CONSOLIDATION AND EFFICIENCY IN THE MAJOR EUROPEAN INSURANCE MARKETS[1]

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Abstract

This paper examines the relationship between mergers and acquisitions, efficiency and scale economies in the major European insurance markets. Cost and revenue efficiency is estimated over a period of significant consolidation and harmonisation of currency and insurance regulation rules. Contrary to prior US-based research, acquiring firms achieve greater efficiency gains than either target firms or firms that have not been involved in mergers or acquisitions. Financially vulnerable firms are more likely to be acquisition targets. This activity has not however in general had a beneficial effect on efficiency of target firms in the industry. Overall, mergers and acquisitions in the major European insurance markets reflect the effects of market segmentation and concentration, and the differences in regulatory framework between UK and Continental European countries.

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1. Introduction

European insurance markets have undergone a significant consolidation in the last eight years since the third generation Insurance Directives first standardised accounts, cross-border registration and solvency rules, Euro standardised currency and interest rate volatility in 12 Euro States, and increasing cross-border competition among banks and other financial institutions. This has facilitated the distribution of standardised policies across a range of countries as insurers seek to take advantage of government efforts to spread the cost of burdensome retirement incomes to the private sector provision, and insurers take advantage of the economies of scale associated with distribution in multiple markets. Moreover, competitive pressures induced by greater freedom of capital, increased stock market volatility and highlighted solvency concerns have increased pressures for consolidation.

Currently these pressures are increasing, with imminent standardization of accounting rules (IFRS 4); the development of solvency standards across the European Union (Solvency II) has led insurers to focus on strengthening their financial statements in accordance with the proposed new capital adequacy requirements. This has facilitated the consolidation of capital markets in which insurers invest and operate. Moreover a number of insurers have consolidated banking and insurance practices to generate greater interest among consumers and have invested significantly in new technological innovations in order to enhance their product delivery, distribution and underwriting. Finally crises in corporate governance in some of the largest insurance firms, the increasingly hard insurance market and extreme volatility in capital markets highlight the importance of financial service firms to the overall business culture and led to demands for reform in the provision of actuarial, accounting and audit attestation services.

The objective of this paper is to provide additional information on the effects of deregulation and consolidation on financial services market efficiency by analyzing the major European insurance markets. The European industry has been affected by the overall deregulation of European insurance markets, particularly through the EU's Third Generation Insurance

Directives, implemented in July 1994. The Third Directives effectively deregulated the EU insurance market, with the exception of solvency regulation, which is carried out by the insurer's home country. The market changes have been particularly significant in Europe because some governments began tightening solvency standards and encouraging mergers and acquisitions in the insurance industry even prior to the adoption of the Third Generation Directives. The 1995 regulations were intended to strengthen the solvency, efficiency and competitiveness of the major European Union insurance markets. Currently the EU is developing more uniform solvency standards.

As a result of these changes, over the last few years a large number of insurance firms have either merged with, or been taken over by, other insurance or financial services firms in the major European insurance markets, and the number of insurers operating in the European insurance market has declined dramatically during both the 1980s and 1990s. However the number of insurance groups registered to operate in multiple European states has doubled in that period. Nevertheless, many small niche-market insurers remained in the market during the end of the 1990s, specializing in particular product lines and/or geographical regions.

Government policies encouraging consolidation make sense if larger firms tend to be X-efficient, if there are unrealized scale economies, and/or if consolidation leads to more vigorous competition that increases market efficiency. Prior research by Cummins et al. (1999) finds that US life insurers engaging in M&A activity had higher efficiency gains than non M&A firms. Cummins and Xie (2005) find that M&As US property-liability insurance were primarily associated with financial vulnerability and the desire for earnings diversification.

This paper develops prior events-study research in this area (Cummins et al., 1999; Cummins et al., 2003; Campbell et al., 2003) by directly examining the alleged benefits in M&A activity in the major European insurance markets, by reference to enhancement in operating efficiencies.[1] These European countries have the largest world share of the global insurance market

outside the United States and Japan (ranked first and second in each market, respectively). France, Germany, and the United Kingdom are the largest European insurance markets for both the life and non-life insurance markets; Switzerland has the highest insurance density of all European markets. The United Kingdom and Switzerland have the highest insurance penetration for the life market and non-life markets, respectively. (Klumpes et al., 2006).

