

The Impact of Deregulation on the German and UK Life Insurance Markets: An Analysis of Efficiency and Productivity Between 1991 - 2002

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Abstract

This paper provides an intra and inter-country assessment of deregulation and industry efficiency in the European insurance industry. The impact of deregulation is expected to be magnified within an analysis of the Continental maximal regulated German industry and the Anglo minimal regulated UK industry. Results suggest that while increased competition in the UK is reflected in higher intra-industry cost efficiency; an inter-industry analysis indicates that the German industry dominates UK cost efficiency both before and after deregulation. DEA and Tobit analysis provide limited evidence of a dynamic improvement in post deregulation efficiency and point instead to firm level determinants of efficiency.

INTRODUCTION

In 1994 the Third Generation Insurance Directive deregulated the European insurance market. By enabling insurance companies to operate across national boundaries and by removing regulations on

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pricing and product ranges, the process of deregulation was expected to spawn improvements in cost efficiency, productivity growth; as well as improved pricing levels for consumers.

Arguably, the impact of deregulation was likely to vary across different European markets; with the process of deregulation making a greater impact on markets and firms which previously operated in highly regulated environments. For example, in contrast to the pre-existing deregulated UK market; Germany with a high degree of price, product and operational regulation, was a clear candidate for significant change following deregulation (Grenham, et al., 2000). The German life insurance market moved from a maximal-regulation policy, which placed emphasis on maintaining insurer solvency; control of insurance rates and policy conditions, to a lighter European regulatory approach (Rees and Kessner, 1998). The former, German, regulatory scheme created a stable and transparent market for consumers. However, regulation came with a cost: low levels of price competition and limited availability in product ranges. The only clear evidence of competition came in the form of customer service (Ennsfellner and Dorfman, 1998, Swiss Re, 1996). Within such a regulated environment, the replacement of market forces with regulatory rules reduced the disciplined pursuit of cost minimizing and profit maximizing strategies (Rees and Kessner, 1998).

The purpose of this paper is to address the impact of insurance market deregulation through a comparison of the UK and German markets before and after the point of deregulation. By comparing the productivity developments of the highly competitive UK market with the productivity developments of the deregulated German market, it is possible to evaluate the beneficial impact of the Third Generation Insurance Directive. Despite the significant economic importance of insurance (Ward and Zurbruegg, 2000), only Mahlberg and Url (2000) and Cummins and Rubio-Misas (2001) have analyzed the affects of deregulation and consolidation by examining the combined, life and non-life, Spanish and German insurance industries, respectively².

This study adds to this limited literature by analyzing the life insurance sector; and in so doing does not confound the analysis within a combined study of life and non-life. Furthermore, Cummins and Rubio-Misas (2001) sample period ends in 1998, while Mahlberg and Url (2000) ends in 1999. In a critical review of efficiency studies within the financial services sector, Amel et al. (2004) note that most studies suffer from a reliance on data from the early 1990's, thereby precluding an extended and more dynamic assessment of deregulation on efficiency levels. In contrast, by using the years 1991 to 2002, this study enables a longer assessment of the post deregulation changes; and thereby shifts the weight of the analysis from pre-deregulation developments in productivity, to post-deregulation variations in productivity. In developing the analysis, the dynamic impact of deregulation on company level efficiency is investigated using a Tobit analysis, which seeks to understand both company and temporal determinants of company level efficiency.

Finally, Weill (2004) has shown that the competing parametric and non-parametric approaches to efficiency measurement provide markedly different results when examining the European banking sector. Weill's (2004) study lends support to the view of Cummins and Zi (1998) that both parametric and non-parametric approaches should be employed by researchers. This paper follows this advice and adds to Weill's (2004) work by investigating the comparability of efficiency measures within the insurance sector.

The remainder of this paper is organized as follows. In section two, the operational and regulatory characteristics of the German and UK life insurance markets are compared and contrasted. Section three links industry deregulation to pricing, competitiveness, consolidation, and ultimately efficiency. The choice of variables is discussed in section four. Section five presents the results; and section six offers conclusions and proposes avenues for future research.

THE GERMAN AND UK LIFE INSURANCE SECTORS

² A detailed overview of the remaining efficiency studies covering the European insurance industry are given in the two survey papers by Cummins and Weiss (1999) and Berger and Humphrey (1997).

The importance of the European life insurance market is immense. Representing 37% of total world life premiums, the European market leads the US's world share by 11 percentage points. While the US is still the single biggest country level market, the UK ranks second and Germany fifth, measured by premium volumes (Swiss Re, 2005). Between 1999 and 2003, the European life insurance industry showed the biggest world-wide insurance industry growth rate and has often outpaced GDP growth (Swiss Re, 2001). An understanding of deregulation and productivity developments in the industry is, therefore, of great interest to academics and policymakers.

In terms of country differences, UK companies, measured by premiums written are, on average, seven times bigger than their German counterparts. The importance of insurance companies' financial assets also vary, with German companies representing 39.1% of GDP and UK companies achieving a ratio of 110.1% (GDV, 2003). German product distribution is predominately through tied agents, while the UK has maintained a significant use of independent agents. This makes entry into the German market more difficult. Forcing companies to either use expensive independent distribution, or enter by acquisition to gain access to distribution.

In terms of regulation, two distinct regulatory approaches evolved in Europe, the Anglo and the Continental approach. The Anglo approach in the UK and the Netherlands has enabled entrepreneurial freedom, leaving product development, price setting, and serving overseas markets to the discretion of insurance companies. In contrast, the Continental approach popular in Germany, Italy and Austria, emphasized maintaining insurer solvency, control of insurance rates, and policy conditions. Supporting this characterization Hogan (1995) in a survey of insurance managers' perception of regulatory intensity found higher levels of perceived regulations in Germany; and lower levels in the UK and the Netherlands.

