare prices, and direct insurers work to attract customers with lower premiums. On the other hand, quality variables may also influence competition in a liberalized market as insurers introduce new products or innovate on existing products or services to improve their own market position.

A final part of market structure is the possible scale effects resulting from increased M&A activities in a liberalized market.[58] Insurance firms are likely to realize increasing economies of scale because they have relatively large fixed costs from investments in computer systems and financial capital, and because the industry operates on the basis of the law of large numbers. The larger the policy portfolio of similar risks, the better the insurance firm's ability to assess the risks and the lower the risk volatility (e.g., Cummins and Rubio-Misas, 2006). The establishment of the single market was expected to lead to increasing M&A activities from intensified competition and the possible realization of scale economies (e.g., Hogan, 1995). This process may be enforced by increasing integration of the European insurance markets. Foreign life insurers most often rely on M&A activities to enter new markets, while the establishment of branches or agencies, as well as the direct cross-border trade, is much more infrequent (Beckmann et al., 2002). The realization of economies of scale would result in an increased scale efficiency, but M&A activities may also bring high coordination and adjustment costs, including difficulties in integrating data-processing systems (Rhoades, 1998) and product portfolios (Diacon et al., 2005). High costs may also arise as a consequence of the coordination of the different distribution systems after a merger or acquisition.

The possible effects of these presented variables on *market performance*, i.e. on the performance of the German life insurance industry, lead to the hypotheses to be tested in our study. We also take into account possible feedback effects of changes in market performance on the other variables. The development of the market performance of an industry may be analyzed by changes in the levels of cost, scale and profit efficiency. Cost efficiency describes a firm's ability to produce a given output at minimum costs, whereas scale efficiency

[58] There may also be economies of scope with other financial services, e.g., banking products in the field of old-age provision. There is an increasing trend in the European financial markets toward combining the activities of banking and insurance firms (known by the term "bankassurance") (e.g., Amel et al., 2004). Though, possible economies of scope due to the cooperation between banks and insurance firms are not in the focus of this study, and are not further considered in the following.

describes how far away a firm operates from its optimal size, i.e., from the production size where minimum average costs are reached. Profit efficiency encompasses firms' revenues and describes the relationship of actual to potential firm profits. An industry's market performance may also be analyzed by the measure of technical change, which turns positive if an improvement in technology occurs which alters the production function, i.e. if technological changes allow the industry to produce a given output with a smaller amount of inputs (e.g., Färe et al., 2008). Changes in cost efficiency, technical change, and scale efficiency combine and lead to TFP growth (e.g., Coelli et al., 2003).[59]

4.3.2 Hypotheses

According to the above analysis, market liberalization has induced changes in market structure, and correspondingly, in firms' conduct, which affects market performance. If the aimed effects of liberalization are fulfilled, the increase in potential competition should lead to higher efficiency levels among the firms in the industry (e.g., Rees and Kessner, 1999).

We analyze cost efficiency change, as increased competition may force firms to minimize costs: inefficient insurers have a strong incentive to improve their efficiency; otherwise, they would be forced to leave the market (e.g., Cummins, 2002). Insurance firms aim at realizing cost reductions by internal reorganizations, the reduction of overhead costs, and the restructuring of distribution channels (Muth, 1993). Hess and Trauth (1998) also point out that the liberalization of services and establishment throughout Europe allows insurance firms to better diversify their risks and by this, to lower costs.

However, increased competition may also force firms to realize potential profits, either by competing through prices or quality of services (e.g., Kumbakhar et al., 2001; Weiss and Choi, 2008). Hence, we additionally take into account profit efficiency, which measures the ratio of actual to potential profits. If the aims of the liberalization process have already been achieved, profit efficiency change in the industry should also be positive. As has been explained in section 4.2, the German life insurance market before market liberalization was characterized by price and product regulation leading to excessive sales activities (e.g., Finsinger et al., 1985; Finsinger, 1986). The existing cost-plus price regulation set inventives for firms to inflate costs and to maximize revenues, thus firms were not induced to act profit efficient. In contrast to that, firms now are induced to maximize profits.

[59] A detailed and formal analysis of these concepts can be found in section 4.4.

It is important to measure profit efficiency besides cost efficiency due to the following: The introduction of new insurance products and additional services by firms may raise customers' willingness to pay, enabling innovative insurance firms to charge higher prices and realize higher profits. However, the introduction of these innovations may raise firms' costs, and consequently, lower their cost efficiency (e.g., Berger and Mester, 2003). Increases in cost levels may be caused by the implementation of new technologies, additional services, and changed distribution structures. Distribution structures have undergone major restructuring in the German life insurance market, which heavily relied on exclusive sales forces before its liberalization. Most multi-channel insurance firms, which represent over 80 percent of all life insurers, have added additional distribution channels like independent brokers, direct channels and sales via bank branches, reducing their own sales forces at the same time. Thus, an exclusive analysis of cost efficiency change might lead to misleading results, disregarding the possibility that an increase in costs may be accompanied by increasing revenues, resulting in an overall positive effect on profit efficiency. An ongoing process of innovations may explain why these higher profits are not competed away. Though extraordinary innovation profits are competed away over time, subsequent innovations permit the anew realization of innovation rents (Berger and Mester, 2003). Boone (2001) further showed in a formal model that increasing competition in an industry may set incentives for the firms to innovate. If above all the market leaders innovate, they may increase their market share further by innovating, leading to an increased market power of the industry leaders and an increased concentration in the industry. Thus, as a consequence of increased competition, prices and profits in the industry may rise (Boone, 2001). Finally, eased investment rules may lead to increased investment income of insurers after the liberalization of the market (e.g., Rees and Kessner, 1999).

Summarizing, the following main hypotheses should hold if the liberalization of the market has enhanced competition and thus, increased efficiency:

H 1: Cost and profit efficiency in the German life insurance industry increased during the observation period.

However, as has been explained, service and product innovations may have raised costs, although to a lesser extent than revenues have increased. Thus, we additionally formulate the following hypothesis:

H 2: Cost efficiency decreased, and profit efficiency increased during the observation period.

We now turn to possible scale effects: As has already been explained, market liberalization followed by increased competition in the German life insurance market may foster the exploitation of economies of scale by a growing firm size, mainly by M&A activites. Especially less profitable insurance firms which used to be protected by the former regulatory regime may become M&A targets. Thus, we derive the following hypothesis:

H 3: Scale efficiency in the German life insurance industry increased during the observation period.

Finally, we analyze technical change: As has been argued, technological changes in the information technologies have had a major influence on the supply of insurance services. In the long run, technical progress in the information technology should have a positive effect on technological change in the life insurance industry. This development may be reinforced by the liberalization of the market, as increased competition increases incentives for firms to improve productivity and innovate (e.g., Cummins et al., 1999; Cummins, 2002).

H 4: Technical change has been positive.

4.3.3 Previous Evidence

An overview of existing studies which analyze the effects of regulatory changes and market liberalization on insurance markets reveals only two extant studies which analyze the effects of market liberalization on the German insurance market.

Hussels and Ward (2004) analyzed changes in cost efficiency and TFP growth in the German life insurance industry for the years 1991-2002. They concluded that the expected gains in efficiency were not achieved; a TFP growth of 2.6 percent occurred in the industry, but the observed time span included both years of productivity increases and years of productivity decreases. Mahlberg and Url (2007) examined the development of the German insurance industry for the years 1991-2001, using DEA and Malmquist analysis. They found that TFP increased during the observation period, although the liberalization process did not lead to converging efficiency scores. The authors futher reported important improvements in scale efficiency and less pronounced gains in technical and cost efficiency.

Several other studies conducted similar analyses for other European countries. Hardwick (1997) examined the effects of market liberalization on the development of the UK life insurance industry by employing a stochastic cost frontier approach. He found evidence for increasing returns to scale and significant cost inefficiencies and concluded that large and inefficient insurers are most likely to benefit from the European Single Market. Fuentes et al.

(2001) employed a parametric distance function approach to estimate a Malmquist productivity index for Spanish insurance companies from 1987-1994. The authors found a very low rate of growth in productivity and that technical efficiency did not improve as a consequence of market deregulation. Diacon et al. (2002) focused on European specialist and composite insurers for the years 1996-1999. Employing non-parametric DEA, the authors found evidence for declining technical efficiency over time, which they attributed to high costs incurred in the restructuring and M&A processes.

Campbell et al. (2003) examined the impact of the Second and Third Life and Non-Life Directives on the stock returns of insurance firms in 14 European Union countries, plus Norway, and Switzerland. They found positive effects on wealth for European life insurance firms, the highest effects of which were in formerly highly regulated countries. Ennsfellner et al. (2004) employed Bayesian SFA to analyze the productive efficiency of the Austrian insurance industry for the years 1994-1999 and found evidence for an increase in productive efficiency over time, which they attributed to market deregulation. Cummins and Rubio-Misas (2006) analyzed the effects of deregulation and market consolidation for the Spanish insurance market from 1989-1998. Using non-parametric DEA and Malmquist analysis, and paying special attention to M&A activities in this market, they found significant TFP growth, which was due primarily to an increase in cost efficiency among Spanish insurance firms. Further, Spanish firms experienced efficiency gains as a consequence of liberalization and market consolidation. Fenn et al. (2008) employed SFA to analyze the market structure and efficiency of European insurance companies between 1995 and 2001 and found evidence of increasing returns to scale among European life insurance firms. The authors also found the mean cost efficiency for German life insurance firms remained unchanged over time, which they explained as the result of M&A activities that annulled the efficiency gains from market liberalization. Bikker and Gorter (2008) examined the performance of the Dutch non-life insurance industry. The authors estimated a stochastic cost frontier and found that increasing economies of scale persisted in the market despite the consolidation process after the liberalization of the European markets. They also reported large differences in firms' cost efficiency levels, suggesting that competitive pressure might be insufficient to force insurance firms to improve their cost levels.

4.4 Methodology

This section describes our methodology and the estimation approach we follow to obtain technical cost and profit efficiency scores of German life insurers and a measure of TFP growth during the observation period. In section 4.4.1, we introduce the input distance function and describe the way it will be constructed in our analysis. Section 4.4.2 describes our estimation methodology, the parametric SFA. In section 4.4.3, we illustrate how individual technical cost and profit efficiency scores for firms may be obtained from the estimation of a stochastic input distance frontier. Finally, section 4.4.4 shows how TFP growth will be measured and decomposed in our study.

4.4.1 Parametric Input Distance Functions

In this study, a parametric input distance function, rather than a cost function, is used to obtain firm-individual measures of firm's technical cost efficiency, i.e., measures of the over-usage of costs by firms.[60] We are able to use an input distance function approach because the inputs used in this study represent the relevant cost categories of insurance firms, so the input distance function can derive firm-individual efficiency scores which represent cost over-usage. We have chosen the input distance function approach in this study because direct estimation of a cost frontier is not practical since data is limited and there is insufficient variation in some of the input prices. In these cases, a distance function approach proves superior to the direct estimation of a cost function (Coelli, Singh and Fleming, 2003). Although the econometric estimation of distance functions is a fairly recent concept, an increasing number of applications can be found in the literature, including some which use distance functions for the measurement of TFP growth, as will be done in this study (e.g., Atkinson and Primont, 2002; Orea, 2002; Coelli and Rungsuriyawiboon, 2006). Applications of the distance function approach to efficiency and TFP growth measurement to the field of financial services can be found in Fuentes et al. (2001) and Orea and Cuesta (2002).

[60] In the following, the efficiency scores obtained from the estimation of the input distance function are labelled *technical cost efficiency* in order to differentiate this concept of efficiency measurement from the cost efficiency estimates obtained from a cost function.

Distance functions, a concept introduced by Shepard (1953), can be differentiated into input and output distance functions. While an input distance function characterizes the production technology by seeking the minimal proportional contraction of the input vector, given an output vector, the output distance function gives information about the maximum proportional expansion of the output vector, given an input vector. This study uses an input distance function because the output of an insurance firm, as measured in this study, is largely exogenously determined by the incurred benefits of a firm. (See section 5 for additional details.)

An input distance function which summarizes all economically relevant characteristics of the production technology can be defined as:

$$D^I(x,y) = \max\{\rho : (x/\rho x \in L(y_0)\}, \tag{4.1}$$

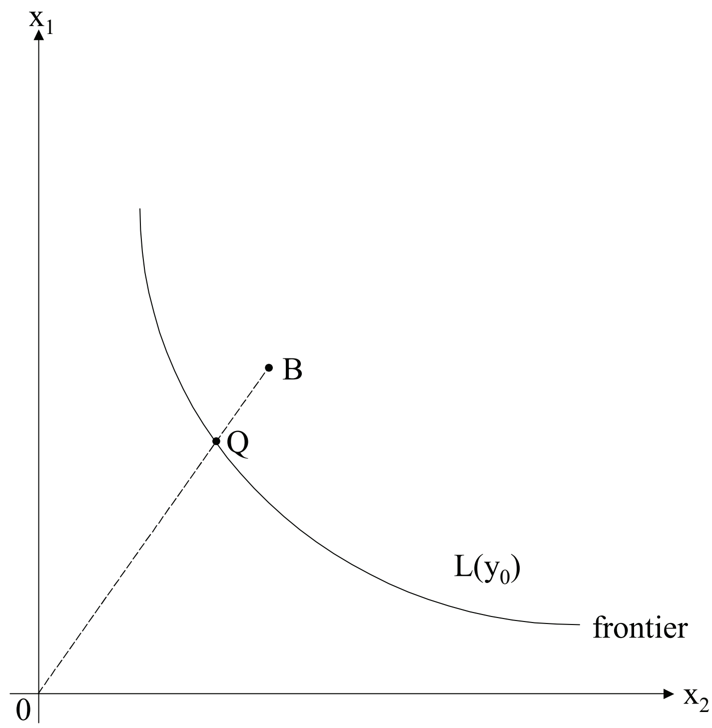
where the input set L(y) represents the set of all input vectors x that can produce the output vector y.

Färe and Primont (1995) showed that the following properties hold for an input distance function: $D^I(x,y)$ is

- non-decreasing in x and non-increasing in y
- linearly homogeneous in x
- concave in x and quasi-concave in y, and, finally,
- if $x \in L(y_0)$, then $D^I(x,y) \geq 1$, with $D^I(x,y) = 1$, if x belongs to a firm on the frontier of the input set.

Figure 4.2 shows an input-oriented distance function for the two-input (x_1, x_2), one-output (y) case. The isoquant shows the frontier of the technology for a given output vector y_0. The area $L(y_0)$ represents all input quantity vectors x which can produce the output quantity vector y_0. $L(y_0)$ is bounded below by the isoquant, which represents the minimum input quantities which are necessary to produce a given output vector y_0. The value of the distance function at B, then, is equal to the ratio $\rho = 0B/0Q > 1$, as the firm could reduce its input usage and still produce the given output vector.