Cummins and Rubio-Misas (2003) analyse the Spanish insurance industry over the ten-year period 1989-1998. They measure efficiency by estimating 'best practice' production and cost frontiers for each year in the period using data envelopment analysis.[1] They also use Malmquist analysis to measure total factor productivity change. They find that small, inefficient and financially under-performing firms were eliminated from the market due to insolvency and liquidation. They conclude that the market experienced significant growth in total factor productivity over the sample period, and reduced the number of firms operating with increasing returns to scale and increased the number operating with decreasing returns to scale. The concluded that many large firms should focus on improving efficiency by adopting best practices rather than on further growth.

However a major impediment to competition is press claims of poor investment management and risk management practices, and a severe lack of transparency by the European insurance industry (e.g. The Economist, January 31, 2005). In order to address this issue we also consider the implications of takeover activity for the revenue to cost function for each firm. The efficient frontier is thus a joint outcome of production, investment and risk management decisions. Consequently our study focuses on the importance of takeover activity in enhancing service provision to customers, through the enhancement of asset-liability management and risk management practices, as well as technical efficiency, revenue and cost efficiency.

To provide additional information on the effects of consolidation, this study separately analyses the characteristics of targets and acquiring firms operating in the major European insurance markets. Several types of efficiency are calculated over the period 1997-2001, by using data envelopment analysis. The European industry has been affected by the overall deregulation of

European insurance markets, particularly through the EU's Third Generation Insurance Directives, implemented in July 1994. The Third Directives effectively deregulated the EU insurance market, with the exception of solvency regulation, which is carried out by the insurer's home country. The market changes have been particularly significant in Europe because some governments began tightening solvency standards and encouraging mergers and acquisitions in the insurance industry even prior to the adoption of the Third Generation Directives. The regulations were intended to create insurers that would be financially stronger, more efficient, and more competitive both nationally and internationally. Because the EU directives both have had the effect of facilitating the creation of larger and presumably more competitive insurers, we pay particular attention to the issue of revenue and profit efficiencies. This facilitates a broader analysis of firms that are targets of mergers and acquisitions activity and those who have not been by reference to both national and European frontiers. This facilitates the analysis of the scope for the rationale for both cross-border as well as intra-country takeover activities.[2]

Traditionally, life insurance and general insurance has been sold and purchased by consumers from traditional distribution channels. However multi-national firms are increasingly being subject to competition from other firms with different national traditions. The purpose of this study is to examine whether the development European regulations in the presence of highly segmented and concentrated insurance markets have facilitated similar efficiency gains. Scale economies and efficiency are analysed in the major European insurance markets in the five year window the regulations coming into effect, in order to examine potential alternative rationales for this activity. Comparative analysis across both business lines, and with firms operating with differing ownership structure and degree of affiliation in major European markets allows one to determine which of these factors dominate the M&A takeover activities in each of the major European integrated insurance market, thus facilitating comparative analysis which is unconstrained by a given institutional or legal background. Comparative analysis can determine which of these

factors dominate the M&A takeover activities in each of these countries, thus facilitating comparative analysis which is unconstrained by a given institutional or legal background.

Prior US evidence provided by Cummins et al. (1999) and Cummins and Xie (2005) suggests that M&As in both life insurance and property-liability insurance is primarily associated with value-maximisation. By contrast, the major findings of this study suggest that acquiring firms have gained more efficiency benefits from M&A activity than either target firms or non-target and non-acquisition firms. These results are further conditioned by business class and country regulatory differences: acquirer firms are more active in the UK market, are less likely to unaffiliated and are likely to be operating in the general insurance industry. These results have public policy implications for significant variation in regulatory frameworks, degree of market concentration and segmentation underlying M&A activity in various European insurance markets.

The paper proceeds as follows. Section 2 discusses efficiency concepts used in this study. Section 3 describes the method use to calculate insurance inputs and outputs. Section 4 presents the hypotheses. Section 5 presents our estimates of efficiency and scale economies, and Section 6 concludes the paper.

2. Efficiency concepts relevant to this study

Although efficiency is often used generically as an objective of the firm, there are actually several types of efficiency concepts that convey different information about firm performance. These relate to a class of benchmarking methods called frontier efficiency methodologies. The frontier methodologies measure firm performance relative to ‘best practice’ frontiers derived from firms in the industry. Such methods are considered to be superior to traditional techniques such as financial ratio analysis, since they summarise firm performance in a single statistic that controls for differences among firms using a sophisticated multidimensional framework. Frontiers have been estimated to measure firm success in employing technology (technical efficiency), attaining optimal size (scale efficiency), minimizing costs (cost efficiency), maximising revenues (revenue efficiency), and maximising profits (profit efficiency).