The aim of the supervisory office in Germany was to achieve complete, clearly arranged, and standardized insurance contract terms. New contracts by one provider were discussed by members of the industry and consumer groups before being approved. Insurance firms, therefore, used very similar policies, which effectively ruled out product competition and the opportunity for insurance companies to increase their market share through product differentiation was limited. In the UK, no contract regulations existed. Germany also encountered limited price competition, through the imposition of cost plus pricing formulas on the industry. Regulated prices were typically set at 30% of average industry costs; enabling the most inefficient providers to remain in the market. Even efficient firms faced a penalty for good performance, with rules ensuring that 90% of surpluses were distributed to policyholders through terminal bonuses; see Rees and Kessner (1998) for further details.

UK life insurance companies faced none of these restrictions and similarly were relatively unrestricted in their investment decisions. While the investment portfolios of UK companies were heavily weighted towards equities, German regulations forced companies to hold the majority of their assets in low yielding government and secured debt (Swiss Re, 1996).

UK regulation was most apparent in the provision of sales and investment advice to potential consumers, (Ward, 1997). However, following a policy of increased product disclosure, the regulator sought to reduce informational asymmetries between the insurer and the potential insured; and as such, regulations were designed to make the market work more effectively. In contrast, German regulations focused on the maximum commissions paid to agents and the amount of revenue that could be allocated to advertising spend, which in both cases reduced effective competition.

It is therefore clear that the Anglo based system of the UK and the Continental based system of Germany engendered differing competitive effects. Since the Third Insurance Directive transmitted a regulatory model similar to that of the UK across Europe, then it is envisaged that deregulation had the greatest impact on the level of competitiveness and productive development in the German life insurance sector.

DEREGULATION, COMPETITION, AND EFFICIENCY

Efficiency:

Deregulation was expected to have a number of beneficial consequences. First was the improvement in operating efficiency. By lowering the level of regulation, administrative resources could be reduced, or transferred to output generating activities. The facilitation of cross-border competition was also envisaged to improve competition and ultimately operating efficiencies.

Finally, and perhaps most importantly, the removal of pricing and product regulation was anticipated to enhance competitive intensity amongst existing domestic insurance companies. In terms of evidence, Cummins and Rubio-Misas (2001) and Mahlberg and Url (2000) indicate that increased domestic competition has been the most evident characteristic of deregulation. Similarly, OECD (2003) provides strong evidence that the number of foreign firms operating in the German and UK markets remained almost constant. In explaining these patterns, Amel et al. (2004) highlight that allowing and enabling cross border trade are different, with enabling being conditioned on similarities in culture, consumer protection laws and taxation.

Increased domestic competition can occur through a number of routes. The removal of price regulation can lead to competition based on cost leadership. Less efficient firms must then, either: (i) raise their level of efficiency, (ii) move to a differentiated niche, or (iii) exit the sector completely. In all regards, increased price competition should lead to a ratcheting up of the industry's efficiency.

Consolidation and economies of scale:

Through the removal of poorly performing management teams by more efficient rivals, acquisitions can lead to improvements in overall efficiency of the industry. Furthermore, by merging and increasing in size, firms can seek to achieve productivity gains through economies of scale. Therefore, increased competition and industry consolidation are seen to be directly related. In the Spanish industry Cummins and Rubio-Misas (2001) found that acquiring firms targeted relatively efficient firms; leaving financially under performing and inefficient firms to exit the market. This positive aspect of consolidation was tempered by the twin effect from merger. Where some firms gained economies of scale and others suffered diseconomies of scale by growing too large. While in Germany Mahlberg and Url (2000) found that intra-group consolidation was more efficiency enhancing than inter-group, suggesting that a rationalization of shared group overheads was a more effective means of gaining efficiency than the integration of a rival's assets with those of the acquirer.

Developments of efficiency over time:

In terms of the dynamic development of efficiency, Cummins and Rubio-Misas (2001) found that consolidation in the Spanish industry increased the overall efficiency of the industry. Relatively efficient firms merged, while inefficient firms exited the market. In contrast to the convergence in technical efficiency, technological improvements in efficiency were limited. Mahlberg and Url (2000) found for Germany that a lack of consolidation led to less improvement in technical efficiency, but a greater development in technological improvements over time.

These extant, single country studies highlight how deregulation can, in the case of Spain, work through increased competition in the market for corporate control and/or increased product market competition; as was the case in Germany; ultimately leading to differing dynamic developments of industry efficiency. The purpose of this study is to provide an improved assessment of the efficiency improvements brought about by deregulation. By using the UK as a benchmark of a deregulated industry, it is possible to compare its productivity development with the adjustment of the highly regulated German industry³. Moreover, this study will also seek to address possible weaknesses within the existing research.

³ It is recognised that Diacon et al. (2002) provide a cross-country comparison of efficiency in the combined life and non-life insurance sectors. But, the study is only an ex-post analysis, focusing upon the years, 1996 to 1999; and potentially compounds the analysis by bringing scope economies into the analysis through the combined use of life and non-life companies.

A particular concern in the extant literature stems from the limited number of years under analysis, which centre closely on the initiation of deregulation. An improved research design would enable a more longitudinal assessment of efficiency, where a greater gestation period for efficiency gains to occur is allowed.