Figure 4.2: Input Distance Function in the Two Input – One Output Case



Source: Own composition following Coelli et al. (2005), p. 50.

Thus, we are able to derive a measure of input-oriented technical efficiency in terms of the input-distance function. According to Farrell (1957), the efficiency at the production point B is measured by

$$TE = 0Q/0B = 1/\, D^I\,(x,y), \text{ where } 0 \le TE \le 1. \qquad (4.2)$$

Technical efficiency, then, represents the reciprocal of the value of the distance function. A fully efficient firm which operates on the frontier obtains an efficiency score of 1, and the value of the input distance function also equals 1 (e.g., Balk, 1998). In this study, the efficiency scores obtained from the estimation of an input distance function are denoted as technical cost efficiency, as all input categories used represent firm’s costs.

In order to estimate a parametric input distance function, a functional form has to be chosen for D^I (x,y). Coelli et al. (2003) stated that, ideally, the functional form chosen should satisfy certain conditions: It should be flexible, linear in its parameters, and it should permit the imposition of homogeneity. The translog function chosen for this study, which has all these properties, was introduced by Christensen et al. (1973), and represents a generalization of the Cobb-Douglas functional form. Compared to the Cobb-Douglas function, the translog function is a second-order flexible form, i.e., it has enough parameters to provide a second-order approximation of a Taylor series. In general, the more flexible a functional form is, i.e., the more parameters in the function, the better able it will be to reproduce the "true" frontier. Further, by taking the logarithm of both sides of the function, the translog function can be estimated in a linear framework. Finally, homogeneity is easily imposed, as shown below.

A translog input distance function is parametrized as follows in the K (k = 1,…K) input (x), one-output (y) case:

$$\begin{aligned} \ln D_i^I(x,y) = \alpha_0 + \beta_1 \ln y_{it} + \frac{1}{2}\beta_{11} \ln y_{it}^2 + \sum_{k=1}^{K} \gamma_k \ln x_{kit} + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \gamma_{kl} \ln x_{kit} \ln x_{lit} \\ + \sum_{k=1}^{K} \delta_k \ln x_{kit} \ln y_{it} + \sum_{k=1}^{K} \phi_k \ln x_{kit} t + \kappa_1 \ln y_{it} t + \eta_1 t + \frac{1}{2}\eta_{11} t^2, \end{aligned} \tag{4.3}$$

where t represents a time trend to approximate technical change. Fuentes et al. (2001) pointed out that in the context of a parametric approach, the incorporation of a time trend into the function is superior to other approaches, e.g., incorporating T-1 dummy variables (Baltagi and Griffin, 1988) or estimating T separate functions (Althin et al., 1996); compared to the alternative approaches, the time trend saves degrees of freedom. The subscripts i (i = 1,2,…N) and t (t =1,2,…T) index firm and time period, respectively, while the parameters to be estimated are β, γ, δ, ϕ, κ, and η.

To ensure that the first-order translog parameters can be directly interpreted as the production elasticities at the sample mean, every series is divided by its geometric average, a process which does not change the results (e.g., Coelli et al., 2003). Homogeneity of degree 1 in inputs is imposed by the following constraints:

$$\sum_{k=1}^{K} \gamma_k = 1; \sum_{l=1}^{K} \gamma_{kl} = 0; \sum_{k=1}^{K} \delta_k = 0; \sum_{k=1}^{K} \phi_k = 0. \tag{4.4-4.7}$$

Symmetry is given if the second order coefficients satisfy:

$$\gamma_{kl} = \gamma_{lk}. \tag{4.8}$$

4.4.2 Estimation Methodology – Stochastic Frontier Analysis

In this study, a parametric approach is used to derive the “best practice” input distance frontier and to measure technical cost efficiency in the German life insurance industry. In contrast to non-parametric approaches to efficiency measurement (e.g., DEA), which rely on mathematical programming techniques to obtain the “best practice” frontier, the econometric approach requires that a functional form of the underlying production function be specified and that the “best practice” frontier using econometric methods be estimated. (For a detailed overview of both concepts, see, e.g., Fried et al., 2008.) Both approaches have been widely employed in the analysis of insurance markets, but neither has proven superior, as both approaches have advantages and shortcomings. (A detailed overview can be found in Cummins and Weiss, 2000.) The parametric approach, for which a function form must be chosen, is stochastic and can help disentangle the effects of statistical noise and inefficiency. The non-parametric approach, on the other hand, does not require the assumption of a functional form, which comes at a cost, since all deviations from the “best practice” frontier represent inefficiencies (e.g., Fried et al., 2008). In this study, a parametric approach is chosen in order to accommodate the derivation of profit efficiency scores, in keeping with Kumbakhar (2006), who chose a parametric approach for deriving profit efficiency measures.

This study employs SFA in order to estimate the presented translog input distance function and to obtain measures for firm-individual inefficiency.

For this purpose, the input distance function D_i^I (x,y) presented in equation (4.1) has to be put in the form of an econometric model: First, homogeneity is imposed by deflating K-1 inputs by the K^{th} input. In log form, this may be expressed as

$$D_i^I – x_{iK} = g\ [(x_i\text{-}x_{iK}),y_i)], \tag{4.9}$$

where g(.) represents the chosen functional form – in our case a translog function – and i indexes the firm (i = 1,….,N). To proceed with econometric estimation, the translog input distance function presented here must be rearranged, as the dependent variable D_i^I is unobserved. In doing so, we obtain

$$-x_{iK} = g[(x_i\text{-}x_{iK}),\ y_i] - D_i^I, \tag{4.10}$$

where D^I represents an error term reflecting the distance between the data and the estimated function (e.g., Coelli and Perelman, 1999; Greene, 2008).

The econometric estimation of (production) frontiers which account for (in)efficiency of the observed firms goes back to Aigner and Chu (1968), who estimated a deterministic production frontier where the error term represents only inefficiency and a distributional assumption for it must be made. The main drawback of these deterministic models is that any stochastic disturbance is attributed to inefficiency, as these models do not account for measurement error.

This main shortcoming of deterministic frontiers is overcome by estimating stochastic frontiers, which were developed by Aigner et. al (1977) and Meusen and van den Broeck (1977). A second component, v_i, is added to the inefficiency term u_i, with the random error term v_i representing noise in the data. Random noise, v_i, may result from the omission of relevant variables from the distance function, as well as from measurement errors or from using an unsuitable functional form. Further, u_i and v_i are assumed to be distributed independently from each other and to be uncorrelated with the explanatory variables in the function.

In the case of an input distance function, the stochastic frontier approach results in

$-x_{iK} = g[(x_i\text{-}x_{iK}), y_i] + v_i\text{-}u_i.$ (4.11)

The noise component v_i shows properties identical to the properties of the noise component in the classical linear regression model, that is, the v_i's are assumed to be independently and identically distributed normal random variables with zero means and variances σ_v^2: $v_i \sim \text{iidN}(0, \sigma_v^2)$. (4.12)

The inefficiency component u_i is characterized by a non-zero mean and by further properties, that depend on the chosen model (e.g., Coelli et al., 2005). The most common distributional assumptions were developed by Aigner et al. (1977), Meusen and van den Broeck (1977), Stevenson (1980) and Greene (1980a, 1980b):

Aigner et al. (1977) suggested a half-normal distribution for the u_i's, where the firm-individual inefficiencies are independently and identically distributed half-normal random variables with zero means and scale parameter σ_u^2. Thus, the probability density function of each u_i is a truncated version of a normal random variable with zero mean and variance σ_u^2:

$u_i \sim \text{iidN}^+(0, \sigma_u^2)$ (4.13)

Later models replaced the half-normal assumption, e.g., the normal-exponential model by Aigner et al. (1977) and Meusen and van den Broeck (1977), where u_i is exponentially distributed with mean λ, or the normal-gamma model by Stevenson (1980) and Greene (1980a, 1980b), where u_i follows a gamma distribution. Whereas the normal-exponential model delivers similar results to the normal-half normal model, the normal-gamma model is not found in many applications, as the estimation procedure proves rather difficult. (For a more detailed discussion, see, e.g., Greene, 2008.)

The truncated normal frontier model by Stevenson (1980) is applied more frequently in the literature. In this case, u_i follows a truncated normal distribution with mean μ and scale parameter σ_u^2:

$$u_i \sim iidN^+ (\mu, \sigma_u^2) \quad (4.14)$$

After the distributional assumptions of u_i have been decided, estimation of stochastic frontier models most often occurs by the method of Maximum Likelihood, which has proved to be superior to other estimators, including OLS and Corrected Ordinary Least Squares (COLS) (Coelli, 1995).

We employ a panel data model to estimate the stochastic input distance frontier, so that a firm's inputs and outputs vary freely through time and among firms. Many of the studies in the past have relied on estimating several annual frontiers or applying cross-frontier estimators to obtain information about changes in efficiency and TFP growth. However, the first approach may be problematic, since SFA delivers relative measures, which may only be compared with each other if the frontier does not change from one year to another (e.g., Coelli et al., 2003). The cross-sectional approach shows a major drawback in that it neglects the development of a firm over time but treats every observation as an individual firm. Several panel data models are available for estimating stochastic frontiers; they can be roughly differentiated into fixed effects (FE) and random effects (RE) models.

Schmidt and Sickles (1984) reinterpreted the common FE model to measure inefficiency. In this model, firm-specific intercepts are estimated for each firm, and a firm's inefficiency is then obtained by calculating its deviation from the firm with the smallest intercept. This model has three major drawbacks: For a given firm, the variables must show enough within variation over time, the inefficiency component is assumed to be invariant over time, and the inefficiency measures are always obtained relative to the most efficient firm in the sample and, thus, represent only relative measures (e.g., Greene, 2008). Pitt and Lee (1981) and Schmidt and Sickles (1984) proposed early RE models for the estimation of stochastic frontiers. In contrast to the FE model, the firm-specific effects in the RE models are assumed to be independent and, thus, uncorrelated with the regressors. Nonetheless, both models have the drawback that the firm-specific efficiency scores may not change over time, which is a clearly inappropriate assumption in this study, as it is our purpose to examine efficiency change over time.

Among the first models to allow for time-varying inefficiency were Kumbakhar (1990), and Battese and Coelli (1992). In these models, efficiency varies over time according to:

$u_{it} = f(t) \cdot u_i,$ (4.15)

where f(.) is a function that determines how inefficiency changes over time. A major drawback of these models is that the rank-ordering of the firms' inefficiency is not allowed to change over time, which is a rather restrictive and possibly unrealistic assumption.

Another important aspect to deal with in the estimation of stochastic frontier models is heterogeneity. According to Greene (2008), observed and unobserved heterogeneity must be differentiated. Observed heterogeneity describes differences between firms which may be accounted for by measured variables. These additional variables, z_{it}, may enter the cost function or the mean of the inefficiency term. Another possibility is that these variables affect the variance of the inefficiency term u_{it} and/or the random error term v_{it}. Unobserved heterogeneity enters the model in the shape of "effects". Recently, Greene (2004a, 2004b, 2005) suggested two different models, the true fixed and random effects models. These are intented to account for unobserved heterogeneity, which would otherwise enter the inefficiency term and bias the inefficiency estimates.

In the case of an input distance frontier, the true FE model is modeled as follows:

$-x_{iK} = \alpha_i + g[(x_i-x_{iK}), y_i]+v_{it}-u_{it},$ (4.16)

where α_i represents firm-specific dummies which measure the firm-specific heterogeneity, v_{it} follows the standard normal distribution, and u_{it} may follow a half-normal, truncated-normal or exponential distribution.

The true RE model is parameterized as:

$-x_{iK} = (\alpha+w_i) + g[(x_i-x_{iK}), y_i]+v_{it}-u_{it},$ (4.17)

where $(\alpha+w_i)$ represents the random constant term accounting for firm-specific heterogeneity. The application of this model theoretically requires the assumption that there is no correlation between the firm-specific effects and the additional variables to be met.

In this study, we use the true FE model presented in equation (4.16) for two reasons: First, it accounts for unobserved heterogeneity, such that systematic differences between the insurance firms are considered by including a firm-specific fixed effect, α_i, which accounts for firm-specific characteristics not captured by the included variables.[61] Second, efficiency varies freely through time. This is in contrast to most of the other models which allow for time-varying efficiency by assuming a given inefficiency u_i for every firm which varies through time in a given time path (e.g., Battese and Coelli, 1992) or because of the influence of additional variables in the inefficiency term (e.g., Battese and Coelli, 1995). Since this study is especially interested in the development of efficiency (and other TFP components) as a consequence of market liberalization, we prefer to let efficiency vary freely through time. Further, the true effects model allows for cross-firm variation in the efficiency of firms, since it is possible that some firms increase their efficiency while others decrease efficiency in a given year. Concerning the incorporation of measured heterogeneity into a true FE effects model, only-time-variant variables may be included directly into the distance function, as a fixed effects estimator does not allow the direct incorporation of time-invariant variables into the estimated function. Regarding the incorporation of firm-specific measured heterogeneity into mean and/or the variance of the inefficiency term u_{it}, or into the variance of the error term v_{it}, Greene (2007) noted that the estimated true effects models deliver rather poor results, even with carefully constructed data sets. We experienced similar problems when including firm-specific characteristics into the model. As all the variables of interest are time-invariant in our case, we decided to leave out any additional variables z_{it}.

Summarizing, our estimation approach is as follows:

$$\begin{aligned} -\ln(x_{Ki}) = {} & \alpha_i + \beta_1 \ln y_{it} + \frac{1}{2}\beta_{11} \ln y_{it}{}^2 + \sum_{k=1}^{K-1}\gamma_k \ln\frac{x_{kit}}{x_{Kit}} + \frac{1}{2}\sum_{k=1}^{K-1}\sum_{l=1}^{K-1}\gamma_{kl}\ln\frac{x_{kit}}{x_{Kit}}\ln\frac{x_{lit}}{x_{Kit}} \\ & + \sum_{k=1}^{K-1}\delta_k \ln\frac{x_{kit}}{x_{Kit}}\ln y_{it} + \sum_{k=1}^{K-1}\phi_k \ln\frac{x_{kit}}{x_{Kit}}t + \kappa_1 \ln y_{it} t + \eta_1 t + \frac{1}{2}\eta_{11}t^2 + \varepsilon_{it}, \end{aligned} \tag{4.18}$$

where $\varepsilon_{it} = v_{it} - u_{it}$ represents the composed error term. Following Greene (2004a, 2004b, 2005), Maximum Likelihood estimation of the model yields the coefficients β, γ, δ, ϕ, κ, and η in the frontier. A normal-half normal distribution was chosen for the error terms, and the parameters associated with the K^{th} input were calculated using the estimated parameters and

[61] We conducted a Hausman test to test the assumption of no correlation between the firm-specific random effects and the exogeneous variables in the model. The result strongly rejected the assumption of no correlation between the variables. Thus, the estimation of a true RE model would not be appropiate in our case, and the true FE model was chosen. For details about the Hausman test, see, e.g., Greene (2003).

the restrictions presented in equations (4.4-4.7). The procedure also delivers estimates of the standard deviations of the error components, σ_u and σ_v, and the total error variance $\sigma^2 = (\sigma_u^2 + \sigma_v^2)$. Further, the parameter $\lambda = \sigma_u / \sigma_v$ is constructed. If $\lambda \rightarrow + \infty$, the deterministic frontier is the result because all variation in the error term is attributed to inefficiency. Conversely, if $\lambda \rightarrow 0$, there is no inefficiency in the disturbance, so the estimated function could be estimated by OLS.