Methods for calculating "best practice" cost, revenue, and profit efficiency frontiers have been widely utilized to analyze efficiency in many industries, including banking and insurance. The major benefit of frontier efficiency analysis for performance benchmarking purposes is that it provides a standardized basis of scaling product-based, periodic costs, revenues, and profits of each firm, relative to that incurred by the "best practice" sample firms.

Prior literature specifies efficiency in terms of several types of efficiency concept that convey different information about firm performance. Much of these concepts are focused on the production frontier, rather than in terms of the investment frontier, which gives the maximum attainable investment portfolio return for each level of risk. Firms operating on the production frontier are efficient in the sense that they are using the minimal amount of inputs to produce their outputs. Another way of looking at the production frontier is in terms of technology. Firms operating on the production frontier are using the optimal technology available to produce their outputs, while firms not on the frontier by improving their technology. The frontier represents the best performance that can be achieved using the currently available technology.

Methods for estimating efficiency

The two major methodologies that are used in frontier efficiency analysis are econometric modeling and mathematical programming (data envelopment analysis or DEA). Cummins and Xie (2006) note that DEA can be interpreted as a maximum likelihood estimator for modelling M&A activity in the US insurance industry. Aigner et al. (1977), on the other hand, applied the parametric approach and introduced the stochastic frontier approach (SFA).[4]

A more detailed overview of the relevant literature in this area is included in appendix A. Of direct relevance to the present study, Fenn et al. (2006) and Klumpes (2004) use stochastic frontier methodologies to estimate Fourier Flexible cost and revenue functions for European and UK insurance companies, respectively. Fenn et al. (2006) adopt a common European frontier and

assume that all insurance companies in fourteen countries operate on or below this common frontier. They also find that larger companies operating in more concentrated markets are less revenue efficient but more cost efficient.

Klumpes (2004) finds that UK firms using independent agent distribution channels are more cost inefficient than firms using direct sales channels, but are not more profit efficient. However Klumpes (2004) exploits detailed regulatory data on commissions and expenses to exploit the data, Fenn et al. (2006) use aggregated accounting data and do not discreiminate between life and non-life segments.

Cummins and Zi (1998) apply a wide array of econometric and mathematical programming methods to a sample of US life insurers from 1988-1992. They report that average efficiencies differ significantly across methods. The efficiency rankings are found to be consistent among the econometric methods. However, the rankings are found to be less consistent between the econometric and mathematical programming methods and between the data envelopment analysis and free disposal hull techniques. Accordingly the authors conclude that the choice of estimation method can have a significant effect on the conclusions of an efficiency study and hence more than one methodology should be used in analysing efficiency. Cummins and Zi (1998) finds that econometric methods and DEA produce efficiency estimates for US life insurers that are highly correlated and quite consistent. They also find that DEA estimates of efficiency for life insurers are more highly correlated with conventional performance measures than are the estimates obtained from the econometric approach.

Given that the degree of concentration in major European insurance markets is relatively high, this may affect the nature of the M&A market in Europe relative to US markets. Following the prior literature, this study therefore uses DEA to estimate efficiency.

3. Measurement of value added

Insurance firms are analogous to other firms in the financial sector in that their outputs primarily consist of intangible services. The approach used in many financial institutional efficiency studies is to measure output as the value added by the firms in the industry, i.e. the difference between the value of output produced and the value of inputs consumed. Insurance inputs is usually represented by a combination of operating expenses and available measures of capital. The stochastic nature of the industry will be captured by exploring the dynamic relationships between unanticipated capital or cost shocks and subsequent premium-setting decisions. It will be desirable to decompose these shocks into common (industry-wide) or firm-specific changes using standard panel data methods.

This section identifies particular issues affecting the measurement of outputs and inputs in insurance. It concludes with a discussion of methods available to implement efficiency measures.

3.1. Outputs and output prices

The definition or identification of the outputs produced by the institution under study is critical to the measurement of its performance. However, especially in the case of financial institutions, there exists little agreement about what they produce. In the case of banking industry, where the frontier analyses have been applied most commonly, Berger and Humphrey (1992) distinguish three alternative approaches to the definition of inputs and outputs: ‘the asset approach’, ‘the user cost approach’, and ‘the value-added approach’. The asset approach assumes that banks collect funds, deposits and purchased funds, and intermediate these funds into loans and other assets. The user cost approach involves classifying financial goods into input and output categories according to their ‘user costs’ or signs of their derivatives in a bank profit function which is estimated empirically as in Hancock (1985). The value added approach considers all liability and asset categories to have some output characteristics instead of separating inputs from outputs in a

mutually exclusive way. The categories with significant value added, depending on the operating cost allocations, are used as important outputs. Others are considered as unimportant outputs, intermediate products or inputs, according to the specifics of the category (Berger and Humphrey 1992, 250).