An additional concern is that previous studies of insurance market deregulation have used the non-parametric data envelopment analysis, DEA, to measure efficiency. The prevalence of DEA, over stochastic approaches, possibly reflects the relative ease with which the DEA approach enables an extraction of the technical, allocative and scale efficiencies; and also requires no assumptions to be made regarding the distribution of the efficiency term, or the functional form of the cost curve. However, Weill (2004) has shown for the European banking industry that there is a significant lack of comparability between parametric and non-parametric techniques for measuring efficiency. These findings mirror the work of Bauer et al. (1998) who investigated the comparability of efficiency methods in the US banking sector. With a low correlation between parametric and non-parametric measures of efficiency and a weak correspondence between the two approaches in identifying the strongest and weakest firms, the research on the comparability of the approaches raises the concern that the results of Cummins and Rubio-Misas (2001) and Mahlberg and Url (2000) are highly conditioned on the choice of estimation method used. Therefore, this study checks the rank correlation of the DEA approach with the parametric distribution free approach; and in so doing additionally adds to the literature on the comparability of alternative efficiency measurement techniques.

METHODOLOGY AND DATA

Methodology:

Cost efficiency is measured by the estimation of efficient frontiers. The efficient frontier represents the optimal cost level for a given use of inputs in the creation of output. Based upon the sample, the frontier is comprised of benchmark firms with an efficiency score of 100%. The distance of the remaining firms from the frontier provides a measure of their inefficiency. Following Dietsch and Lozano-Vivas' (2000) comparison of the French and Spanish banking sectors, this study estimates single country and combined frontiers. Single country frontiers assume a comparability of productive technology within a country and enable a comparison of intra country efficiency. Common frontiers assume a similarity in technology across countries and thereby enable a comparison of inter country efficiency.

It is assumed that the reader is familiar with the various parametric and non-parametric approaches for estimating inefficiency, which are discussed in detail in Bauer et al. (1998) and Cummins and Weiss (1999). Given that both Bauer et al. (1998) and Weill (2004) find a high rank correlation amongst alternative parametric approaches, the choice of a particular parametric comparator to DEA is unlikely to impact the comparability assessment. This study, therefore, utilizes the parametric distribution free approach, DFA, introduced by Berger (1993), preferring its lack of an assumed distribution for the efficiency term. The average residual for each firm proxies for its measure of efficiency, when it is assumed that the random element of the residual averages to zero. Noting that random errors may not perfectly cancel each other out, the residuals are truncated at the upper and lower 5% of the distribution. As in Hardwick (1997) and Ward (2002) a translog cost function is employed; and then in order to deal with zero outputs, a Box-Cox transformation, as outlined in Khaled et al. (2001), is utilized. The non-parametric approach utilizes data envelopment analysis, DEA, and follows the cost specification proposed by Färe et al. (1994) and operationalized within the software package DEAP (Coelli, 1996). In order to understand the determinants of the overall cost efficiencies in the German and UK industries, the DEA efficiency measures are separated into technical, scale and allocative efficiency. Finally, to facilitate an understanding of the dynamic development of efficiency, Malmquist indices were also estimated using DEAP.

Data:

The data covers the years 1991 to 2002. The German data was collected manually from the respective annual company accounts. After eliminating inactive firms and firms where data were only available for part of the sample period, thirty-one life insurance companies, accounting for 65 percent of total premiums, were included in the final sample. The UK data is made publicly available through the THESYS and EUROETHESYS databases, which draw on the statutory solvency returns to the UK regulator by all insurance companies. Again, after eliminating inactive firms and firms with incomplete data for the entire sample period, 47 firms, representing 76 percent of the industry premiums, were left.

In line with the majority of existing studies, such as Cummins et al. (1996), Hardwick (1997), Cummins and Zi (1998), Cummins and Rubio-Misas (2001), and Ward (2002), this paper adopts the value added approach to identify and measure insurance outputs. Life insurance companies provide two main services to customers, risk-bearing/risk-pooling services and financial intermediation. A common means of measuring risk-bearing and risk-pooling has been the use of net premiums written. However, as Yuengert (1993) argues, net premiums are not a measure of output, as they do not strictly measure output, but price times output. As an alternative, incurred benefits to policyholders, has been proposed by Berger et al. (1997) as a good approximation for risk-pooling and risk-bearing. However, Diacon et al. (2002) contend that management are unlikely to maximize the value of insurance claims; and therefore incurred benefits is difficult to justify as a measure of value added. In accord with Hardwick (1997), Ward (2002), and Diacon et al. (2002) this study employs net written premiums as a measure of risk bearing and pooling.

The measurement of intermediation services is also contested within the literature. Cummins and Rubio-Misas (2001) use the real value of invested assets, but as a stock measure, it is difficult to see how this variable is capable of capturing the flow characteristics of value added. This study utilizes additions to reserves, which represent additional accrued benefits to policyholders. This accords with the approach of Mahlberg and Url (2000) and closely matches investment returns proposed by Diacon et al. (2002).

Two input measures are included for estimating the frontier functions, namely labor and cost of capital, which is in line with the existing literature (Cummins and Weiss, 1999). To capture the effects of labor and capital over the twelve years of the study, the annual average number of employees per company and total assets minus total liabilities, at the end of each financial year, are used. As in Hardwick (1997) and Ward (2002), the price of labor is measured by the average gross weekly earnings of workers in the insurance sector. Measurement of the cost of capital is more complicated by the incidence of mutual organizations within the industry. The price of cost of capital for each year is estimated by utilizing the traditional capital asset pricing model⁴. All variables were deflated to 1995 prices using GDP deflators for each country. All variables were then converted into US\$ for comparative purposes, using the exchange rate published by the International Monetary Fund (2003).

The descriptive statistics for each country are provided in *Table 1*. While German companies collect greater premium income than UK companies, the opposite is true of additions to reserves. These two results may reflect the differing regulatory environment, with German companies investing in less risky, lower yielding assets; whilst also being able to charge higher regulated, non-market determined prices for insurance.