Both inputs and outputs in this estimation approach appear as regressors in the distance function. Thus, concerns about a possible simultaneous equation bias might arise: When working with an input distance function, outputs should be treated as exogeneous and inputs are endogenous. However, Coelli and Perelman (1996) argued that, as a consequence of the normalization by the K^{th} input, only input ratios will appear as regressors. These may be assumed to be exogeneous, as the input distance function is defined for radial contraction of all inputs, given the output level; hence, by definition, the input ratios are held constant for each firm. Another problem discussed in connection with the application of distance functions is the possible correlation of the explanatory variables with the composite error term, which would signify a violation of one of the basic assumptions of the stochastic frontier model. However, Coelli (2000) showed that this may not be a problem for Cobb-Douglas and translog specifications.

4.4.3 Estimation of Technical Cost and Profit Efficiency

The estimation approach presented here does not allow direct observation of the inefficiency measure u_{it} because the estimation procedure delivers only an estimate of the composite error term $\varepsilon_{it} = v_{it} - u_{it}$. Thus, the efficiency scores are estimated following the procedure by Jondrow et al. (1982), who used the conditional distribution of u, given the error term ε. For the normal half-normal model, a point estimator of technical cost efficiency is given by equation (4.19), i.e., by the mean of u_{it}, given ε_{it}:

$$E(u_{it} \mid \varepsilon_{it}) = \frac{-\lambda \varepsilon_{it}}{\sigma} \tag{4.19}$$

Technical cost efficiency (TCE) per firm and year may then be calculated as

$$TCE_{it} = [\exp(-u_{it})]. \tag{4.20}$$

We now turn to the derivation of profit efficiency according to Kumbakhar (2006). Our study analyzes the reaction of German life insurers to the changes in the market environment that resulted from liberalization. In so doing, the study also accounts for possible changes in the firms' profit efficiency as a consequence of the firms' increasing price-setting power arising from offering superior services or innovations, as explained in section 4.3. Thus, the standard neoclassical profit function that assumes given input and output prices may not apply in this case. Humphrey and Pulley (1997) suggested a nonstandard (alternative) profit function (NSPF) that allowed for imperfect output markets.

$$P(w,y) = py - wx, \tag{4.21}$$

where w is a vector of input prices ($w = w_1,\ldots,w_K$), p is the price for the output y, P is a firm's profits, and the remaining variables are as explained above.

In this approach, output prices are assumed to be endogenous and are determined from the pricing opportunity set. Thus, the NSPF in equation (4.21) is expressed as a function of output quantities and prices, not of output and input prices, as in the standard neoclassical case. However, Kumbakhar and Lovell (2000) pointed out that the NSPF does not satisfy theoretical foundations, as the optimal prices which are derived from the pricing opportunity set are not related to the production technology. Thus, the cost of production is not considered when determining optimal output prices. Kumbakhar (2006) suggested a new approach to determine a firm's profits and profit efficiency under the assumption of non-competitive output markets.

Kumbakhars analysis departs from the fact that, in both the NSPF and the cost function, w and y are the arguments in the function. The only difference between the functions is in the left-hand side of the equations: In the NSPF, profit (revenue minus cost) forms the left-hand side, whereas in the cost function, it is cost.

$$P(w, y) = py - wx \Leftrightarrow C(w, y) = wx \tag{4.22}$$

As can be seen from the equation (4.22), the NSPF can be transformed easily into a standard cost function by subtracting revenues and multiplying the function by -1. Thus, a standard cost function may be also used to calculate profit efficiency of a firm as follows:

$C\big|_{u=0}$ represents the product of firm's actual costs C and the technical efficiency score $TE = \exp(-u_{it})$, i.e., minimum costs. In Kumbhakar (2006), u was obtained from the estimation of a cost function. However, Kumbhakar assumed allocative efficiency, so u represented input-oriented technical inefficiency. Kumbhakar noted: "In our formulation u is input-oriented technical inefficiency (percentage over-use of all inputs). Therefore, it is also the percentage by which cost is increased…." (p. 254).

In our study, we modify Kumbakhar's approach by deriving u_{it} from the estimation of an input distance function, as it has been presented in equation (4.18). We likewise assume that all firms act allocatively efficient.

As all inputs used in this study represent monetary costs, minimum costs may be calculated as:

$$C^{D}\big|_{u=0} = \sum_{k=1}^{K} x_{kit} \cdot TCE_{it} = \sum_{k=1}^{K} x_{kit} \; [\exp(-u_{it})], \tag{4.23}$$

and actual costs as:

$$C^{D} = \sum_{k=1}^{K} x_{kit} \,, \tag{4.24}$$

where all variables are as presented before, the superscript D indicates that the distance function approach is used to calculate minimum and actual costs.

Profit efficiency is defined as the ratio between a firm's actual profits $(\hat{\pi}(w,y)\big|_{u})$ and the maximum attainable profits $(\hat{\pi}(w,y)\big|_{u=0})$. Actual profits are determined as:

$$(\hat{\pi}(w,y)\big|_{u}) = py - C^{D}, \tag{4.25}$$

And maximum attainable profits are calculated by

$$(\hat{\pi}(w,y)\big|_{u=0}) = py - C^{D}\big|_{u=0} \,. \tag{4.26}$$

Finally, profit efficiency is calculated as:

$$PE = \frac{(\hat{\pi}(w,y)\big|_{u})}{(\hat{\pi}(w,y)\big|_{u=0})}; -\infty \le PE \le 1. \tag{4.27}$$

A fully profit-efficient firm shows a profit efficiency of 1. As profits can turn negative, profit efficiency is not bounded below by 0, but can turn negative (zero) if actual profits are negative (zero).[62] Further, the measure would be undefined if the maximum attainable profit in an industry were negative (e.g., Banker and Maindiratta, 1988).

[62] Following the proceeding in chapter 2, we decided not to remove firms which exhibit negative profits from the sample, as it is possible that firms incur short-term losses but are able to establish themselves solidly in the market in the long run. This is especially true for young firms which enter the market and incur high initial investments. Our sample contains a number of young firms which entered the market after the liberalization of the German insurance market in 1994. As we found very few firms showing only small negative profit efficiency scores, and none of these with negative profit efficiency scores over the whole observation period, the impact on the market-wide profit efficiency scores is rather small.

4.4.4 Measurement of TFP Growth and Efficiency Change

The traditional approach to TFP measurement equates technical change with the percentage growth in TFP. According to this traditional Divisia approach (Solow, 1957), TFP growth is calculated as:

$$\dot{TFP} = \dot{y} - \dot{F}, \text{ where } \dot{F} = \sum_{i=1}^{K} \frac{w_i x_i}{C} \dot{x}_i = \dot{TC}. \qquad (4.28)$$

All variables are as presented before, F is an aggregated measure of input usage, TC represents technical change, and rates of change are denoted with a dot over the variable. Equation (4.28) only holds under restrictive assumptions, i.e., there are constant returns to scale, neutral technical change, and perfect competition in both output and input markets (e.g., Baltagi and Griffin, 1988). Further, it is assumed that all firms act efficiently overall, which is unrealistic in most cases. Thus, recent work decomposes TFP change into different sources, including technical change, technical and allocative efficiency change, and scale efficiency change (e.g., Kumbhakar and Lovell, 2000; Orea, 2002). Coelli et al. (2003) applied the decomposition of TFP change to the input distance frontier case such that the log of the TFP change between periods t and t +1 for the i^{th} firm is calculated as:

$$\begin{aligned} \ln(TFP_{i\,t+1}/TFP_{it}) = {} & \ln(TCE_{i\,t+1}/TCE_{it}) + 0{,}5\,[(\partial \ln D_{it}/\partial t) + (\partial \ln D_{i\,t+1}/\partial t)] \\ & + 0{,}5\,[(SF_{it}\varepsilon_{it}) + (SF_{i\,t+1}\varepsilon_{i\,t+1})] \cdot (\ln y_{i\,t+1} - \ln y_{it}) \end{aligned} \qquad (4.29)$$

The three terms on the right-hand side of equation (4.29) represent technical cost efficiency change, technical change and scale efficiency change, respectively. Technical cost efficiency change is easily calculated by taking the log of the ratio between the technical cost efficiency scores for a given firm i in periods t+1 and t.

The technical change measure represents the mean of the technical change measures, which are calculated at the period t and period t+1 data points with the distance frontier:

$$\partial \ln D_{i\,t+1}/\partial t = \eta_1 + \eta_{11} t + \sum_{k=1}^{K} \phi_k \ln x_{ki\,t+1} + \kappa_1 \ln y_{i\,t+1} \qquad (4.30)$$

$$\partial \ln D_{it}/\partial t = \eta_1 + \eta_{11} t + \sum_{k=1}^{K} \phi_k \ln x_{kit} + \kappa_1 \ln y_{it} \qquad (4.31)$$

The third summand in equation (4.29) measures the change in scale efficiency. For it, production elasticities are calculated at each data point for both periods:[63]

$$\varepsilon_{i\,t+1} = \partial \ln D_{i\,t+1} / \partial \ln y_{i\,t+1} = \beta_1 + \beta_{11} \ln y_{i\,t+1} + \sum_{k=1}^{K} \delta_k \ln x_{ki\,t+1} + \kappa_1 t \qquad (4.32)$$

$$\varepsilon_{it} = \partial \ln D_{it} / \partial \ln y_{it} = \beta_1 + \beta_{11} \ln y_{it} + \sum_{k=1}^{K} \delta_k \ln x_{kit} + \kappa_1 t \qquad (4.33)$$

The scale factors SF_{it} are calculated as:

$$SF_{it} = (\varepsilon_{it} + 1), \qquad (4.34)$$

where ε_{it} equals the negative of the standard returns to scale elasticity (RTS).

RTS is calculated as:

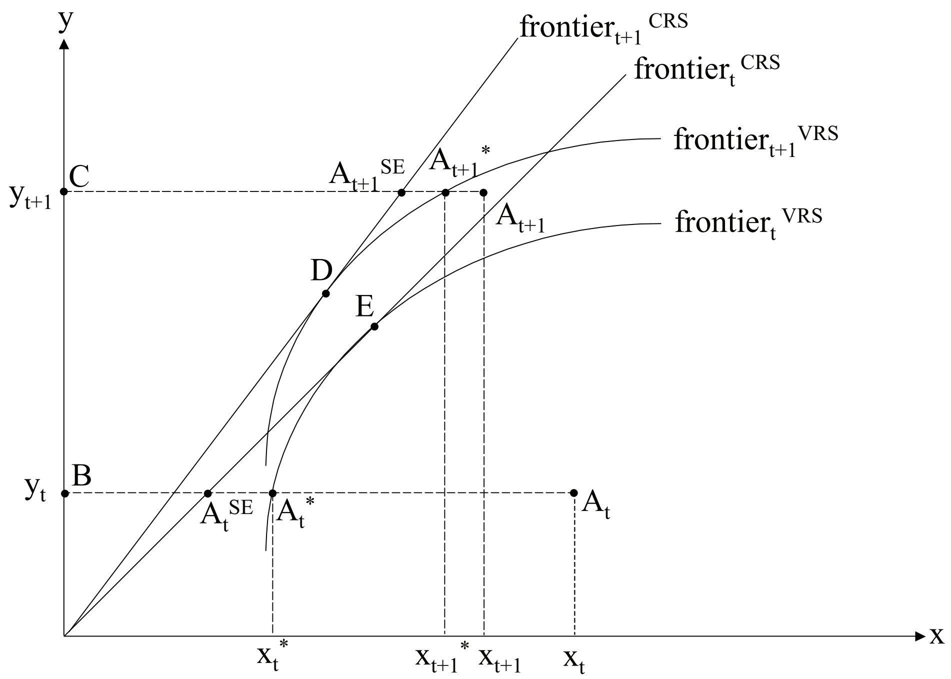
$$RTS = -\frac{1}{\varepsilon_{it}} = -\frac{1}{\frac{\partial \ln D_{it}}{\partial \ln y_{it}}} \qquad (4.35)$$

Thus, if constant returns to scale prevail, ε_{it} equals –1, RTS equals 1, and the scale efficiency change equals 0. Thus, increasing returns to scale are represented by values of RTS > 1, and decreasing returns to scale by RTS < 1.

[63] We assume that firms are allocatively efficient. Thus, the additional component of TFP change which accounts for changes in allocative efficiency is left out of this study.

Figure 4.3 displays the single components of TFP change for the one input (x) – one output (y) case: *frontier*$_t^{CRS}$ and *frontier*$_{t+1}^{CRS}$ are the efficient frontiers under the assumption of constant returns to scale in periods t and t+1, respectively, while *frontier*$_t^{VRS}$ and *frontier*$_{t+1}^{VRS}$ are the efficient frontiers under the assumptions of a production technology which exhibits variable returns to scale in periods t and t+1, respectively. D and E are the most productive production sizes (Banker, 1984) in periods t and t+1, respectively, i.e., the size at which firms exhibit constant returns to scale, and the CRS frontier equals the VRS frontier at that point.

Figure 4.3: Technical Change, Efficiency Change and Scale Efficiency Change in the One Input – One Output Case



Source: Own composition.

Starting with technical change, positive technical change can be found from period t to period t+1: The productivity of the industry increases, as it is possible to produce a given output y with a smaller amount of input x. This is represented by an upwards movement of the frontiers.