Cummins and Weiss (2000) argue that the asset approach is not the optimal approach for either property-liability (P/L) or life insurers. P/L insurers provide many services in addition to financial intermediation, which is in fact incidental to P/L insurers. In the case of life insurers the problem is less severe as intermediation is the most important function. However, not taking into account insurance outputs is likely to provide less accurate results than an alternative approach that considers a wider range of outputs. The user cost method is not suitable for the insurance industry either, as it requires precise data on product revenues and opportunity costs, which are not available in the insurance industry due to the fact that insurance policies bundle together many services. Accordingly, the value added approach is the most appropriate for studying performance in the insurance industry.

Following value added approach, Cummins and Weiss (2000), specify three main services or outputs produced by insurers:

1. Risk-pooling and risk-bearing: Insurance provides a mechanism through which individuals and businesses exposed to losses can engage in risk reduction through pooling. The actuarial, underwriting and related expenses involved in risk pooling constitute a main element of value added in insurance.
2. Real financial services relating to insured losses: Insurers provide a variety of real services such as financial planning and counselling, risk surveys, loss prevention services etc.
3. Intermediation: Insurers issue debt contracts and invest the funds until they are withdrawn by policyholders or used in claim settlements. The net interest margin between the rate of return earned

on invested assets and the rate credited to policyholders reflect the value added from the intermediation function.

Insurance firms thus create value by providing risk-pooling and risk-bearing, ‘real financial strives for policyholders and intermediation. The outputs can be identified by identifying the sources of operating costs. If an industry is competitive, operating costs represent the amounts that consumers are willing to pay for these services. Operating costs of insurance firms typically comprise commissions paid to agents, personnel costs for functions other than investments and sales, and investment expenses.

Insurance provides institutions and individuals with financial protection against the uncertain future occurrence of specified events. It is also a form of financial intermediation whereby funds are collected from policy holders and invested in assets which are held as reserves to meet future claims. Typically insurance companies do not make a separate charge for the services of arranging the financial protection or security that they provide. Whenever insurance companies do make explicit charges these should be treated as payments for services rendered and counted as output in the normal way.

For other services some estimate has to be made. One recommendation is that the total output of insurance services be obtained as actual premiums earned in the period plus income from the investment of the insurance technical reserves less claims which become due for payment during the accounting period less changes in actuarial reserves and reserves for with profits insurance. This measure represents the amount available to the insurance company to cover its costs and provide for an operating surplus and is therefore a measure of output. This approach has been adopted in a large number of studies even though premiums represent revenues (i.e. price times quantity) rather than quantity. Diacon et al. (2002) identify other problems with using premiums, such as whether premiums should be measured using a cash flow versus accrual basis (particularly

for life insurance business and long-tailed general insurance). A similar issue arises for investment income.

An alternative is to measure output in terms of simply the sum of incurred benefits and additions to reserves. Incurred benefits represent payments received by policyholders in the current year and thus are expected to be useful proxies for the risk-pooling and risk-bearing functions. Benefits are a measure of the amount of funds pooled by insurers and redistributed to policyholders as compensation for insured events. Most life insurance products also involve the accumulation of assets, either to pay future death benefits or to be received as income. Finally, the funds received by insurers that are not immediately for benefit payments and expenses are added to policyholder reserves. Since the funds backing the reserves are invested by insurers in financial instruments, additions to reserves are therefore expected to be highly correlated with the intermediation function performed by life insurers. Finally, both incurred benefits and additions to reserves are correlated with benefit administration and financial planning services.

However this raises further difficulty because management may not seek to maximise the value of insurance claims (especially general insurance) and because it violates the principle that more output should be preferred to less (Diacon et al., 2002, 448).

Because major lines of insurance business differ in types of contingent events that are covered and differ in terms of the relative importance of risk pooling, risk bearing, intermediation and real services, U.S. studies tend to use a combination of output variables by line of business. For example, Cummins (1999) define multiple output variables, reflecting each of the major lines of business offered by life insurers. However this information is not commonly available on a standardized basis for European insurance firms.