Table 1: Descriptive statistics

Variable	Germany				UK			
	Mean	Stdev	Max	Min	Mean	Stdev	Max	Min

⁴ The cost of capital was estimated by using the CAPM formula ($k=r_f + \beta(r_m - r_f)$). The risk free rate (r_f) for each year was approximated by using short term government bonds as published by the International Monetary Fund (2003) and the market premium (r_m) were measured by a benchmark market index. The beta, the measure of the systematic and non-diversifiable risk, was approximated for each year by taking the industry betas published in Kielholz (2000) and own estimations.

Addition to reserves (Mio US \$)	478.2	831.4	7,820.2	0	706.1	1,698.4	20,653.1	0
Total premiums (Mio US \$)	1,025.1	1,265.8	7,484.2	0	803.2	1,329.7	14,179.2	0
Shareholders Equity (Mio US \$)	1,586.3	2,661.5	18,188.0	33.04	6,232.4	8,532.5	54,293.4	0
Cost of capital (%)	4.84	1.85	8.28	2.72	6.39	2.01	11.19	3.78
Number of employees	1,703	2,312	12,423	5	2,884	4,785	33,583	23
Weekly wage rate US \$	753.34	60.07	873.02	653.90	660.69	46.61	735.05	570.90
Number companies			31				47	

RESULTS

Table 2 provides an assessment of the comparability of the DEA and DFA efficiency measures. In both the UK and Germany the mean efficiency score provided by DEA is higher than the DFA score. This is not dissimilar from the results reported for the European banking sector by Weill (2004). But it is inconsistent with the results of Bauer et al. (1998) for the US banking industry where an intuitive argument is made for higher mean parametric efficiency scores on the basis that the inclusion of an error term controls for statistical noise and measurement error. However, Weill (2004) argues that a comparison of the rank order of efficiency scores across the two approaches is more important for policy decisions, than a consistent ranking of average efficiency scores. In this regard, the Spearman rank correlation coefficients for both the UK and Germany are positive and statistically significant. This result strongly contrasts with the European banking sector, where Weill (2004) reports statistically significant rank correlations. Nevertheless, for this study, we have strong evidence in support of comparability across the parametric and non-parametric approaches to efficiency measurement; and we can feel reasonably confident in the singular use of DEA.

Table 2: Comparability of DEA and DFA cost efficiency

	Germany		UK	
	DEA	DFA	DEA	DFA
Mean	0.574	0.444	0.744	0.531
Stdev	0.3116	0.1930	0.2993	0.1629
Spearman Rank Correlation	0.4308**		0.3354***	

*** Statistically significant at the 1% level

** Statistically significant at the 2% level

Table 3 presents the various DEA measures of efficiency. The estimates are calculated from separate frontiers for Germany and the UK, enabling an examination of efficiency within each country. In addition, using the pooled sample of German and UK, efficiency is calculated from a joint, global frontier, enabling a comparison of efficiency across countries.

Taking the UK first as the benchmark country, the results indicate that overall cost efficiency declined over the period 1991 to 2002, but did show some improvement post 1995. With an average cost efficiency of 65%, the average firm could be expected to reduce its costs by 35%. These results are in line with those of Hardwick (1997), Ward (2002), and the joint consideration of life and non-life business by Diacon et al. (2002). Importantly, the UK results are vastly higher than the 17% cost efficiency in the Spanish industry provided by Cummins and Rubio-Misas (2001) and the 36% provided by Mahlberg and Url (2000) for the German industry. Therefore, despite the decline in UK cost efficiency, many firms in the industry appear to be achieving high levels of cost efficiency; and operating near to the best in the industry. This arguably reflects the less stringent regulatory regime and the more competitive environment.

By breaking cost efficiency into technical, allocative and scale efficiency, it is clear that the UK excels in allocative efficiency, with a high mean of 86%, indicating that UK firms are good at using the correct mix of labor and capital for a given level of output. In contrast, scale efficiency has declined in the UK reflecting an increase in the number of firms operating within decreasing returns to scale. This could be a point of concern for policymakers, since competition and consolidation can also lead to falling efficiency, which is then compounded by market dominance and power over pricing.

Turning to Germany, overall cost efficiency varied very little over the period 1991 to 2002 and averaged 56%, suggesting that the average firm could reduce their costs by 44%. The lack of variation; and, moreover, the lack of improvement in cost efficiency is somewhat surprising given the scale of deregulation in Germany. While clearly there was a drop in cost efficiency in 1996, arguably reflecting the industry's adjustment costs to the new regulatory environment, there is no subsequent short, or long-term trend growth in cost efficiency above the pre-deregulation levels.

The results for technical, allocative and scale efficiencies stay close to their mean values throughout the period; and often the higher values for these series occur before deregulation in 1995. Only in the case of technical efficiency there is evidence of a positive trend post 1995. Therefore, the evidence in support of deregulation driving improvements in cost efficiency through increased technical efficiency, or economies of scale appears to be limited. As such, these results stand in stark contrast to the findings for Spain provided by Cummins and Rubio-Misas (2001).

There are a number of possible explanations for these results. First, the Spanish government actively supported consolidation, helping to drive through efficiency improvements through the merger of efficient companies and the exit of underperforming companies, this did not occur in Germany. Secondly, despite the importance of regulation in Germany; and the inherent lack of competition, the industry was relatively efficient. Cummins and Rubio-Misas (2001) found that the Spanish industry was only 14% cost efficient in 1991. In contrast, this study suggests that the German industry was 56% efficient in 1991. Therefore, the Spanish faced ample more opportunity to improve efficiency than the Germans.