Second, firm's changes in efficiency from period t to period t+1 are shown by firm A where, in period t, firm A shows an input-oriented technical efficiency of BA_t^*/BA_t, i.e., it produces a given amount of output y_t with the input of x_t. However, if the firm acts efficiently, the same output y_t could be produced with the smaller input x_t^*. In period t+1, firm A has moved closer to the $frontier_{t+1}^{VRS}$, i.e., it has become more efficient. Its efficiency in t +1 is measured by CA_{t+1}^{*} / CA_{t+1}. Thus, efficiency change (EFFC) may be measured by the ratio:

$$\text{EFFC} = \frac{\dfrac{\text{CA}^{*}_{t+1}}{\text{CA}_{t+1}}}{\dfrac{\text{BA}^{*}_{t}}{\text{BA}_{t}}} \tag{4.36}$$

If EFFC > 1, efficiency has increased, and if EFFC < 1, efficiency has decreased over time.

Finally, a firm's scale efficiency describes the distance of a firm from the point where the technology exhibits constant returns to scale. Scale efficiency may be measured by comparing firm A's efficiency under the assumption of variable and constant returns to scale (e.g., Coelli et al., 2005). In period t, firm A's scale efficiency (SE_t) is measured as:

$$\text{SE}_{t} = \frac{\dfrac{\text{BA}^{SE}_{t}}{\text{BA}_{t}}}{\dfrac{\text{BA}^{*}_{t}}{\text{BA}_{t}}}, \tag{4.37}$$

whereas, in period t+1, scale efficiency is measured by:

$$\text{SE}_{t+1} = \frac{\dfrac{\text{CA}^{SE}_{t+1}}{\text{CA}_{t+1}}}{\dfrac{\text{CA}^{*}_{t+1}}{\text{CA}_{t+1}}} \tag{4.38}$$

Scale efficiency change is then measured as:

$$\text{SEC} = \frac{\text{SE}_{t+1}}{\text{SE}_{t}}. \tag{4.39}$$

Again, if SEC > 1, scale efficiency increases over time, while a value of SEC < 1 shows decreasing scale efficiency over time. In Figure 4.3, firm A moves closer to the point of optimal size from period t to period t+1, so its scale efficiency increases.

Finally, profit efficiency change (PEC) is calculated by taking the log of the ratio between the profit efficiency scores for a given firm i in periods t+1 and t:

$$\text{PEC} = \ln (PE_{i\,t+1}/PE_{it}). \tag{4.40}$$

4.5 Data Set and Variables

4.5.1 Data Set

The data used in this study are taken from periodically published insurance industry reports and insurers' income statements for the years 1995-2002 (Hoppenstedt, 1997-2004). Since Hoppenstedt registers every licensed insurance firm in Germany, the database contains also information about firms that do not actively participate in the insurance market. We eliminate firms which had not delivered any information at all; firms which showed negative observations for inputs or outputs; firms which operated only in very specialized product niches, offering products only to a very specialized customer base (e.g., civil servants, doctors); and firms which offered only single, specialized insurance products (e.g., exclusively term-life insurance) because they are not representative of the industry as a whole. In the end, our data set accounts for approximately 90 percent of the total premium income of the industry. We use an unbalanced panel in order to account for developments in efficiency/ TFP growth caused by newcomers in the industry and by market exits, which would not be included in a balanced panel. Hence, a balanced panel containing only firms which were active over the whole observation period could bias our results.

Table 4.1 displays information about the number of firms in each year of the observation period (n), and presents two different measures of market concentration: C 5 represents the market share of the top five life insurance firms, and the Herfindahl-Hirschman concentration index (HHI) measures market concentration by the sum of squared market shares of all firms.

Table 4.1: Number of Firms and Measures of Market Concentration, 1995-2002

	1995	1996	1997	1998	1999	2000	2001	2002
n	94	97	89	96	95	92	83	84
C 5	34.29	33.71	32.94	33.34	31.44	31.80	32.70	32.74
HHI	440.46	426.60	408.44	418.11	414.13	403.12	448.56	458.20

Note: C 5 and HHI are presented in percent. Market share is measured by premium income.

Source: Own calculations.

As Table 4.1 shows, the number of life insurance firms increased in the beginning of the observation period as a result of market entries arising out of market liberalization. From 1998 on, the number of firms in the market decreased, mainly because of M&A activities in the market. Cummins and Weiss (2004) analyzed the M&A activities in the European insurance markets for the observation period 1990-2002 and found that German insurance firms were the targets in 126 deals involving a change in control and the acquirer in 167 cases. The high level of M&A activities and the corresponding market consolidation is also reflected in the development of the measures of market concentration: Both the C 5-measure and the HHI initially decrease as a consequence of market liberalization and entry of new firms, then increase again towards the end of the observation period. At the end of the observation period, the HHI measure reaches an even higher value than at the beginning of the observation period, indicating that the market consolidation effect outweighed the competition-enhancing effect of market liberalization.

4.5.2 Variables

Using SFA requires identifying the relevant inputs and outputs of an insurance firm. However, a review of the literature does not show clear consensus on a single input/output specification. This study uses the value-added approach, which is common in the literature (e.g., Cummins and Weiss, 2000).[64] In using this approach, we define the services provided by insurers before choosing suitable output proxies. These services can be split into three major groups: risk-bearing/risk-pooling services, "real" financial services related to insured losses, and intermediation services. Following the value-added approach, then, the output of a life insurance company is defined in our study as follows:

We approximate the risk-bearing function by using *incurred benefits*, net of reinsurance. Incurred benefits are payments received by policyholders in the current year, which can be seen as proxies for the risk-bearing/risk-pooling function because they measure the amount of funds distributed to the policyholders as compensation for incurred losses. The funds received by insurers that are not needed for benefit payments and expenses are added to policyholder reserves; so *additions to reserves* are a suitable proxy for the intermediation function of the insurer. We include *bonuses and rebates* into our output measure because these funds benefit the policyholders. By choosing incurred benefits net of reinsurance and the additions to reserves as output proxies, we follow the majority of life insurance studies (e.g., Meador et al., 1997; Cummins and Zi, 1998; Cummins, Weiss and Zi, 1999; Fenn at al., 2008). All three output measures are correlated with real services provided by life insurers. Because of limited data availability, it is not possible to divide the output measures provided by the life insurance firms according to the different life insurance lines.

[64] A detailed description of different approaches for the measurement of the inputs and outputs of an insurance firm can be found in section 3.5.2.

Besides information about insurers' outputs, data about the costs of an insurance firm are necessary in order to estimate the stochastic input distance frontier. Insurers' inputs can be classified into three principal groups: labor, business services and materials, and capital. In most cases, physical measures for these inputs (e.g., the number of employees) are not available, but information about the costs an insurance firm incurs for their use is available. To measure insurers' costs, we choose acquisition and administration expenses, which sum to equal *operating expenses*, as a proxy for the insurers' inputs for labor and business services (e.g., Berger et al., 1997; Cummins and Zi, 1998), since administration and acquisition expenses contain the insurers' expenses for labor and business services.

The consideration of financial capital is also important in the case of insurance firms.[65] Insurance studies frequently use financial equity capital but seldom use financial debt. Equity capital is used as an input because insurance is viewed as risky debt (e.g., Cummins and Danzon, 1997). With this approach, insurance premiums are discounted in the market to account for the insurer's default risk. This study follows the majority of extant insurance studies by using *statutory policyholders' surplus* as a proxy for financial equity capital. To measure the cost of equity, financial equity capital should be valued according to the firm-specific price for equity capital. (For an overview of the different approaches to measuring the cost of equity, see Cummins and Weiss, 2000.) Because of limited data availability and the small influence of the different approaches on the efficiency results found in other studies, we assume identical prices for equity capital over all firms in a given year. *Equity costs* are then obtained by valuing statutory policyholders' surplus with the price for equity capital in a given year. The average price for equity capital in the industry is obtained by calculating the average return on the book value of equity for the industry in a given year. Similar approaches can be found in the literature, as when Fenn et al. (2008) used a rate of interest variable from long-term government bond rates as a proxy for the price of capital, and Cummins and Rubio-Misas (2006) used the rate of total return of the most important Spanish Stock Exchange as a proxy for the price of equity capital for every year in their observation period. As the rate of total return of the most important German Stock Exchange (DAX) showed negative values in some of the observation years because of the stock market crash in the year 2000, we prefer to

[65] Some studies also include physical capital as an input measure (e.g., Meador et al., 1997) but, in general, the amount of physical capital used by insurance firms is comparatively small. We checked for the influence of physical capital by including *capital expenses* into our analysis, but the estimated coefficient has a very small value. Thus, the influence on the obtained results is very small, with all the outcomes remaining largely unchanged. To avoid an unnecessary loss of degrees of freedom in the estimation, we decided to leave the variable out of the estimation.

use the average return on the book value of equity as a proxy for the price of equity. The return on the book value of equity has been used before by Cummins and Weiss (1993) and Cummins and Sommer (1996). The latter noted that the use of market values instead of book values in calculating the rate of return is preferable but is limited because of the small number of insurers with publicly traded equity. This holds especially true for the German market, where only about 20 percent of the stock insurance firms are listed on the stock exchange (Elgeti and Maurer, 2000), and there is a significant number of mutual and public-owned insurance firms.

Finally, the calculation of profit efficiency requires information about the *revenues* of an insurance firm. Revenues are defined as the sum of *net premium income* and *investment income*. Net premium income is measured by the sum of gross written premiums, less ceded reinsurance premiums, less the change in the provision for unearned premiums.

Table 4.2 presents the summary statistics for the variables used in the analysis for the whole observation period. An analysis of the development of the single variables over time reveals that the output of the industry increased by approximately 68 percent over time, while *operating expenses* increased by approximately 97 percent, and *equity costs* slightly decreased from 1995 to 2002. On average, industry revenues more than doubled.

Table 4.2: Variables and Summary Statistics, 1995-2002

		1995	1996	1997	1998	1999	2000	2001	2002	Total
Operating Expenses	Mean	61043.35	62482.22	75075.08	75499.62	105259.17	90646.41	108812.60	120273.11	86578.05
	(SD)	(98330.63)	101325.97	(117315.48)	(123382.59)	(171856.59)	(141489.76)	(175015.88)	(192603.93)	(143649.99)
	Min	97.94	62.37	224.40	106.72	168.73	123.00	1224.00	119.82	62.37
	Max	630640.35	678437.11	745224.87	820366.37	1164376.76	843474.00	999369.48	1229533.54	1229533.54
Equity costs	Mean	6843.61	5925.53	7826.77	6879.60	7420.82	7725.02	5043.59	5718.95	6698.34
	(SD)	(12688.07)	(11035.00)	(14135.48)	(12929.12)	(14000.97)	(14354.64)	(9290.31)	(14681.98)	(12984.27)
	Min	257.37	200.77	210.68	225.08	220.31	208.45	199.24	211.14	199.25
	Max	106358.96	94549.10	109295.69	105054.74	112858.60	116531.67	72974.50	120425.07	120425.07
Output	Mean	512481.19	541446.73	703043.00	716161.69	838529.96	901315.46	908291.01	858787.68	742635.07
	(SD)	(1028925.04)	(1085527.96)	(1270764.59)	(1386754.91)	(1576125.05)	(1678347.40)	(1757272.90)	(1619070.86)	(1440513.11)
	Min	11.52	20.95	375.32	1295.26	64.09	2154.00	5284.62	2878.66	11.52
	Max	8418832.61	8992354.08	9822743.11	11414185.26.92	12759379.92	13501076.00	13664132.16	12786620.81	13664132.16
Premiums net of reinsurance	Mean	343584.97	360270.74	448945.54	456772.95	524384.61	584622.40	623357.42	687359.51	498805.85
	(SD)	(612134.45)	(641511.60)	(732904.76)	(797152.07)	(903013.74)	(970137.23)	(1034890.13)	(1167132.82)	(872302.57)
	Min	30.73	32.16	1041.58	986.10	1320.25	1703.00	8376.24	9691.68	30.73
	Max	4669592.95	4945336.82	5325206.91	6213595.24	6976208.57	7359222.00	7430964.18	8732933.42	8732933.42
Investment income	Mean	220627.50	234939.02	316161.56	340717.54	396008.68	454982.89	470784.33	508431.45	363887.57
	(SD)	(468622.32)	(501885.25)	(610428.63)	(689993.31)	(796304.93)	(911084.40)	(989838.51)	(1126772.70)	(786414.13)
	Min	181.96	195.88	258.16	22.55	448.63	600.00	796.62	598.69	22.55
	Max	3981811.68	4335788.21	4907201.25	5745969.84	6598508.56	7433390.00	7858182.00	9366708.21	9366708.21

Note: All variables are expressed in 2000 Thousand Euro units deflated with the German Consumer Price Index.

Source: Own calculations.

4.6 Results

In this section we present the results of estimating the stochastic input distance frontier and the results of calculating TFP growth and changes in efficiency. We start with a discussion of the parameter estimates in section 4.6.1, while section 4.6.2 analyzes the development of TFP growth and efficiency change over time.

4.6.1 Estimation Results

The data described in section 4.5 was used in the panel estimation of the stochastic distance function described in section 4.4. The ML parameter estimates for the function are listed in table 4.3. The data used in the estimation were transformed by dividing all the variables used by their respective geometric means so that the first-order parameters of the translog distance function can be interpreted as elasticitities at the sample means.

All the estimated coefficients are statistically significant and show the expected signs. Concerning the overall evaluation of the model, the λ coefficient is significantly different from zero, indicating that inefficiency effects are significant in the stochastic frontier model. Therefore, it would be an inappropriate representation of the data if we estimated a model without the assumption of inefficiency. The Wald-Chi-Squared test of the overall significance of the model also proves highly significant. We finally analyzed whether the chosen translog specification is appropriate by testing it against a Cobb-Douglas functional form. Unlike a Cobb-Douglas specification, the translog specification contains the second-order and cross-term coefficients. Our likelihood ratio (LR) test strongly rejects the hypothesis that the Cobb-Douglas function fits the data better, so we conclude that the translog specification is appropriate. We further test whether the assumption of technical change is appropriate; the hypothesis of no technical change is rejected based on the results of the LR test, so we conclude that the incorporation of a time trend is adequate.

Table 4.3: Translog Input Distance Function – Estimation Results

True Fixed Effects Model Dependent variable: -(ln(Equity costs))			
Variable	**Parameter**	**Coefficients**	**Standard Error**
Ln(Opex)	γ_1	0.484***	0.011
Ln(Output)	β_1	-0.768***	0.010
Time	η_1	0.060***	0.003
½ (ln(Opex))^2	γ_{11}	0.079***	0.015
Ln(Opex)*ln(Output)	δ_1	0.011**	0.005
Ln(Opex)*time	ϕ_1	-0.024***	0.004
½ (ln(Output)^2	β_{11}	-0.132***	0.002
Ln(Output)*time	κ_1	0.008***	0.002
½ (time*time)	η_{11}	0.007**	0.002
Variance parameters			
σ		0.797***	0.010
σ_u (one-sided)		0.774	
σ_v (symmetric)		0.190	
$\lambda = \sigma_u / \sigma_v$		4.065***	0.193
Log Likelihood function		-184.81	
Wald test statistic (χ^2) (H_0: No influence of exogenous variables)		8885.85***	
LR test (H_0: Cobb-Douglas)		222.01***	
LR test (H_0: No technical change)		13.535**	
Wald test statistic (χ^2) (H_0: CRS)		519.98***	

Note: **: significant at a 5 percent level; ***: significant at at 1 percent level; Estimated with "LIMDEP 9.0".