The price of each insurance output is defined as the sum of premiums and investment income, minus output for the line divided by output. This price is considered to be a measure of value added because it represents the amount of money spent in providing services in the industry,

again under the assumption that the industry is competitive so that buyers receive services commensurate with the funds absorbed by insurers in producing output (Cummins, 1999, 86).

However other authors (e.g. Diacon et al., 2002) have simply applied premium income without applying the output*price methodology (e.g. applied net earned premiums by line of business and total investment income). It should be noted that while this approach is more amenable to the use of aggregated accounting data commonly available in databases such as EUROTHESYS, this analysis necessarily assumes that relevant costs and revenues are variable, which may not reflect reality. For instance, premium income derived from regular business is traditionally regarded as being more fixed revenue than single premium income; correspondingly, administrative costs charged to policyholders in the form of deferred acquisition costs may bear little or no relationship to current period business expenditures.

As transactions flow data is not available in insurance industry, proxies must be identified to the services provided by the insurers. Yuengert (1993) notes two common measures of output in the life insurance efficiency literature: reserve levels and premiums. He argues that as reserves are a stock, they take into account only the amount of business an insurer carries from year to year but exclude the costs of new business. Premium revenue, on the other hand, while capturing the flow of services, does not capture output but price times output. Hence price differences across firms may cause distortions in performance measures. Accordingly, he suggests that additions to reserves may proxy output more closely.

Subsequent to the criticisms of Yuengert on the use of premiums, a number of recent studies proposed alternative proxies to insurance outputs. Cummins, et al. (1999) Cummins and Zi (1998), for example, have employed present value of real losses incurred and incurred benefits plus additions to reserves as proxies for the output of property-liability insurers and life insurers, respectively. It is argued that losses incurred provide a good proxy for the risk pooling and real insurance services provided as the objective of risk-pooling is to collect funds from the

policyholders and redistribute them to policyholders who experience losses, and the amount of claims settlement and risk management services are highly correlated with loss aggregates. Similarly, incurred benefits are useful proxies for the risk pooling function and additions to reserves are expected to highly correlate with the intermediation function. Both of them are also correlated with the real services provided by the insurers. (Cummins and Nini, 2002; Cummins and Weiss, 2000).

Cummins and Weiss (2000), at the same time, note a potential disadvantage of using losses as an output in that losses are a random variable. As a result there is a potential that there will be errors-in-variables bias in the case of econometric applications and the error will be accounted as inefficiency by DEA. They suggest as an alternative using a measure of expected losses equal to premiums earned multiplied by the average loss ratio over a period of years prior to the year of analysis. Ward (2002) and Brockett et al. (2004) criticise "the production approach" and the use of losses paid as an output. For example if losses increase exogenously while inputs remain the same, this would be bad and not efficiency increasing for an insurance company.

3.2. Inputs and input prices

Insurance inputs will be represented by a combination of operating expenses and available measures of capital. The stochastic nature of the industry will be captured by exploring the dynamic relationships between unanticipated capital or cost shocks and subsequent premium-setting decisions. It will be desirable to decompose these shocks into common (industry-wide) or firm-specific changes using standard panel data methods.

U.S. based efficiency studies typically use up to four kinds of insurance inputs – these include administrative labor, agent labor, business services and financial capital. Agent labor and administration labor are treated separately because the two types of labor have different prices and

are used in different proportions by firms in the industry. However most of non-labor intermediary consumption costs relate to business administration expenses.

Value added may be measured either as a gross or net concept, that is before or after deducting consumption of fixed or financial capital. As value added is intended to measure the additional value created by a process of production, the consumption of fixed capital ought to be accounted for and thus net value added would be a preferred measure. However, it is often difficult to measure capital consumption and as such gross value added may often be used. Further, only a small fraction of expenses are for physical capital such as buildings, so many studies do not define physical capital as a separate input but do include it in the business services category.

Prices of agent labor, home office labor and business services can be based on survey data of wages. Quantities of agent and administrative labor can be obtained by dividing expenditures on these items by agent and home office wage variables. Alternatively, some studies (e.g. Diacon et al., 2002) simply define total operating expenses as an input variable. However this classification does not segregate labor, administrative and physical capital expenditure from other types of expenditure and hence confuses net and gross value added.