These ideas are additionally borne out in an examination of the results from the joint UK and German frontiers. With German cost efficiency estimated at 56% and the UK's at 42%, then it is clear that the German industry is more likely to be defining the global frontier; and is therefore the more efficient industry. This is a persistent finding throughout the period 1991 to 2002 and stands in stark contrast to the envisaged result where Germany was viewed as over-regulated and potentially uncompetitive. Where the German industry succeeds is in delivering technical and scale efficiency, both of which improved throughout the period and post 1995. The UK still dominates the German industry in terms of allocative efficiency and this may reflect the greater ease with which UK employment law enables companies to reassign, or even dismiss surplus labor.

Table 3: Cost, technical, allocative and scale efficiencies

Germany		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Mean
Cost		0.564	0.576	0.537	0.535	0.566	0.499	0.573	0.571	0.584	0.595	0.568	0.552	0.560
Technical		0.821	0.810	0.739	0.719	0.724	0.738	0.745	0.764	0.782	0.784	0.791	0.753	0.764
Allocative		0.664	0.680	0.682	0.693	0.729	0.697	0.709	0.692	0.696	0.708	0.666	0.678	0.691
Scale		0.711	0.788	0.83	0.804	0.729	0.717	0.738	0.564	0.618	0.619	0.637	0.797	0.713
UK		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Mean
Cost		0.750	0.575	0.756	0.638	0.588	0.637	0.698	0.709	0.649	0.608	0.580	0.639	0.652
Technical		0.832	0.762	0.839	0.732	0.775	0.771	0.798	0.844	0.748	0.733	0.727	0.751	0.776
Allocative		0.955	0.821	0.931	0.874	0.824	0.838	0.867	0.838	0.827	0.789	0.848	0.879	0.858
Scale		0.710	0.196	0.601	0.548	0.654	0.216	0.759	0.585	0.609	0.506	0.732	0.566	0.557
Germany and UK		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Mean
Cost	G	0.549	0.548	0.531	0.534	0.566	0.586	0.570	0.566	0.581	0.594	0.562	0.552	0.562

	UK	0.567	0.441	0.686	0.328	0.185	0.338	0.430	0.446	0.519	0.410	0.386	0.287	0.419
Technical	G	0.809	0.739	0.718	0.721	0.734	0.742	0.764	0.782	0.784	0.791	0.753	0.763	0.758
	UK	0.572	0.455	0.695	0.332	0.191	0.346	0.439	0.454	0.526	0.417	0.392	0.290	0.426
Allocative	G	0.648	0.646	0.676	0.693	0.732	0.760	0.711	0.686	0.694	0.707	0.660	0.678	0.691
	UK	0.984	0.953	0.984	0.983	0.973	0.969	0.975	0.974	0.981	0.975	0.975	0.982	0.976
Scale	G	0.711	0.788	0.831	0.806	0.734	0.722	0.743	0.564	0.618	0.619	0.637	0.797	0.714
	UK	0.580	0.253	0.553	0.523	0.846	0.448	0.907	0.561	0.488	0.351	0.463	0.455	0.536

Table 4 presents the Malmquist indices of total factor productivity changes, separated into technical and technological efficiency improvements. In the case of the UK, a 4% decline in technical efficiency is partially offset by the 2.2% improvement in technological efficiency. Therefore, while the best practice frontier improved each year by 2.2%, a number of firms managed to fall away from the frontier resulting in an overall reduction in total factor productivity. Germany also managed a 2.2% technological improvement and with a 0.5% improvement in technical efficiency managed to raise total factor productivity. The size of the technological improvements are in line with those found by Cummins and Rubio-Misas (2001) for Spain and lie within the range of productivity gains found in the European banking industry by Casu et al. (2004). Furthermore, as in the banking sector, improvements in productivity seem to hinge more on technological improvements, than on catch-up effects. This suggests that industry level productivity gains are driven more by leading firms pushing out the frontier each year, as opposed to underperforming firms striving to reduce their technical inefficiency.

An explanation for the UK's under performance in improving technical efficiency maybe found in the use of additions to reserves as an output measure. With UK companies being more heavily dependent upon equities for investment returns than their German counterparts, then the output of UK firms is more volatile (relative to its inputs). This may explain why the total factor productivity scores for Germany are more stable than those for the UK.

Table 4: Malmquist indices

Germany	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	91/02
<i>Effch</i>												
Mean	1.192	1.029	0.962	0.877	0.984	0.926	0.916	1.129	1.034	1.002	1.040	1.005
Stdev	2.516	0.755	0.178	0.166	0.250	0.208	0.372	0.330	0.218	0.149	0.310	0.830
Max	15.085	5.058	1.310	1.200	1.913	1.705	2.775	2.783	1.394	1.349	2.198	15.085
Min	0.872	0.759	0.596	0.617	0.444	0.554	0.430	0.743	0.552	0.773	0.495	0.430
<i>Techch</i>												
Mean	0.989	1.035	1.106	1.255	1.015	1.019	1.091	0.918	0.978	0.928	0.948	1.022
Stdev	0.153	0.142	0.181	0.149	0.068	0.066	0.130	0.121	0.298	0.172	0.058	0.177
Max	1.507	1.223	1.515	1.595	1.250	1.139	1.320	1.177	1.947	1.232	1.106	1.947
Min	0.625	0.705	0.945	1.062	0.883	0.810	0.949	0.684	0.787	0.374	0.811	0.374
<i>Tjpch</i>												
Mean	1.178	1.065	1.065	1.100	0.998	0.944	1	1.036	1.011	0.929	0.985	1.026
Stdev	2.465	0.645	0.245	0.210	0.261	0.215	0.444	0.232	0.354	0.197	0.322	0.813
Max	14.798	4.519	1.774	1.914	1.936	1.683	3.34	2.009	2.558	1.232	2.172	14.798
Min	0.843	0.574	0.722	0.787	0.431	0.58	0.535	0.508	0.589	0.347	0.468	0.374
UK	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	91/02
<i>Effch</i>												
Mean	0.389	2.317	0.817	1.222	0.354	2.981	0.864	1.019	0.706	1.294	0.837	0.960
Stdev	0.587	1.838	0.486	2.488	0.408	2.116	0.473	0.850	0.766	0.584	0.598	0.751
Max	3.594	7.595	2.688	17.735	2.267	10.383	2.694	3.280	4.013	2.851	3.588	17.735
Min	0.102	0.084	0.166	0.315	0.149	1	0.261	0.083	0.144	0.306	0.271	0.083
<i>Techch</i>												
Mean	2.924	0.380	0.965	0.984	2.863	0.425	1.163	0.904	1.144	0.792	1.035	1.022
Stdev	1.473	0.256	0.135	0.249	0.967	0.192	0.375	0.316	0.122	0.154	0.363	0.421
Max	6.848	1.718	1.313	1.958	4.623	1.215	2.477	1.667	1.461	1.492	2.354	6.848
Min	0.885	0.176	0.596	0.737	0.737	0.324	0.691	0.479	0.931	0.627	0.336	0.176
<i>Tjpch</i>												
Mean	1.113	0.880	0.789	1.202	1.014	1.267	1.005	0.922	0.827	1.025	0.866	0.981
Stdev	0.997	0.434	0.409	2.812	0.550	0.956	0.962	0.596	0.854	0.571	0.543	0.677