Source: Own estimations.

We now turn to the estimates of the input elasticities in table 4.3. The estimate of 0.484 for the operating expenses shows the expected sign and is highly significant. The coefficient for the second input, equity costs, is calculated via the homogeneity restriction presented in section 4.4, and amounts to 0.516.

The estimated parameters also provide information on scale economies and technical change. The first order coefficient of the output variable (β_1) is less than one in absolute value, indicating increasing returns to scale for the industry at the sample mean. We tested the assumption of constant returns to scale in the industry by applying a Wald test, and the hypothesis of constant returns to scale is strongly rejected, confirming our theory that, on average, German life insurers operate under increasing returns to scale, i.e., firms are able to reduce costs by increasing firm size.

The first-order coefficient of the time trend variable (η_1) estimates the technical change over time; the positive sign of the coefficient indicates that there has been positive technical change in the industry during the observation period. The quadratic time trend (η_{11}) shows a weakly significant positive sign, indicating technical change growing at an increasing rate during the observation period. These results already indicate that hypothesis 4 cannot be rejected because the industry experienced positive technical change, resulting in potential savings for the firms. Further, the coefficient of the cross term of operating expenses and the time trend (ϕ_1) is negative and highly significant, indicating non-neutral technical change (e.g., Färe et al., 1997; Sipiläinen, 2007, for an application in a distance function estimation framework). The elasticity with respect to operating expenses decreases over time, indicating labor-saving technical change. This is according to our expectations, as the improvements in information technologies were mainly labor-saving. Correspondingly, the coefficient of equity costs with respect to time is calculated via the homogeneity restrictions and amounts to 0.02. Thus, the elasticity with respect to equity costs increases slightly over time.

4.6.2 Efficiency Levels, TFP Change and Profit Efficiency Change

Table 4.4 is a summary of the technical cost efficiency measures obtained from estimating the stochastic distance function, and the profit efficiency estimates calculated in a second step, following Kumbakhar (2006). Results are presented as yearly average values and as mean values over the whole sample.

Table 4.4: Average Technical Cost and Profit Efficiency, 1995-2002

	Technical cost efficiency	**Profit efficiency**
	Mean (SD)	Mean (SD)
1995	0.6620 (0.1262)	0.8777 (0.2490)
1996	0.6949 (0.1169)	0.8817 (0.2156)
1997	0.6804 (0.0993)	0.9328 (0.1199)
1998	0.6989 (0.0815)	0.9196 (0.1906)
1999	0.6505 (0.0877)	0.8912 (0.2059)
2000	0.6671 (0.1074)	0.9311 (0.089)
2001	0.7054 (0.1057)	0.9305 (0.1032)
2002	0.6637 (0.1547)	0.9539 (0.038)
Total	0.6778 (0.1125)	0.9137 (0.1703)

Source: Own estimations.

The yearly results give an initial insight into the development of technical cost and profit efficiency. As far as the mean values of technical cost efficiency are concerned, no clear trend emerges for the observation period; the average value over the whole observation period is 67.78 percent, with the efficiency scores for the single years ranging from 65.05 percent in 1999 to 70.54 percent in 2001. Further, we find that the standard deviation of the technical cost efficiency scores for the single years decreased until 1998, but then increased again until the end of the observation period. This may indicate that increased competition after liberalization led to converging efficiency scores in the industry at first, but since 1999 the dispersion in the technical cost efficiency of the firms increased again. Mean profit efficiency over the whole observation period adds up to 91.37 percent. There seems to be an upward trend in the development of profit efficiency over time, although the standard deviation of the mean efficiency scores for the single years is quite large, indicating significant variations in the profit efficiency of single firms. Thus, the decomposition of TFP growth into its components and the analysis of profit efficiency change provide a more detailed analysis of productivity change in the industry. Table 4.5 reports the results for the single periods and as mean values over the whole sample. The calculation of TFP components and changes in profit efficiency in the last line of the table compare the beginning and ending years of the sample period, 1995 and 2002, so the results in this line contain only those firms which were active during the whole observation period. The comparison of these results with the mean values delivers some interesting differences. We start with a discussion of the reported mean values delivered by year-to-year comparisons.

Table 4.5: Average TFP Change and Profit Efficiency Change, 1995-2002

	Technical change	**Technical cost efficiency change**	**Scale efficiency change**	**Total factor productiviy change**	**Profit efficiency change**
1995/96	4.031	5.429	12.715	22.175	0.017
1996/97	5.022	-2.304	12.066	14.784	1.088
1997/98	6.017	3.581	6.219	15.817	1.703
1998/99	7.081	-7.616	5.108	4.574	-2.402
1999/2000	7.762	2.364	6.030	16.159	1.445
2000/01	9.186	5.267	-1.604	12.849	2.063
2001/02	10.605	-9.408	-1.122	0.075	-1.535
Total	7.019	-0.353	5.837	12.503	0.361
1995-2002 [1]	7.289	-0.214	24.265	31.339	1.518

Note: All measures are in percentage terms. [1] Calculation of TFP components and profit efficiency change for 1995 versus 2002.

Source: Own calculations.

The mean value reported for the TFP change measure is 12.503, so the average annual change of TFP in this period is 12.50 percent. The single components of this TFP change measure are the center of interest of this study, as the decomposition of TFP into technical change and efficiency change allows us to differentiate between a shift of the frontier (technical change) and a movement towards the frontier (efficiency change).

We start with the development of technical change (TC), and focus afterwards on the development of technical cost efficiency (TCEC) and scale efficiency change (SEC). Finally, we analyze profit efficiency change (PEC).

As can be seen from table 4.5, German life insurance firms experienced significant positive technical change during the observation period. On average, over the observation period, the industry benefited from cost reductions of 7.019 percent resulting from pure technical change, which slightly increased over time. Thus, our hypothesis 4 is confirmed: Improvements in information technologies and connected innovations in communication and distribution services of insurance firms have led to significant technological progress in the industry. The liberalization of the market may have induced firms to adopt technological innovations and thereby caused positive technical change.

No clear trend in the development of technical cost efficiency can be deduced from the results. Technical cost efficiency increased for three years of the observation period, but the industry also experienced significant decreases in technical cost efficiency in three years of the observation period, leading to a small negative mean value (-0.353 percent) over the whole period. Table 4.5 shows that profit efficiency remained more stable than technical cost efficiency; only modest changes were observed during the observation period, resulting in an average change close to zero (0.361 percent). From these results, we conclude that hypothesis 1 must be rejected; there was no clear upward trend in the development of technical cost and profit efficiency in the German life insurance industry.

We conclude that potential competition as a consequence of market liberalization has not resulted in technical cost and profit efficiency increases. We find no clear evidence for hypothesis 2, as profit efficiency levels remained much more stable compared to technical cost efficiency, and we find only a small increase in the average value over the whole observation period, while technical cost efficiency slightly decreased. However, the effects are far too small to indicate that firms realized significant gains in profit efficiency resulting from cost-increasing innovations. Further, there is no evidence of negative correlation between changes in technical cost efficiency and profit efficiency; on the contrary, in two of the three years in which technical cost efficiency decreased, profit efficiency also decreased.

Firms have realized important increases in scale efficiency, as the industry experienced a significant positive scale efficiency change of 5.837 percent on average. The first years, from 1997-2000, showed significant positive scale efficiency changes, while the last two years showed a negative contribution of scale efficiency change to TFP growth. Thus, output growth in the presence of increasing returns to scale leads to positive scale efficiency change, whereas a decrease in output leads to negative change in scale efficiency. Related to this, decreasing returns to scale lead to positive scale efficiency change if output decreases, and vice versa. Increasing returns to scale are found for the sample mean and for all single years. The negative scale efficiency change in the last two years may be explained by decreases in output, which may have been a consequence of the bursting of the dotcom bubble and the stock market crash in 2000. Overall, hypothesis 3 cannot be rejected because market liberalization and subsequent market consolidation have led to positive changes in scale efficiency. By increasing firm size, partly as a consequence of M&A activities, firms have moved closer to their optimal size.

The positive contribution of changes in scale efficiency to TFP growth may partially explain why technical cost and profit efficiency have not increased significantly. The descriptive results indicate that market concentration increased again after an initial decrease as a reaction to market liberalization. Thus, firms may have reacted to increasing competition primarily by realizing scale economies. This, in turn, may have decreased competition again and consequently lowered efficiency-enhancing incentives of the firms, in keeping with the "quiet life" hypothesis (Hicks, 1935). The "quiet life" hypothesis postulates a positive relationship between market power and inefficiency, which may be caused by different factors. For example, higher market concentration may allow firms to set prices above marginal costs. As a consequence, they are not forced to realize cost-saving potential. Further, behavior other than profit-maximizing behavior may be pursued because of the lack of competitive pressure, causing high costs. This explanation may be supported by the fact that foreign insurers have entered the German market through M&A with German firms, while the establishment of foreign branches and agencies, as well as direct cross-border trade, remains limited (Beckmann et al., 2002). This indicates that market liberalization, which was meant to increase competition, may have resulted in higher market concentration, as remaining barriers to entry make it difficult for foreign insurers to enter the market via cross-border trade or the establishment of agencies or branches. Weill (2004) and Casu and Girardone (2006) found a similar effect in the U.S. and the European banking markets, i.e., that the deregulation and liberalization of the banking markets forced banks to be more efficient. (In our study, firms mainly increase their scale efficiency.) However, as a second step, the most efficient banks increased their market share and, thus, the market became more concentrated. The authors concluded that the liberalization of the markets has thus not resulted in more competitive markets.

A second reason for the co-incidence of unchanged technical cost and profit efficiency with increased scale efficiency may be found in large post-merger integration costs, especially as a consequence of cross-border mergers (e.g., Rhoades, 1998). In that case, the detrimental effect on efficiency would be transitory, leading to an increase in technical cost and profit efficiency once the integration process has finished.

In comparing the first and last year of the observation period, i.e., those which include only those firms which remained in the market throughout the whole observation period, we find very similar results concerning technical cost efficiency change, which decreased by only 0.214 percent. This suggests that firms which were active during the whole observation period did not increase their cost efficiency, either. However, profit efficiency change is positive for those firms, although the effect is relatively small: Profit efficiency increased by 1.518 percent between 1995 and 2002. This finding provides at least some evidence for hypothesis 2 holding true, since those firms which remained in the market during the whole observation period increased profit efficiency, though not in cost efficiency. This may indicate that those firms have realized service and product innovations which increased revenues by more than they raised costs. Finally, the scale efficiency effect is much stronger for those firms (24.265 percent), possibly because it was mainly these firms which acquired other life insurers over the observation period, thus increasing their size and realizing important gains in scale efficiency.

To summarize, the positive TFP change in the German life insurance industry is driven mainly by significant positive technical change. Thus, the industry has achieved productivity gains by the implementation of new advances in information technology. The large effect of positive technical change may also explain why the majority of German life insurance firms continue to operate under increasing returns to scale; large fixed costs in conjunction with investments in information technologies may result in an increase in the optimal size of the firm (e.g., Cummins et al., 1999).

Besides technical change, changes in scale efficiency also contribute significantly to TFP growth, especially for those firms which remained in the sample over the whole observation period. Increasing returns to scale permitted firms to realize efficiency gains by increasing their size. This is a consequence of market liberalization, since firms have engaged intensively in M&A activities as a reaction to increased competition since then. Finally, change in technical cost efficiency does not show the expected positive development, and profit efficiency has seen only a small increase over the observation period, possibly because of post-merger integration and transaction costs. Another possible explanation may be that competition and, thus, efficiency-enhancing incentives were reduced again by ongoing market consolidation. However, future research is needed to confirm this explanation. Finally, we find some evidence that those firms which remained in the market over the whole observation period realized small improvements in profit efficiency.

4.7 Conclusions

This study analyzed the effects of liberalization of the European insurance industry on the German life insurance market. The Third European Life Insurance Directives exposed European life insurance markets to cross-border competition. In the case of the heavily regulated German life insurance market, former price and product regulation was abolished. These major changes were implemented to increase the efficiency of the industry by enhancing competition.

To test the effects of market liberalization on the performance of German life insurers, we developed several hypotheses: Increased competition leads to gains in cost efficiency and profit efficiency; increased competition leads to gains in profit efficiency because necessary innovations raise costs and decrease cost efficiency; increased firm size from market consolidation results in gains in scale efficiency; and market liberalization provides incentives for firms to realize technological innovations and leads to positive technical change in the industry.

This study tested the hypotheses by analyzing TFP growth in the German life insurance industry for the years 1995-2002 and decomposing it into its sources – technical cost efficiency change, technical change, and scale efficiency change. We applied a stochastic distance frontier panel approach to derive estimates of technical cost efficiency and, following a recent approach by Greene (2005), we accounted for firm-specific heterogeneity by estimating a true fixed effects model. Further, we estimated changes in profit efficiency following Kumbakhar (2006), as the underlying non-standard profit function allows for price-setting power of firms which may have occurred as a consequence of market liberalization.

The reported mean technical cost and profit efficiency values are higher than those reported in chapter 3. This is not surprising since, in that study, non-parametric DEA, which usually delivers higher efficiency estimates, was used to obtain efficiency scores.

We found evidence for positive TFP growth in the German life insurance industry over the observation period, but the decomposition of TFP growth reveals that positive technical change is the main driver of positive TFP growth. Thus, we concluded that hypothesis 4 may not be rejected. These results were confirmed by Hussels and Ward (2004), who found positive technical change in the German life insurance industry for the period 1991-2002, although to a smaller extent. Their results must be treated cautiously, as the authors included yearly data of only 31 life insurance firms in their calculations.

Technical cost efficiency did not increase during the observation period, indicating that firms have experienced small efficiency losses over the observation period. These results are broadly in line with existing studies on the German market; Hussels and Ward (2004) found comparable changes in cost efficiency for the same observation period, while Mahlberg and Url (2007) reported a modest positive change in technical efficiency for the whole German industry, and Fenn et al. (2008) found that mean cost efficiency of German life insurers remained largely unchanged after liberalization. We also found that profit efficiency remains largely unchanged, so hypothesis 1 must be rejected. The aims of the liberalization process to increase market efficiency significantly were not reached until 2002, which may be partly explained by post-merger integration and transaction costs. We find no clear evidence for hypothesis 2 holding true, because only those firms which were active during the whole observation period realized small improvements in profit efficiency.