Financial capital is also used as an input to efficiency studies. Unlike physical capital, financial capital is an important input in insurance and capital costs represent a significant expense for insurers. However because insurance firms are required to maintain capital both to ensure policyholders that they will receive payment and to satisfy regulatory requirements, capital allocated to a decision making unit is not necessarily equal to the capital consumed by that business unit. Consequently it is not possible to determine the meaningfulness of capital as a figure (e.g. Diacon et al., 2002). Other studies report the amount of capital that is reported to the regulator, and then separately measure the cost of capital as the price of this input (e.g. Cummins, 1999). However this procedure is necessarily arbitrary since the cost of capital is normally based on a categorisation of financial ratings assigned by credit rating agencies. We take account of the Babbel and Merrill

(2005) criticisms of accounting practices and adjust our measures of financial capital to account for securitisation and financial engineering strategies used by insurance firms.

4. Hypotheses formulation

The seven major European insurance markets, while similar in size to the US and Japanese markets, have traditionally been subject to stringent regulation affecting pricing, contractual provisions, the establishment of branches, solvency standards, etc. A separate market existed in every European country, and cross-border transactions were rare, except for reinsurance and some commercial coverages. Competitive intensity was very low, with minimal price and product competition and stable profit margins (Swiss Re, 1996).

The implementation of the EU's Third Generation Directives, beginning on 1 July 1994, represented a major step in creating conditions in the EU resembling those in a single deregulated national market. The Third Generation Directives have three key components: (1) the establishment of a single EU license, whereby an insurer is required to obtain only one license to operate in the EU rather than being licensed in each member nationl (2) the principle of home country supervision, whereby an insurer is regulated only by the nation which issued its license and not by each host country where it operates. And (3) the abolition of 'substantive insurance supervision', meaning that regulation is limited to solvency control and pricing, contracting and other insurer operations are effectively deregulated. Thus, insurers are allowed to engage in true price competition in personal lines and also to compete more freely in products and services. The Directives also encouraged the entry of foreign firms and banks into the domestic European markets, making it more difficult for small, inefficient firms to survive.

The European insurance market was undergoing significant regulatory changes that offered opportunities for aggressive insurers to gain market share, potentially both reducing costs and enhancing revenues. During the past decade the major European insurance markets have

experienced an unprecedented wave of mergers and acquisitions. The traditional industry specialist firm has been faced with competition from non-traditional sources such as banks, mutual funds and investment trusts. The increased competition has narrowed profit margins and motivated insurers to seek ways to reduce costs. Firms can grow either internally via the acquisition of productive assets, or externally through the acquisition of other 'ongoing' firms.

There is evidence of considerable rationalisation of the European insurance market in recent years. Diacon et al. (2002, 454) find that the number of competing firms nearly halved from 1996 to 1999 in Spain, Netherlands and Switzerland, and reduced by 30% in France, Germany and the UK. However prior empirical evidence on takeovers in the US and UK generally is mixed on the costs and benefits of takeovers to owners of both target and acquiring firms (Klumpes, 2004).

Mergers and acquisitions may be motivated by a number of reasons. The most stated reason is to increase shareholder value by exploiting opportunities to improve firm operating performance. Mergers may enhance a firm's efficiency by adopting the best practice technology (technological efficiency) and by adopting the optimal mix of production inputs (allocative efficiency), taking as given output levels and input prices. In addition, costs can be reduced by attaining the optimal scale –through increasing firm size if the firm is below optimal scale or reducing firm size if the firm is larger than the optimal size. We develop hypotheses that predict the systematic relation between variations in cost and/or profit efficiency, the incidence of merger and acquisition activity, and various characteristics of the acquirer and/or target firm. We classify these as risk diversification, operating and financial synergy and financial vulnerability hypotheses.

An alternative rationale for mergers and acquisitions – risk (and/or earnings) diversification – may provide a particularly strong motivation for mergers and acquisition activity in the European general insurance industry and in the reinsurance industry due to multiple sources of risk. Sources for risk facing insurance firms include investment risk, operational risk, underwriting risk and credit receivables default risk. By increasing the breadth of the policyholder pool, losses become more predictable and earnings volatility due to underwriting income is reduced. This gives the insurer an

opportunity to take on more risky, higher yielding investments, thus increasing revenues for a given level of overall risk. This provides another rationale for the hypothesis that acquired firms should show greater revenue efficiency gains than non-M&A firms.

Cummins et al. (1999) argue that are a number of operating and financial synergy reasons to believe that mergers and acquisitions can permit insurance firms to operate more efficiently. Operating synergies allow firms to increase their operating income, increase growth or both. Consequently, opportunities for post-merger performance improvements may be greater in firms that are currently relatively inefficient, and thus M&A may involve relatively efficient insurers taking over and reforming inefficient firms.