Max	5.613	2.221	2.407	19.597	4.110	4.694	5.481	2.850	5.588	3.355	3.334	19.597
Min	0.162	0.018	0.159	0.252	0.389	0.337	0.298	0.061	0.113	0.293	0.100	0.018

Notes:

Effch = Efficiency change relative to constant returns to scale frontier

Techch = Technological change

Tfpch = Total factor productivity change

In order to understand the factors that lead to improved levels of efficiency, the various measures of efficiency were regressed on a variety of organizational variables and time dummies. These broad categories of organizational and time variables enable a clearer distinction to be drawn between firm level determinants of efficiency and time varying regulatory influences. A Tobit specification was used to accommodate the efficiency score lying between 0 and 1. The independent variables and their hypothesized relationship with efficiency are detailed in *Table 5*. A novel feature of this research is the recognition of differing asset classes in the investment portfolio of insurance companies. The results from the regression analysis are presented in *Table 6*⁵.

⁵ Investment costs, debenture and loan holdings are not reported by UK companies and so were excluded from the UK model.

Table 5: Descriptive statistics for Tobit model of efficiency

Variable	Description	Hypothesized relationship with efficiency	Germany				UK			
			Mean	Stdev	Max	Min	Mean	Stdev	Max	Min
Organizational form	Dummy variable: 0=Mutual, 1=Stock company	+/-	0.67339	0.46992	1	0	0.72973	0.44485	1	0
Acquisition costs	Acquisition costs as a % of total premiums	-	0.15850	0.08021	0.61585	0	0.16611	0.30128	3.00823	0
Administrative costs	Administrative costs as a % of total premiums	-	0.04704	0.02619	0.18476	0	0.11056	0.16627	1.04656	0
Expenses incurred in the administration of investments	Expenses incurred in the administration of investments as a % of total investments	-	0.00481	0.01449	0.12923	0				
Investment portfolio	Land and equivalent titles and buildings including buildings and leased land as a % of total assets	+/-	0.03232	0.02263	0.09650	0	0.03124	0.04130	0.21884	0
	Shares in affiliated companies plus investments in affiliated companies and participating interests as a percentage of total assets as a % of total assets	+/-	0.04673	0.04532	0.20739	0	0.00832	0.02433	0.17401	0
	Shares, investment units and other non-fixed interest securities as a % of total assets	+/-	0.19928	0.11047	0.49298	0.00155	0.27992	0.79181	13.2413 9	0
	Bearer bonds and other fixed-interest securities plus loans secured by mortgages, land and annuity charges as a % of total assets	+/-	0.17886	0.08505	0.50352	0	0.21864	0.15991	0.79972	0
	Registered debentures plus borrowers' notes and loans as a % of total assets	+/-	0.42096	0.15741	0.87318	0				
	Loans and advance payments on policies as a % of total assets	+/-	0.00921	0.00507	0.03135	0				
	Deposits at banks plus current credit balances at banks, cheques, and cash on hand as a % of total assets	+/-	0.01472	0.01546	0.13579	0.00026	0.04763	0.06706	0.58016	0.00000
Solvency ratio	Total capital as a % of total assets	+	0.86071	0.10848	0.97996	0.40020	0.87662	0.11553	1.04783	0.52253
Debt ratio	Year-end total debt as a % of year-end total assets	-	0.11458	0.72253	11.3543 4	0.00154	0.03105	0.10243	1.30906	0.00001

Table 5: Descriptive statistics for Tobit model of efficiency (continued)

Variable	Description	Hypothesized relationship with efficiency	Germany				UK			
			Mean	Stdev	Max	Min	Mean	Stdev	Max	Min
Claims ratio	Incurred losses as a % of total premiums	-	0.64117	0.28127	1.64620	0.0162	3.66910	16.73944	156.865	0.01726
Location	Germany: 0=West, 1=East ('Neue Bundesländer'); companies are differentiated according to postcode where headquarters are located	+/-	0	0.25	1	0	1	0.31	1	0
Age	Years since the point of the initial entry into the trade register	+/-	83	47	175	4	45	39	152	4
Size	Natural logarithm of total assets	+/-	8.54306	1.35322	11.4600	4.4984	15.1414	1.83956	18.5194	8.80193
Year 1996	Dummy variable: 1=1996, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Year 1997	Dummy variable: 1=1997, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Year 1998	Dummy variable: 1=1998, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Year 1999	Dummy variable: 1=1999, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Year 2000	Dummy variable: 1=2000, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Year 2001	Dummy variable: 1=2001, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Year 2002	Dummy variable: 1=2002, 0=other years	+	0.13	0.33	1	0	0.13	0.33	1	0
Time	Dummy variable: 1-8 for each year	+	4.50	2.30	8	1	4.50	2.30	8	1