Scale efficiency has increased on average, as was hypothesized. Market consolidation in the presence of scale economies leads to efficiency gains as the firms move closer to their optimal size. By estimating firm-specific scale elasticity, we found that increasing returns to scale prevailed for the majority of the firms over the whole sample. These results are confirmed by previous literature; Mahlberg and Url (2007) reported large improvements in scale efficiency for the whole German insurance industry, and Fenn et al. (2008) also found increasing returns to scale prevailing in the German life insurance industry.

This significant increase in scale efficiency, taken together with the descriptive measures of market concentration, which indicate that market concentration increased again towards the end of the observation period, leads to an interesting conclusion: The liberalization of the European financial markets aimed at increasing competition and the efficiency of the markets. However, the increase in (potential) competition primarily provided incentives for the firms to realize economies of scale, mainly through M&A activities. This market consolidation may, in turn, reduce competition and efficiency-enhancing incentives. Fenn et al. (2008) drew a similar conclusion in finding that gains in scale efficiency of European insurance firms are linked with increasing X-inefficiencies.

Our work represents a twofold contribution to the existing literature. First, it contributes to the existing research on the development of European insurance markets after the liberalization of the market and, in doing so, is the first study to disentangle TFP growth into its three components for the German life insurance industry. The study used a recent approach for estimating stochastic frontiers by Greene (2005). The present study is also the first study to incorporate changes in profit efficiency into the analysis by applying an approach by Kumbakhar (2006) which allows for the price-setting power of firms.

The results indicate that the intended effects of the European financial market liberalization have only partially been achieved in the German life insurance market. It seems that increasing market consolidation as a reaction to market liberalization, in combination with still-existent barriers to entry, may reduce competition again as a feedback effect. However, this paper aims to analyze the effects of market liberalization on the performance of the industry, so a detailed analysis of the relationship between efficiency, and the structure and performance of the market is beyond the scope of this paper. In the industrial organization literature, some hypotheses associate higher concentration and market shares with less efficient markets and harmful effects to consumers (among them the "quiet life", the SCP, and the Relative Market Power hypotheses (Hicks, 1935; Mason, 1949; Bain, 1951; Sheperd, 1982)), while the "efficient structure" hypothesis (Demsetz, 1973, 1974) states that the most efficient firms are able to charge lower prices, and by this, increase their market share. Thus, in the latter case, higher concentration would benefit both the firms and the consumers. As a task for future research, these central hypotheses which link market structure and performance should be tested for the German insurance market.

5 Conclusions

The liberalization of the European insurance markets in the wake of the Third Life and Non-Life Insurance Directives in the early 1990s has been an important part of the creation of a single market for financial services. By establishing the principle of freedom of services and establishment, every insurance firm in the European Union is allowed to operate freely throughout the member states under the principle of home country supervision, and to establish a branch or agency in any foreign member state. The implementation of the Third Directives in 1994 induced major changes in the German insurance markets, which had been highly regulated. Remaining elements of price and product regulation were abolished to a large extent, and insurers have been exposed to increased competition in terms of both prices and products while insurance customers enjoy an increasing variety of suppliers and products.

This work contributes to knowledge of the German insurance industry after its liberalization by analyzing changes in the structure and choice of distribution channels in private insurance markets in the first and second article. In a third article the development of market performance since the implementation of the Third Directives is analyzed for the German life insurance industry. By this, we are able to assess to what extent the aims of the liberalization process have already been achieved in the German market. In this chapter, we summarize the major findings of the articles, address issues for future research, and conclude by combining the results of the single articles.

Until 1994, German private insurance markets were characterized by large, exclusive distribution forces which permitted the firms to engage heavily in selling activities. As minimum premium levels were regulated, insurers pursued a revenue-maximizing approach by maximizing turnover. Restricted competition and homogenous products and tariffs limited the demand for counseling and advice by independent agents. Thus, independent agents and brokers were of only minor importance in private insurance markets. The implementation of the Third Directives was expected to lead to important changes in the shape of the distribution channels: On the one hand, the liberalization and deregulation of the German insurance market should lead to an increasing price competition in insurance markets. As a consequence, distribution via direct distribution channels was expected to increase, as increased price competition should foster the direct distribution of lower-cost insurance products. This development should be backed by technological progress, particularly in terms of distribution of insurance products via the internet. Liberalization and deregulation was also expected to lead to an increased variety of products and increasing product complexity. This was expected to enhance the importance of independent insurance agents who are able to compare a number of insurance products and to provide better service. Our findings showed an increasing market share of both direct distribution and distribution via independent agents in private insurance markets, although this is primarily reflected in the use of an increasing number of distribution channels by multi-channel insurers; the market share of single-channel insurers remains small.

In chapter two, we analyzed if the increasing demand for services by independent agents may be because they provide customers with a higher service intensity and better performance. The product quality hypothesis states that independent agents should be able to supply both the insurer and the customer with better services than exclusive agents can. By this, they are able to recoup their higher costs and to coexist with exclusive agents in a separating equilibrium, where independent agents focus on complex, counseling-intensive products and exclusive agents sell primarily standardized products. To test the product quality hypothesis for the German market, we conducted an online survey among German insurance intermediaries and collected a data set containing information about 608 German insurance intermediaries with exclusive and independent insurance agents. Because a direct measurement of service quality proved elusive, we selected various input indicators which to approximate the service intensity of the intermediary. The chosen output indicators described the outcome of the counseling process and, thus, were able to represent performance-oriented measures. In the multivariate regression analyses of input activities and the outcome of the counseling process, we tested whether independent agents showed a higher service intensity and whether this higher level of service intensity translated into better performance. Because the input and output indicators were binary variables, ordered variables, or share values ranging between 0 and 1, we conducted ML binary logit, ML ordered probit and OLS regressions, respectively. (In the last case, the dependent variable was transformed into its log-odds ratio.) As exogenous variables, we included the type of the intermediary, proxies for the complexity of the intermediated insurance products, the size of the insurance agency, and the scope of the provided services, as well as a variable which accounts for the membership of the intermediary in a professional organization. We found evidence for the product quality hypothesis, as measured by the chosen indicators, in five of seven models, where we estimated higher values of the input and output indicators for independent agents than for exclusive agents. Thus, independent agents may show a higher level of service intensity, which also translates into better output performance. We also found that an increasing share of complex insurance products, as well as an increasing number of services which are provided by the intermediary, had a positive influence on the dependent variables. To a limited extent, membership in a professional organization as a quality measure also showed a positive effect on the indicators, but we did not find clear evidence for a significant influence of increasing firm size on the dependent variables. This is in line with previous research, which also found only limited influence for increasing returns to scale in insurance agencies. The separating equilibrium in the market, according to our findings, is reflected in independent agents' having above-average representation in some complex insurance lines, while exclusive agents have a higher share of turnover in only one standardized insurance line.

Our results provide some support for the product quality hypothesis in German private insurance markets by this explaining the increasing importance of independent intermediaries in those markets. Lacking information about the total population of insurance intermediaries in the German market, however, we were not able to exclude the possibility of a selection bias in the data. Thus, future research could focus on surveying the industry based on information obtained from the newly created central register for insurance intermediaries. From 2009 on, this register will contain information about every insurance intermediary operating in the German market and should contribute to testing the sensitivity of the results to the sample selection.

Chapter three addressed how the increasing importance of independent agents and direct distribution, as a reaction to the liberalization and deregulation process, are reflected in the distribution channel decisions of German life insurance firms. Despite the increasing importance of distribution via independent agents, as discussed in chapter two, the market share of those insurance firms using only independent agents (independent agency insurers) remains small. The same holds true for direct insurers which only use direct distribution channels. The majority of German life insurers have added direct distribution channels and distribution via independent agents to their exclusive-agent channels in order to use a multi-channel approach. Based on this observation, the second article investigated why direct insurers and independent agent insurers have not gained a larger market share in the German life insurance market. We hypothesized that single-channel strategies should prove superior to the multi-channel approach because they focus on either a cost advantage (direct insurers), or on a quality advantage (independent agent insurers). The higher cost efficiency among direct insurers would suggest a cost advantage over multi-channel insurers, while the higher quality of independent agent insurers should lead to higher levels of profit efficiency as they outperform multi-channel insurers in terms of revenues resulting from higher-quality services. By realizing higher revenues, independent agent insurers would be able to compensate their higher cost levels.

Data about output, cost, and revenue levels of German life insurance firms were obtained from periodically published industry reports for the years 1997-2005. We applied non-parametric DEA to estimate cost and profit efficiency of multi-channel versus single-channel insurers. Because of limited data, we followed a novel approach by Cooper et al. (2006) to estimate cost and profit efficiency in the absence of information about firms' individual input and output prices. We also investigated the scale efficiency of the firms to obtain information about the nature and size of returns to scale prevailing in the market. Our results showed that multi-channel insurers are superior to both types of single-channel insurers. First, in contrast to our theoretical expectations, direct insurers did not outperform multi-channel insurers in terms of costs but had a lower scale efficiency than that of multi-channel insurers. This can be explained by the fact that direct insurers, under the presence of increasing returns to scale, do not reach a sufficient firm size. Their growth in the life insurance market may be limited by the fact that the majority of life insurance products are rather complex, counseling-intensive products. For their part, independent agent insurers showed lower levels of both cost and profit efficiency, so they did not prove superior to multi-channel insurers either. They may have suffered from the fact that multi-channel insurers increasingly distribute their products through independent agents, especially in the life insurance industry. Thus, customers who prefer independent agents are no longer limited to the products offered by independent agent insurers. Our findings, then, are that distribution via multiple channels proved superior in a liberalized insurance market characterized by an increasing product variety. Confirming previous studies, our analysis revealed that the majority of firms operate under increasing returns to scale. Future research should primarily focus on data issues, e.g., it would be preferable to obtain a measure for individual firms' equity prices. Our data limitations require the assumption of an identical price for equity over all firms in a given year.

Chapters two and three revealed changes in the market structure resulting from the liberalization and deregulation process. However, the question how the liberalization and deregulation process affected overall market performance remained open. Chapter four used the revised SCP paradigm to analyze market performance in the life insurance industry after its liberalization in order to determine to what extent the aims of the liberalization have already been achieved in the German life insurance market. We applied the revised SCP-paradigm to analyze how changes in market structure may affect firms' conduct and market performance. The development of market performance was measured by changes in cost and scale efficiency and technical change, which sum up to TFP growth, and changes in profit efficiency. A successful liberalization process would lead to an increase in cost and profit efficiency, as increased competition forces firms to reduce costs and to realize potential profits. It is important to account for changes in profit efficiency besides cost efficiency, because, as a consequence of the liberalization process, life insurance firms have innovated by creating new products and services. These innovations may raise costs, but they may also lead to increased revenues. In contrast to cost efficiency measurement, which takes only the cost side into account, profit efficiency measurement also considers firms' revenues and, thus, allows a more complete analysis of changes in market performance. We also expected an increase in terms of scale efficiency, as competition may foster market consolidation and help firms realize efficiency gains by moving closer to an optimal firm size. Finally, technical change is assumed to be positive over time, as progress in information technologies, together with increased pressure to realize potential cost savings, force firms to apply technological innovations. Data about output, cost and revenue levels were obtained from periodically published industry reports. We applied a parametric SFA to an unbalanced panel of German life insurance firms for the years 1995-2002, thus avoiding the possible panel distortions caused by the recovering from the stock market bust in the beginning of this century. To obtain technical cost efficiency levels, we estimated a stochastic input distance frontier, which proved superior to directly estimating a cost frontier, since data is limited and there is insufficient variation in some of the input prices. To account for unobserved firm-specific heterogeneity, we applied a true FE estimator, in keeping with Greene (2005). In a second step, we derived profit efficiency measures, following Kumbakhar (2006); this novel approach accounted for the possibility of temporary price-setting power of the firms as a consequence of service and product innovations. Finally, we calculated technological and efficiency changes over time.

Our results showed that technical cost and profit efficiency of German life insurance firms did not increase as a consequence of market liberalization, but we did find significant increases in scale efficiency, which were largest for firms that remained in the industry over the whole observation period. A finding of positive technical change also confirmed our hypothesis that technological progress in information technologies, along with increased competitive pressure, would lead to positive technical change. Again confirming the results in chapter three, we found that increasing returns to scale prevailed in the industry over the whole observation period. We also obtained higher values for the technical cost and profit efficiency scores than the results obtained in chapter three; this could be expected, as parametric approaches usually reveal higher efficiency values than do non-parametric methods because the latter consider all deviations from the efficient frontier to be inefficiencies.

Our findings in chapter four were that the intended effects of the liberalization process have only partially been achieved in the German life insurance market. A possible reason for limited effects on changes in technical cost and profit efficiency is that market liberalization resulted in market consolidation as companies pursued increasing returns to scale. As a consequence, competition and efficiency-enhancing incentives of the firms may have decreased again. Our descriptive results confirmed that market concentration first decreased as a consequence of market liberalization, but then increased again to an even higher level towards the end of the observation period. While a detailed analysis of the relationship between efficiency and the structure and performance of the market is beyond the scope of this article, it offers interesting tasks for future research. Prospective work could center on testing the central hypotheses from the industrial organization literature which link market structure and performance for the German insurance market.

From the major findings of this collection of articles, we conclude that the liberalization and the ensuing deregulation in the German insurance markets have led to major changes in the structure and choice of distribution channels. As could be expected, the dominance of distribution via exclusive agents has decreased, especially in the life insurance industry, while independent insurance agents have gained importance. We showed that this may be explained because independent agents provide better services to their customers, which makes them better able to meet the requirements of an increasing variety and complexity in most insurance lines. Simultaneously, removal of price regulations has also made room for low-cost distribution via direct distribution channels, primarily for less complex insurance products (e.g., term life insurance). However, our analysis in chapter three revealed that single-channel insurers which rely exclusively on distribution via direct channels or independent agents have not been benefited from this development. In fact, the well established multi-channel insurers, which formerly focused on distribution via exclusive agents, have benefited most from diversification of their distribution strategies by the incorporation of new channels. Since they have outperformed single-channel insurers, we conclude that, on average, established multi-channel insurers have successfully adapted their distribution strategies to the changed market environment in the life insurance industry. Finally, an analysis of market performance since liberalization revealed that the expected benefits have been only partially achieved in the German life insurance industry. This finding is in line with the European Commission's finding that, because of remaining barriers to cross-border trade, financial retail markets have not benefited to a sufficient extent from the liberalization of services (European Commission, 2005). Future research on the German insurance market should center on a more detailed examination of the reasons for the limited success of the liberalization process in order to guide future policy actions.