Cummins et al. (1999) argue that this reasoning would imply that insurance targets should exhibit lower efficiency prior to their acquisition, and/or that less efficient firms should be more likely to be acquired. Acquiring poorly managed firms and removing incumbent management practices should increase the value of control. If the managers of acquiring firms are more capable than those of acquirers then one would expect to observe cost or revenue efficiency gains, or both, resulting from change management following a merger or acquisition.

In addition, Cummins et al. (1999, 327) argue that there are financial synergy benefits attributable for relatively efficient firms in terms of cost and revenue-related efficiency gains from affiliating with others. The predominant organisational model in the insurance industry is the insurance group, consisting of several insurers under common ownership. Merger and acquisition activity involving the formation of an insurance group develops a business model consistent with Williamson's (1985) M-form organisation. A number of the largest insurance enterprises in Europe, such as Allianz, Axa and Aviva, involve the creation of a holding company that undertakes low-frequency activities, such as planning, budgeting and treasury, while high-frequency activities concerning operational decision –making are delegated to the subsidiary level. Although members of groups operate relatively independently in terms of marketing, a number of important operations such as information systems, investments, and policyholder services usually are conducted

centrally. Spreading the fixed costs financing these operations over a broader base has the potential to improve financial capital allocation and thus enhance cost efficiency. This implies that the creation or development of an M-form organisation will result in relatively greater revenue efficiency, since consolidation facilitates cross-selling, improves customer satisfaction, and otherwise enhances the firm's ability to produce revenues (Klumpes, 2005). Accordingly, following Cummins et al. (1999), we therefore hypothesize that the revenue efficiency of target firms will tend to increase following an acquisition by an insurance group.

The changes in marketing system and technology have also been dramatic. Consequently, in this environment, firms that possess leading-edge competencies in the areas most subject to change may be viewed as attractive acquisition targets. This may be captured by technical efficiency. However, following Cummins et al. (1999, 326), we do not have a strong prediction with regard to whether acquisition targets are likely to be relatively inefficient or relatively efficient.

The quest for scale economies is often given as another operating synergy rationale for mergers and acquisitions. Under this motive, firms operating with non-decreasing (constant or increasing) returns to scale (NDRS) will be attractive acquisition targets because they are currently operating in the optimal size range or have the opportunity to become more efficient through growth. Firms operating with decreasing returns to scale are likely to be viewed as unattractive acquisition targets because they are already 'too large' in terms of scale economies. We do not examine this hypothesis in this paper since it is unclear whether NDRS will be observable across all six major European insurance markets.

Another objective frequently given for mergers and acquisitions is to enhance market power by increasing market share in a firm's core lines of business or to diversify into new product markets or geographical regions. However this rationale for takeover may be subject to regulatory and political visibility and possibly interference by insurance regulators, national governments and the European Union.

We also hypothesize that general insurance companies are less likely to be acquired than life insurance firms, due to managerial self-interest. Finally, although many insurers have made efforts to restructure their asset portfolios and made other changes to improve their regulatory ratios, the weaker insurers in the industry still face the prospect of having to raise additional equity capital to avoid incurring significant regulatory costs. Raising capital is problematic for many insurers because the industry contains many mutuals and closely held stock companies, organizational forms that are limited in their ability to raise new capital. Insurers that face regulatory costs and capital constraints are likely to be attractive acquisition targets for stronger firms, particularly if they are efficient and/or operating with favourable returns to scale. Thus, we hypothesize that target firms are likely to display one or more signs of financial vulnerability.

This discussion of the potential motivations for insurance M&A leads to several predictions regarding the patterns and effects of merger activity in the industry, if acquisition targets are chosen in accordance with these motives.

The first prediction is that acquisitions are driven solely by efficiency improvements for the acquired firm, since consolidation appears to be driven by pressures to compete more effectively. Because rapid improvements are needed under vigorous competition, more efficient firms will more likely be acquired than inefficient firms. We also predict that members of life insurance insurance groups will more likely be acquired than general insurers, based on the argument that most acquisitions activity is driven by the desire to optimally restructure. Finally, due to regulatory considerations, we predict that financially vulnerable firms will more likely be acquired than stronger firms.