Table 6: Tobit regressions of company level efficiency

Variable	Germany				UK			
	CEFF-VRS	TEFF-VRS	AEFF-VRS	SEFF	CEFF-VRS	TEFF-VRS	AEFF-VRS	SEFF
Constant	2.10951 (0.63521)***	1.06203 (0.42940)**	2.04819 (0.47255)**	1.18052 (0.25332)***	0.51429 (0.4704)	0.43549 (0.4503)	0.83894 (0.31596)***	1.34344 (0.26158)***
OrgForm	0.18936 (0.08198)**	0.07336 (0.0536)	0.09621 (0.0735)	0.01808 (0.0346)	0.00448 (0.0677)	0.05559 (0.0609)	-0.02232 (0.0507)	-0.00280 (0.0392)
Acq Costs	-0.53379 (0.5222)	-0.76311 (0.41575)*	-0.18323 (0.4659)	-0.27291 (0.2717)	-0.01060 (0.0772)	-0.05020 (0.0754)	0.05731 (0.1179)	-0.06105 (0.0852)
Admin Costs	-5.90673 (2.00138)***	-3.83311 (1.28314)***	-1.89413 (1.3545)	-0.79985 (0.8522)	-0.82800 (0.17909)***	-0.87487 (0.17860)***	-0.22629 (0.1469)	0.18498 (0.1540)
Inv Costs	0.10625 (3.5577)	-1.29385 (2.6282)	-3.16119 (2.5897)	0.89667 (1.4475)				
Land Inv	-0.05913 (1.7824)	-2.50863 (1.08386)**	0.48998 (1.5380)	1.48691 (0.80414)*	1.36992 (0.9386)	0.79899 (0.9140)	1.08089 (0.6736)	-0.94932 (0.6202)
Aff Inv	-0.53883 (0.9084)	1.29134 (0.52220)**	-0.65530 (0.7995)	-0.55376 (0.29976)*	-2.29290 (1.6702)	-2.29006 (1.7221)	-1.61679 (1.2555)	-1.34159 (0.8326)
Equity Inv	0.05619 (0.3800)	-0.32038 (0.2735)	0.12773 (0.2959)	0.42442 (0.18625)**	-0.02148 (0.1494)	-0.01241 (0.1464)	-0.03738 (0.1473)	-0.04915 (0.0943)
Bond Inv	-0.02113 (0.4618)	0.02899 (0.3985)	-0.53455 (0.3776)	0.13066 (0.1879)	0.24100 (0.1570)	0.27735 (0.1535)	0.05265 (0.1474)	0.40585 (0.13104)***
Deben Inv	-0.21629 (0.2490)	-0.38644 (0.22417)*	-0.18231 (0.1954)	0.19887 (0.1225)				
Loans Inv	-30.43700 (6.98088)***	-20.17099 (4.88595)***	-21.60837 (6.48667)**	1.42090 (3.3052)				
Deposits Inv	-7.09064 (2.05806)***	-4.47323 (1.35096)***	-6.10955 (1.72069)**	-0.07974 (0.9179)	0.78859 (0.27776)***	0.96234 (0.3295)	-0.01629 (0.3245)	0.61531 (0.4404)
Solvency Ratio	-0.98060 (0.55039)*	0.30203 (0.3026)	-0.68477 (0.39626)*	0.05890 (0.2012)	0.17601 (0.3402)	0.29551 (0.3577)	-0.01068 (0.2794)	-0.26082 (0.2177)
Debt Ratio	0.03137 (0.6634)	0.01531 (0.1246)	0.04886 (0.1854)	0.00430 (0.0555)	0.02707 (0.8850)	-0.10231 (0.8867)	0.18050 (0.7246)	0.40420 (0.2855)
Claims Ratio	0.03616 (0.1824)	-0.38942 (0.12327)***	0.04571 (0.1418)	-0.10063 (0.0759)	0.01027 (0.00175)***	0.00966 (0.00166)***	0.00429 (0.00155)***	-0.00176 (0.00095)*
Location	-0.00224 (0.2736)	0.02489 (0.1974)	-0.12012 (0.1870)	0.08458 (0.0716)	-0.16340 (0.06428)**	-0.25000 (0.07141)***	0.05394 (0.0537)	0.09101 (0.04529)**
Age	-0.00085 (0.0010)	-0.00152 (0.00062)**	0.00056 (0.0009)	-0.00045 (0.0004)	-0.00214 (0.00090)**	-0.00181 (0.00072)**	-0.00096 (0.00053)*	-5.74247D-04 (0.0005)
Size	0.02330 (0.0332)	0.08410 (0.02101)***	-0.02214 (0.0269)	-0.05700 (0.01494)***	0.00313 (0.0185)	0.01701 (0.0167)	-0.00215 (0.0141)	-0.03150 (0.01063)***
Year 1996	-0.06987 (0.0759)	-0.03902 (0.0560)	-0.02915 (0.0743)	0.00851 (0.0363)	-0.13528 (0.06666)**	-0.16244 (0.06948)**	-0.05200 (0.0606)	-0.40220 (0.06546)***
Year 1997	-0.13147 (0.0811)	-0.07612 (0.0616)	-0.07402 (0.0812)	-0.05760 (0.0417)	0.00620 (0.0704)	-0.02660 (0.0740)	0.01123 (0.0645)	0.03949 (0.0607)
Year 1998	-0.19512 (0.08721)**	-0.06893 (0.0706)	-0.12137 (0.0899)	-0.09295 (0.04325)**	-0.00427 (0.0736)	-0.01871 (0.0750)	-0.00659 (0.0628)	-0.05216 (0.0595)
Year 1999	-0.25502 (0.09899)***	-0.05144 (0.0765)	-0.20080 (0.09586)**	-0.04265 (0.0532)	-0.02828 (0.0689)	-0.05722 (0.0778)	-0.07084 (0.0613)	0.02321 (0.0616)
Year 2000	-0.28590 (0.10644)***	-0.06719 (0.0862)	-0.26521 (0.10148)**	-0.01516 (0.0531)	-0.10242 (0.0715)	-0.17637 (0.07303022)**	-0.03814 (0.0632)	-0.05700 (0.0592)
Year 2001	-0.31171 (0.10605)***	-0.03375 (0.0920)	-0.30164 (0.09751)**	0.00466 (0.0529)	-0.04012 (0.0713)	-0.17433 (0.07626)**	0.10796 (0.0708)	0.11193 (0.06297)*
Year 2002	-0.33687 (0.11301)***	-0.09119 (0.0955)	-0.27019 (0.10886)**	0.09892 (0.0607)	-0.09597 (0.0764)	-0.17562 (0.07475)**	0.03377 (0.0776)	-0.08403 (0.0673)
Heteroscedasticity	-0.00253 (0.0606)	-0.08713 (0.0618)	0.16025 (0.05820)**	-0.05187 (0.02861)*	0.10427 (0.03617)***	0.08187 (0.03974)**	0.01172 (0.0465)	-0.13086 (0.02869)***
Sigma	0.31671 (0.16218)*	0.46830 (0.24695)*	0.07619 (0.03711)**	0.21529 (0.05500)***	0.06373 (0.03491)*	0.08938 (0.05349)*	0.21425 (0.15074)***	1.59614 (0.70320)**
Pseudo R2	0.42706	0.57470	0.47267	0.50897	0.45590	0.50166	0.48125	0.46962