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Appendix

Table A 1: Questionnaire

FRAGEBOGEN

I. Allgemeine Angaben zu Betrieb und Leistungsangebot

1. Sind Sie als Einfirmenvertreter, Mehrfirmenvertreter oder Versicherungsmakler tätig?

   (Bitte kreuzen Sie Zutreffendes an.)

   ☐ Einfirmen-, Ausschließlichkeits-, Konzernvertreter
   ☐ Mehrfirmenvertreter
   ☐ Versicherungsmakler
   ☐ Sonstiges: ________________________

2. Für welches Versicherungsunternehmen sind Sie tätig?

   ____

3. Unter wie vielen Versicherungsunternehmen können Sie insgesamt ca. auswählen, wenn Ihre Kunden Sie mit der Vermittlung von Versicherungsschutz beauftragen?

   (Bitte geben Sie die Zahl der Versicherungsunternehmen an, deren Produkte Sie regelmäßig im Auftrag Ihrer Kunden vermitteln.)

   ____

4. Unter wie vielen Anbietern können Sie ca. in den folgenden Sparten auswählen?

   (Bitte geben Sie die Anzahl der Anbieter an, deren Produkte Sie im Auftrag Ihrer Kunden innerhalb der folgenden Sparten vermitteln.)

   ☐ Altersvorsorge: ________________________
   ☐ Private Krankenversicherung: ________________________
   ☐ Kfz-Versicherung: ________________________
   ☐ Private Haftpflichtversicherung: ________________________
   ☐ Private Sachversicherungen: ________________________
   ☐ Gewerbliche Versicherungen: ________________________
   ☐ Industrieversicherungen: ________________________

5. Bieten Sie neben der Vermittlung von Versicherungen weitere Leistungen an?

(Bitte kreuzen Sie Zutreffendes an; Mehrfachnennungen sind möglich.)

- ☐ Keine
- ☐ Vermögens- und Anlageberatung
- ☐ Finanzierungsberatung
- ☐ Investmentfondsgeschäfte
- ☐ Rentenberechnung und -beratung
- ☐ Vermögensverwaltung
- ☐ Bauspargeschäfte
- ☐ Immobilienberatung, -vermittlung
- ☐ Rechtsberatung
- ☐ Technische Schadensverhütung
- ☐ Sonstige: ______________________

6. Welche Produkte bieten Sie auf dem Gebiet der Altersvorsorge an?

(Bitte kreuzen Sie Zutreffendes an; Mehrfachnennungen sind möglich.)

- ☐ Ich biete keine Produkte zur Altersvorsorge an.
- ☐ Kapitallebensversicherung
- ☐ Fondsgebundene Lebensversicherung
- ☐ Private Rentenversicherung
- ☐ Riester-Policen
- ☐ Pflegeversicherung
- ☐ Berufsunfähigkeitsversicherung
- ☐ Betriebliche Altersvorsorge
- ☐ Sonstige: ______________________

II. Angaben zum Vermittlungsprozess

Die folgenden Fragen im Abschnitt II beziehen sich speziell auf die Vermittlung von Produkten zur Altersvorsorge. Bei Beantwortung dieser Fragen ist daher, sofern nicht anders angegeben, immer von der Situation eines Beratungsgesprächs im Bereich der Altersvorsorge auszugehen.

1. Führen Sie im Rahmen jeder Beratung eine Risikoanalyse des Kunden durch?

   (Bitte kreuzen Sie Zutreffendes an.)

   ☐ Ja ☐ Nein

2. Welche Informationen über den Kunden erheben Sie im Rahmen der Risikoanalyse?

   (Bitte kreuzen Sie Zutreffendes an.)

   ☐ Alter
   ☐ Familienstand
   ☐ Aktuelle Tätigkeit
   ☐ Verfügbares Einkommen
   ☐ Nettovermögen
   ☐ Liquides Vermögen
   ☐ Erfahrung mit Anlageformen in der Vergangenheit
   ☐ Risikobereitschaft des Kunden
   ☐ Sonstige: ______________________

3. Wie ermitteln Sie die individuelle Risikobereitschaft des Kunden?

   (Bitte kreuzen Sie Zutreffendes an.)

   ☐ Eigenständige Einschätzung der Risikobereitschaft des Kunden
   ☐ Einordnung des Kunden in vorgegebene Riskotypen/-klassen
   ☐ Computergestützte Ermittlung der Risikobereitschaft
   ☐ Sonstiges: ______________________

4. Wer gibt dabei die Risikotypen/-klassen vor?

   ____

5. Welches EDV-Beratungssystem setzen Sie dabei in der Beratung ein?

____

6. Welche Informationen holen Sie regelmäßig zur Ermittlung des Versicherungsbedarfs des Kunden ein?

(Bitte kreuzen Sie Zutreffendes an; Mehrfachnennungen sind möglich.)

- ☐ Erfassung der laufenden Versicherungsverträge des Kunden im Bereich Altersvorsorge
- ☐ Erfassung aller laufenden Versicherungsverträge des Kunden
- ☐ Erfassung der Restlaufzeiten bestehender Verträge
- ☐ Erfassung der Versicherungssummen bestehender Verträge
- ☐ Erfassung der Prämienhöhen bestehender Verträge
- ☐ Max. Prämienhöhe für abzuschließenden Vertrag
- ☐ Gewünschte Zahlweise der Prämie bei abzuschließendem Vertrag
- ☐ Gewünschte Versicherungssumme für abzuschließenden Vertrag
- ☐ Gewünschte Laufzeit für abzuschließenden Vertrag
- ☐ Sonstige: ____________________

7. Geben Sie bei den folgenden Informationen bitte an, ob Sie diese "immer", "nur auf Nachfrage des Kunden" erteilen oder ob in Zusammenhang mit dieser Information "keine Informationserteilung möglich" ist.

1. Übersicht über verschiedene Angebotsformen

- ☐ Wird immer erteilt
- ☐ Nur auf Nachfrage des Kunden
- ☐ Keine Informationserteilung möglich

2. Informationen über verschiedene Formen der Lebensversicherung

- ☐ Wird immer erteilt
- ☐ Nur auf Nachfrage des Kunden
- ☐ Keine Informationserteilung möglich

3. Informationen zur Aufteilung der Prämie auf verschiedene Anteile bei der Kapitallebensversicherung

- ☐ Wird immer erteilt
- ☐ Nur auf Nachfrage des Kunden
- ☐ Keine Informationserteilung möglich

4. Informationen über Nachteile bei vorzeitiger Kündigung (Zillmerung, Rückkaufswert)

☐ Wird immer erteilt
☐ Nur auf Nachfrage des Kunden
☐ Keine Informationserteilung möglich

5. Informationen über Vergangenheitsrendite bei der Kapitallebensversicherung

☐ Wird immer erteilt
☐ Nur auf Nachfrage des Kunden
☐ Keine Informationserteilung möglich

8. Welche Rolle spielen folgende Informationsquellen für Sie?

(Bitte geben Sie die Wichtigkeit der folgenden Informationsquellen auf der Skala von "1 = sehr wichtig" bis "5 = völlig unwichtig" an.)

1. Informationen von Versicherungsunternehmen

☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

2. Informationen der Berufsverbände

☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

3. Informationen von Rating-Agenturen/Finanz-Test

☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

4. Informationen der Verbraucherverbände

☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

9. Welche Rolle spielen folgende Informationsarten für Sie?

   (Bitte geben Sie die Wichtigkeit der folgenden Informationsarten auf der Skala von "1 = sehr wichtig" bis "5 = völlig unwichtig" an.)

   1. Wissenschaftliche Publikationen

   ☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

   2. Tagungen, Weiterbildungsveranstaltungen

   ☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

   3. Fachmedien

   ☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

   4. Internet

   ☐ sehr wichtig ☐ ☐ ☐ ☐ völlig unwichtig

10. Wie hoch ist Ihr Einfluss in den Verhandlungen mit dem Versicherungsunternehmen auf die endgültige Prämienhöhe bei Verträgen zur Altersvorsorge?

    __________ %

11. Wie hoch ist Ihr Einfluss auf die Provision-/Courtagesätze bei Produkten zur Altersvorsorge?

    ☐ kein Einfluss ☐ ☐ ☐ ☐ sehr hoher Einfluss

12. Wie stark beeinflusst die Tatsache, dass ein Kunde ein hohes Risiko aufweist (z.B. schwere Vorerkrankungen) die Wahrscheinlichkeit, dass es zu einem Vertragsabschluss (vor allem bei BU- und privaten KV-Verträgen) kommt?

    (Bewerten Sie bitte den Einfluss, den das erhöhte Risiko des Kunden auf das Zustandekommen eines Vertragsabschlusses hat, auf einer Skala von 1=kein Einfluss bis 5=sehr hoher Einfluss.)

    ☐ kein Einfluss ☐ ☐ ☐ ☐ sehr hoher Einfluss

13. Welche der folgenden Aktivitäten führen Sie regelmäßig nach Vertragsabschluss aus?

(Bitte kreuzen Sie Zutreffendes an; Mehrfachnennungen sind möglich.)

☐ Hinweise zur Beachtung von Obliegenheiten
☐ Beratung zur Anpassung des Versicherungsschutzes bei Veränderung des Risikos
☐ Beratung über Sicherheits- und Schadenverhütungsmaßnahmen
☐ Hilfestellung bei der Aufnahme des Schadens
☐ Hilfestellung bei der Ausfertigung der Schadensanzeige
☐ Empfehlung eines geeigneten Sachverständigen
☐ Empfehlung von Handwerkern
☐ Übernahme der Verhandlungen mit Versicherungsunternehmen
☐ Sonstiges: ________________________

14. Wie oft erfolgt eine Kontaktaufnahme mit dem Kunden zur Überprüfung seiner Risikosituation?

___________ mal/jährlich

III. Angaben zu Informations-und Dokumentationstätigkeiten

Auch die folgenden Fragen im Abschnitt III beziehen sich auf die Vermittlung von Produkten zur Altersvorsorge. Bei Beantwortung dieser Fragen ist daher weiterhin von der Situation eines Beratungsgesprächs im Bereich der Altersvorsorge auszugehen.

1. Welche mündlichen Informationen erteilen Sie dem Kunden vor dem ersten Vertragsschluss?

(Bitte kreuzen Sie Zutreffendes an; Mehrfachnennungen sind möglich.)

☐ Keine mündliche Informationserteilung
☐ Angaben über Vermittlertyp (Einfirmenvertreter, Mehrfirmenvertreter, Makler)
☐ Angabe der Anzahl der Versicherungsunternehmen, deren Produkte Sie vermitteln
☐ Angabe der Namen der Versicherungsunternehmen, deren Produkte Sie vermitteln
☐ Informationen über eigene Verbandsmitgliedschaft
☐ Informationen über Beschwerdestelle für Versicherungsnehmer
☐ Sonstige: ______________________

2. Erfolgt eine Dokumentation des Beratungsgesprächs?

☐ Ja ☐ Nein

3. Erfolgt eine langfristige Speicherung der Informationen?

☐ Ja ☐ Nein

4. Erfolgt eine Aushändigung einer Kopie an den Kunden?

☐ Ja ☐ Nein

5. Welche Informationen werden im Beratungsprotokoll festgehalten?

☐ Bedarfslage des Kunden
☐ Erfasste Risikoumstände
☐ Vorgeschlagenes Deckungskonzept
☐ Begründung für erteiltes Deckungskonzept
☐ Evt. Einwände des Kunden
☐ Sonstiges: ________________________

6. Wie lang beträgt die Dauer eines durchschnittlichen Beratungsgesprächs im Bereich der Altersvorsorge?

___________ Minuten

7. Wie hoch ist der Anteil der Beratungsgespräche, die zum Abschluss eines Versicherungsvertrags führen?

(Bitte geben Sie den Anteil der Beratungsgespräche, die zu einem Abschluss führen, in Prozent an.)

___________ %

IV. Unternehmensspezifische Informationen und Fragen zur Person

1. Sind Sie abhängig oder selbstständig beschäftigt?

☐ abhängig
☐ selbstständig

2. Sind Sie haupt- oder nebenberuflich tätig?

☐ hauptberuflich
☐ nebenberuflich

3. Wieviele Stunden sind Sie wöchentlich ca. tätig?

___________ Stunden/Woche

4. Wie viele Vollzeitmitarbeiter sind in Ihrem Betrieb beschäftigt?

(Bitte geben Sie die Anzahl der Vollzeitmitarbeiter in Ihrem Betrieb an; schließen Sie sich selbst dabei in die Zählung ein.)

___________ Vollzeitmitarbeiter

5. Wie viele Teilzeitmitarbeiter sind in Ihrem Betrieb beschäftigt?

(Bitte geben Sie die Anzahl der Teilzeitmitarbeiter in Ihrem Betrieb an.)

___________ Teilzeitmitarbeiter

6. Seit wann sind Sie als Versicherungsvermittler tätig?

(Bitte geben Sie das Jahr an, in dem Sie erstmalig als Versicherungsvermittler tätig waren.)

____

7. Welches ist Ihr höchster Schulabschluss?

☐ Hauptschule
☐ Mittlere Reife
☐ Fachhochschulreife
☐ Allgemeine Hochschulreife
☐ Sonstiges: ________________________

8. Haben Sie eine abgeschlossene Ausbildung/Studium?

☐ Nein
☐ Versicherungskaufmann/-frau
☐ Versicherungsfachmann/-frau (BWV)
☐ Servicefachmann/-fachfrau Versicherungen (BWV)
☐ Geprüfter Versicherungsfachwirt/-in
☐ Versicherungsbetriebswirt/-in
☐ wirtschaftswissenschaftliches Studium
☐ rechtswissenschaftliches Studium
☐ Sonstiges: ________________________

9. Verfügen Sie über Zusatzqualifikationen?

(Bitte geben Sie an dieser Stelle vorhandene Zusatzqualifikationen (Weiterbildungen, Fachseminare) an.)