For the UK, only the 1996 time dummy is significant. Providing evidence of an immediate, but not a sustained impact on efficiency following deregulation. In the case of Germany, there is evidence of an immediate and sustained reduction in cost efficiency following deregulation. This result is echoed in the estimates for allocative efficiency. Therefore, the decline in German cost efficiency post 1995 maybe more closely linked to employment constraints within German employment law and a recessionary economy, than any pressures brought about by deregulation.

The only consistent firm level factor, across the two samples, is found for administrative expenses, which are seen to negatively impact cost and technical efficiency. Suggesting that underwriting, enquiring handling and business management are a key aspect of efficient performance.

Only in the case of German cost efficiency is there evidence supporting the hypothesis that the stock mode of organizational form is associated with improved levels of all efficiency measures. The lack of any support for the mode of corporate governance in the UK is in accord with Hardwick (1997) and Ward (2002).

There is no support in the UK results for efficiency improvements stemming from asset allocation. In the case of Germany, the increased use of loans, deposits, land, and debentures is associated with lower cost and technical efficiency, which may reflect the lower yield associated with these types of assets. There is evidence that higher claims are associated with improved cost, technical and allocative efficiency in the UK. This is likely to reflect how higher bonus payments on maturity lead to higher levels of current business.

Finally, younger and perhaps more innovative UK life insurers tend to be more efficient than their older rivals.

CONCLUSIONS

This study has analyzed the dynamic development of efficiency in the German and UK life insurance markets both pre and post deregulation. By also taking a longer post deregulation time period into account, this study improves on existing studies by enabling a longer gestation period for deregulation to have an influence on competition and efficiency. In addition, by analyzing the comparability of the parametric and non-parametric measures of efficiency, concerns regarding a methodological dependent set of results are diminished.

A priori the highly regulated German industry was expected to experience a greater improvement in post deregulation efficiency than the under regulated and competitive UK market. The data does not lend strong support to these assumptions. First, there is a lack of evidence linking deregulation to improving efficiency levels, or the development of total factor productivity. Second, while UK intra industry efficiency is higher than Germany. An examination of the German and UK global frontier suggests that UK inter industry efficiency is and nearly always has been dominated by the Germans. Therefore, while competition in the UK appears to drive more firms towards the frontier, the UK frontier itself is firms less efficient than the German frontier.

Moreover, what is clear from an examination of total factor productivity is that technical efficiency gains in the UK and Germany have always been dominated by technological improvements; and it is this which may explain why Germany is able to be more productive than the UK. Moreover, the dynamic development of insurance market efficiency is strongly determined by the most efficient firms. A result which is mirrored in the European banking sector (Casu et al. (2004). Only in the case of the highly inefficient Spanish industry is there any noticeable improvement in technical efficiency post deregulation. These findings, therefore, raise the issue of how policymakers can achieve productivity gains through technological improvements? Arguably, deregulation, through competition, exacerbates the problems of inefficient firms trailing in the wake of their highly efficient and innovative rivals; and is less focused on fostering technological improvements. A more appropriate policy for the long-term dynamic improvement of the industry's leading companies should perhaps assist those leading companies in accessing pools of highly skilled labor; and developing deeper and more innovative capital markets. In

this way, the supply of high quality inputs as instigators and enablers of technological improvements is effectively managed at an economy wide level.

With the weight of evidencing pointing towards technological improvements, future research should begin to explore not how fast the efficient frontier develops overtime, but what determines technological growth in the insurance industry. This study suggests that firms on the frontier and new industry entrants are worthy of further investigation in this regard.

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