____

10. Wie viel Prozent Ihrer Arbeitszeit verbringen Sie durchschnittlich mit folgenden Aktivitäten?

Informationsgewinnung über Kunden, Produkte und Anbieter:

__________ %

Beratungsgespräche mit Kunden:

__________ %

Weiterbildungsmaßnahmen:

__________ %

Schadenregulierung:

__________ %

Werbemaßnahmen:

__________ %

11. Sind Sie Mitglied in einem Verband?

- ☐ Nein
- ☐ Arbeitgeberverband der finanzdienstleistenden Wirtschaft e.V. (afw)
- ☐ Bundesverband Deutscher Vermögensberater e.V. (BDV)
- ☐ Bundesverband Deutscher Versicherungskaufleute e.V. (BVK)
- ☐ Bundesverband der kleinen und mittleren Unternehmen von Versicherungsmaklern e.V. (KMU)
- ☐ Institut der Versicherungsmaker e.V. (ivm)
- ☐ Verband Deutscher Versicherungsmakler e.V. (VDVM)
- ☐ Verband der Verbraucherorientierten Versicherungs- und Finanzmakler (VVV)
- ☐ Sonstige: ____________________

12. Verfügt Ihr Betrieb über eine eigene Berufshaftpflichtversicherung?

☐ Ja ☐ Nein

13. Wie hoch ist die Deckungssumme Ihrer Berufshaftpflichtversicherung?

(Bitte geben Sie die Deckungssumme in Euro an.)

___________ EUR

14. Ist Ihr Betrieb in einem Versicherungsvermittler-Register eingetragen?

(Bitte kreuzen Sie Zutreffendes an, jedoch ist hiermit nicht die IHK-Mitgliedschaft gemeint.)

☐ Ja ☐ Nein

15. In welchem Versicherungsvermittler-Register sind Sie eingetragen?

____

16. Wie viel Prozent Ihres Umsatzes ist im vergangenen Jahr ist auf Privatkunden entfallen?

___________ %

17. Wie viele Kunden betreuen Sie insgesamt zurzeit?

___________ Kunden

18. Wie viele Kunden sind davon Neukunden des vergangenen Jahres?

___________ Neukunden im vergangenen Jahr

19. Wie viel Prozent Ihres Umsatzes im vergangenen Jahr ist auf Neukunden entfallen?

___________ %

20. Wie viele Verträge haben Sie im vergangenen Jahr in den folgenden Sparten ca. vermittelt?

- ☐ Altersvorsorge ______________________
- ☐ Private Krankenversicherung ______________________
- ☐ Kfz-Versicherung ______________________
- ☐ Private Haftpflichtversicherung ______________________
- ☐ Private Sachversicherungen (z.B. Hausrat, Wohngebäude etc.) ______________________
- ☐ Gewerbliche Versicherungen ______________________
- ☐ Industrieversicherung ______________________

21. Wie hoch war dabei innerhalb der folgenden Sparten der prozentuale Anteil der Verträge, die innerhalb des ersten Vertragsjahres gekündigt wurden?

    (Bitte geben Sie den Anteil der gekündigten Verträge in Prozent an.)

- ☐ Altersvorsorge ______________________
- ☐ Private Krankenversicherung ______________________
- ☐ Kfz-Versicherung ______________________
- ☐ Private Haftpflichtversicherung ______________________
- ☐ Private Sachversicherungen (z.B. Hausrat, Wohngebäude etc.) ______________________
- ☐ Gewerbliche Versicherungen ______________________
- ☐ Industrieversicherung ______________________

22. Geschlecht

- ☐ männlich
- ☐ weiblich

23. Geburtsjahr

____

Sollten Sie Interesse an den Ergebnissen unseres Forschungsprojektes haben, so senden wir Ihnen gerne nach erfolgter Auswertung eine Zusammenfassung der Ergebnisse zu. Dazu würden wir Sie bitten, uns im folgenden Feld Ihre Email-Kontaktadresse zu nennen.

____

Table A 2: Variables and Summary Statistics, 1997-2005

	1997											
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	71490.10 (91610.28)	1479.96	480515.99	15781.50 (18565.84)	761.57	49941.34	38551.41 (40695.31)	224.40	104870.17	61480.89 (83873.58)	224.40	480515.99
Equity costs	7562.10 (9921.56)	272.10	47577.23	2856.34 (3701.58)	210.68	11956.15	2418.42 (1796.04)	414.51	5936.85	6432.12 (9037.92)	210.68	47577.23
Output	665393.96 (841210.13)	16929.43	3605517.22	191125.66 (340009.05)	375.32	1034803.52	257480.60 (366517.78)	985.49	1110370.48	564821.09 (777453.70)	375.32	3605517.22
Premiums net of reinsurance	421225.06 (514967.12)	11904.23	2203442.63	155341.95 (250342.17)	2283.24	750610.51	189567.29 (239347.20)	1041.58	729265.52	364483.79 (476645.65)	1041.58	2203442.63
Investment income	302979.71 (390573.78)	3468.31	1810744.74	73291.94 (152810.95)	258.16	471480.34	115221.79 (156653.97)	357.95	485890.23	255452.37 (360522.05)	258.16	1810744.74
n		64			9			10			83	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

	1998											
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	75244.55 (97541.33)	1486.66	475679.53	14706.06 (19535.24)	732.05	54076.06	38204.53 (42493.02)	106.72	118148.87	63174.95 (88580.20)	106.72	475679.53
Equity costs	6896.81 (8986.51)	225.08	45902.83	2434.58 (3374.53)	287.56	11254.04	2365.37 (1634.72)	658.60	5661.12	5772.22 (8109.04)	225.08	45902.83
Output	717843.49 (902658.89)	12600.30	3891376.61	174614.37 (341555.60)	348.24	1124836.65	235807.11 (372175.59)	1295.26	1225368.03	590017.87 (829585.85)	348.24	3891376.61
Premiums net of reinsurance	458380.36 (563632.78)	10229.26	2289492.51	141669.82 (252033.80)	408.87	814164.17	172832.33 (239860.69)	986.10	802353.05	383267.40 (518166.66)	408.87	2289492.51
Investment income	344094.29 (445027.14)	4991.12	2155050.48	78837.00 (185464.25)	22.55	625372.01	106221.53 (161486.61)	425.91	526065.23	281351.86 (408548.47)	22.55	2155050.48
n		69			11			12			92	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

	1999											
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	109955.98 (143402.42)	1796.73	724927.76	18404.26 (23938.36)	636.22	68182.58	58768.52 (69916.92)	166.37	200539.89	93506.88 (131402.27)	166.37	724927.76
Equity costs	7399.82 (9571.15)	217.22	50422.29	2754.07 (3634.77)	366.45	11848.58	2431.78 (1846.56)	635.68	5660.99	6259.24 (8697.78)	217.22	50422.29
Output	865196.56 (1050325.28)	5468.28	4120042.51	216338.23 (389890.89)	3124.61	1232148.87	263611.73 (394942.11)	1698.93	1327350.51	717803.00 (971548.19)	1698.93	4120042.51
Premiums net of reinsurance	542502.22 (652739.43)	2232.81	2472583.68	174494.42 (283113.38)	4426.79	877200.36	192535.63 (264296.77)	1408.55	901463.82	457774.51 (603170.63)	1408.55	2472583.68
Investment income	405192.68 (505059.75)	5868.62	2339792.33	90908.48 (186718.10)	634.71	601581.35	119145.18 (177897.74)	490.02	578935.16	334489.32 (466515.65)	490.02	2339792.33
n	71			10			12			93		

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

	2000											
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	97909.80 (147833.59)	1122.00	843474.00	17233.60 (21685.05)	420.00	56427.00	71564.33 (82972.30)	123.00	285024.00	85002.82 (133712.12)	123.00	843474.00
Equity costs	9077.12 (16497.41)	208.45	116531.67	2850.17 (3723.97)	336.83	12109.19	2501.01 (2050.73)	610.28	6579.49	7454.33 (14574.26)	208.45	116531.67
Output	1083910.69 (1918057.36)	13801.00	13501076.00	232036.70 (385557.94)	4350.00	1184012.00	276499.42 (404306.53)	2154.00	1328884.00	874627.07 (1704500.53)	2154.00	13501076.00
Premiums net of reinsurane	681127.94 (1088798.48)	9460.00	7359222.00	199397.20 (307958.98)	5514.00	936858.00	211211.67 (260212.73)	1703.00	883050.00	560940.55 (971590.69)	1703.00	7359222.00
Investment income	552107.00 (1045628.17)	5166.00	7433390.00	98003.50 (190399.67)	1214.00	610123.00	128162.92 (194041.58)	600.00	632337.00	441436.15 (926780.84)	600.00	7433390.00
n		65			10			12			87	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

2001												
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	116783.80 (160936.53)	1224.00	760870.02	17582.89 (21977.29)	1476.96	54637.32	61485.88 (58471.55)	4723.62	152271.72	99476.58 (146013.91)	1224.00	760870.02
Equity costs	5129.86 (5998.69)	199.25	28612.09	1307.42 (1113.71)	205.53	3054.54	1739.66 (1373.23)	467.41	5044.22	4291.93 (5487.51)	199.25	28612.09
Output	943774.18 (1139054.51)	9746.10	4152321.06	157749.12 (189336.78)	5284.62	467319.12	284124.80 (407967.16)	11747.34	1295486.70	776560.06 (1051925.94)	5284.62	4152321.06
Premiums net of reinsurance	663081.72 (777463.63)	9238.14	2758385.00	156654.02 (194552.09)	8376.24	484396.98	234714.05 (281087.78)	9444.18	938476.50	554890.78 (716315.23)	8376.24	2758385.00
Investment income	485540.88 (611652.28)	5281.56	2617113.96	79880.28 (99475.80)	1026.12	251298.42	129408.14 (174748.12)	796.62	522694.92	397111.93 (562073.08)	796.62	2617113.96
n		62			8			11			81	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

2002												
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	134494.35 (210914.95)	1161.18	1229533.54	17959.66 (21996.13)	1119.82	56808.99	58549.42 (58433.97)	5514.32	162215.99	111891.08 (189694.46)	1119.82	1229533.54
Equity costs	5216.21 (8480.63)	211.14	59207.87	963.10 (854.01)	231.92	2459.90	1668.02 (1592.16)	388.83	4680.81	4294.21 (7601.31)	211.14	59207.87
Output	1031580.51 (1813338.58)	2878.66	12786620.81	140414.10 (15892.72)	5948.60	464502.79	225907.80 (395082.56)	9714.43	1248947.92	830615.20 (1627870.04)	2878.66	12786620.81
Premiums net of reinsurance	807078.90 (1302804.42)	9691.68	8732933.42	152310.38 (195261.07)	11763.82	517204.73	226614.44 (300396.92)	12532.08	975058.90	660859.39 (1171781.05)	9691.68	8732933.42
Investment income	626032.50 (1283923.43)	6174.01	9366708.21	74897.45 (104634.20)	1426.92	295932.87	114769.76 (182526.56)	598.69	566171.87	500121.97 (1143912.67)	598.69	9366708.21
n		61			9			10			80	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

	2003											
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			**Total**		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	118310.35 (146598.77)	1454.64	617001.44	23133.63 (23829.30)	715.83	60847.22	68178.84 (66376.34)	7442.49	178662.61	100709.89 (133168.39)	715.83	617001.44
Equity costs	22171.60 (24204.04)	1046.06	104040.33	12794.88 (23566.33)	1078.09	74515.80	8685.32 (7344.43)	1936.64	21827.06	19262.35 (22964.35)	1046.06	104040.33
Output	920842.12 (1107858.94)	12590.16	4171369.35	306220.88 (377201.16)	6647.25	1045807.79	315279.73 (413517.92)	16791.06	1364558.91	768432.40 (1011561.34)	6647.25	4171369.35
Premiums net of reinsurance	705769.52 (837311.44)	7789.43	3032742.57	276004.12 (315865.44)	14032.26	840557.25	263052.91 (318241.48)	10340.28	1068751.81	596547.38 (763396.68)	7789.43	3032742.57
Investment income	494271.71 (639754.22)	6867.74	2828119.03	138571.64 (187104.01)	2321.99	574130.32	140468.14 (210406.63)	1153.68	689348.88	405607.46 (581980.00)	1153.68	2828119.03
n		61			9			10			80	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

	2004											
	Multi-channel insurers			**Direct insurers**			**Independent agent insurers**			Total		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	163287.66 (209300.00)	1478.30	881012.90	27681.62 (27691.16)	754.02	71825.18	83804.65 (89733.44)	5563.82	225699.43	138407.60 (191354.88)	754.02	881012.90
Equity costs	16658.93 (21057.20)	519.00	122242.76	8668.99 (15258.72)	807.46	48573.26	5199.89 (4647.16)	1240.89	16509.45	14356.45 (19545.77)	519.00	122242.76
Output	937895.23 (1093076.12)	12391.42	4159399.46	322551.47 (400133.70)	2435.17	1165112.77	279674.51 (293195.84)	20901.22	746233.42	788261.88 (1005391.99)	2435.17	4159399.46
Premiums net of reinsurance	753928.74 (901867.34)	7252.40	3256099.43	287619.69 (323591.59)	3758.42	878850.67	306752.33 (360091.56)	22520.77	1164044.39	646909.66 (826505.42)	3758.42	3256099.43
Investment income	342746.95 (412606.40)	5374.78	1595722.97	134033.84 (180541.48)	45.67	548980.72	132630.74 (207238.64)	1104.48	658715.06	293616.33 (381939.11)	45.67	1595722.97
n		62			9			10			81	

Table A 2 (cont'd): Variables and Summary Statistics, 1997-2005

	2005											
	Multi-channel insurers			Direct insurers			Independent agent insurers			Total		
	Mean (SD)	Min	Max	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.	Mean (SD)	Min.	Max.
Operating expenses	114033.04 (142508.12)	1675.40	610685.29	23938.09 (27745.76)	1123.07	75868.48	65213.82 (70903.01)	2123.76	187892.92	96668.77 (129812.99)	1123.07	610685.29
Equity costs	26168.78 (31981.95)	1196.58	178698.56	11936.75 (21670.59)	1179.41	72036.28	8293.21 (8302.71)	1812.51	28514.04	22155.33 (29580.83)	1179.41	178698.56
Output	1060494.36 (1239131.02)	21321.02	4962515.02	358402.28 (459015.78)	6820.73	1270142.40	414714.71 (502232.49)	19988.93	1580092.67	892010.39 (1133976.93)	6820.73	4962515.02
Premiums net of reinsurance	792810.37 (902858.21)	13590.57	3450666.51	300326.19 (354097.08)	10140.13	871895.14	344564.25 (408646.25)	21054.60	1284288.55	675219.08 (827179.50)	10140.13	3450666.51
Investment income	437933.50 (537406.05)	11149.49	2289547.56	129540.45 (181030.02)	620.56	565360.66	142171.26 (203215.37)	1367.83	612107.27	362414.09 (491390.27)	620.56	2289547.56
n		60			10			10			80	

Note: All monetary variables are expressed in 2000 Thousend Euro units by deflating with the German Consumer Price Index.

Source: Own calculations.