5. European insurance industry structure

This section provides a brief statistical overview of the structure of the life insurance industry to provide the backdrop for the merger analysis. The number of insurers with meaningful

data reporting to the regulators during the period 1995-2003 is shown in table 1, Panel A and B. Panel A shows the number of firms which are either M&A active, exiting or surviving. Panel B gives a further breakdown in the number of deals done during the peak M&A activity of 1999-2000, where both target and acquirer were insurance firms. The data shows that the major markets of the UK, Italy, Netherlands, Germany, Spain and France dominated the total European insurance M&A market during this period.

INSERT TABLE 1 ABOUT HERE

During our sample period the number of companies remained relatively constant. The relative constancy in the number of firms during an era when the industry is undergoing significant restructuring is due to the fact that many transactions involve groups buying and selling companies that remain in existence after the transaction. Another factor is the numbers of firms exiting the market due to merger or insolvency have been partially offset by the formation of new insurers. Consequently, the restructuring of the European industry primarily tends to involve such strategic objectives as an increased emphasis on core competencies or the expansion into new markets. The list show that M&A activity and other exiting resulted in a 30% reduction in the number of insurance companies operating in these major markets over the study period, although the mix and extent varies significantly across individual markets.[8]

There are two major lines of business in the European insurance industry-general and life. The importance of asset accumulation products is particularly noteworthy because this is the market where insurers face the most vigorous competition from banks. Because these non-traditional competitors have much lower distribution costs, than insurers, general insurers face intense pressure to operate more efficiently in order to remain competitive in the asset accumulation market.

Table 2 summarises descriptive statistics of industry concentration ratios, M&A activity during the study period 1997-2001, in each of the seven major European life and non-life insurance markets. Concentration ratios exceed 40% outside the German, Italian markets and the Spanish non-

life market. These results indicate significant segmentation in insurance markets, particularly in smaller countries such as Switzerland and the Netherlands where a few international firms compete globally.

INSERT TABLE 2 ABOUT HERE
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5. Methodology

Consistent with prior research in this area, 'best practice' production and cost frontiers for each year of the sample period, are estimated using data envelopment analysis (DEA), a non-parametric technique (Cooper et al., 2000). A production frontier gives the minimum inputs required to produce any given output vector, while the cost frontier measures the minimum costs to produce the output vector. Efficiency, which is measured for each firm in the sample in each year, ranges from 0 to 1, with firms operating on the frontier measured as fully efficient (efficiency of 1), and firms not operating on the frontier measured as inefficient (efficiency less than 1).

Choice of inputs and outputs

Following Berger et al. (1997, 350), this study uses business services, labor, debt capital and equity capital resources as the main inputs, and premiums, claims and investment income as the main outputs. The prices of business services and labor are obtained from Eurostat. Capital inputs are split between shareholders' capital and reserves, technical provisions, and debt – all measured at the end of the financial year (not start of year as in Diacon et al. (2002), since the relevant M&A valuation is assumed to be based on current prices). Premium and investment income are used to represent output as it is felt that these revenue measures are the available best proxies of the services that insurers provide to their customers. It is assumed for M&A valuation purposes that this spread is calculated as the risk-free interest earned on the investment portfolio.

6. Estimation Results

This section presents the results of the analysis of the relationship between the impact of new European regulations issued in 1994, and mergers and acquisitions and efficiency in the European life insurance industry in the subsequent three years. The analysis focuses primarily on firms that were acquired during the two year window prior to the heavy M&A period 1999-2000 and that continued to operate for at least two years following the acquisition. Focusing on target firms that continue to operate provides a relatively homogeneous sample consisting of the most common type of M&A transaction among life insurers.

This section first presents summary statistics on the characteristics of the firms in the sample and the results of the DEA analysis. Next, results of a regression analysis are presented, where, consistent with prior US literature, the dependent variables represent changes in various types of efficiency over a period ranging from three years prior to the year of acquisition to three years after the year of acquisition. This analysis is designed to test for changes in efficiency while controlling for characteristics of target and non-M&A firms that are hypothesized to be related to efficiency changes. The objective of the regression analysis is to investigate the principle issue addressed in this paper, i.e. whether acquisitions lead to improvement in efficiency.

To test several of the hypotheses discussed in Section 2, we also conduct a probit analysis where the dependent variable is set equal to 1 for target firms and to 0 for firms with non M&A activity. This analysis is intended to identify the predictor variables characterizing target firms. The section concludes with a brief analysis of the efficiency of acquiring firms.

6.1. Summary statistics

The summary statistics (see Table 3) show several statistically significant differences between the target, non-target and acquisition and non-acquisition firms. Target firms have higher RE, technical efficiency change, total factor productivity change than target firms. However, inconsistent with the hypothesis that acquisition targets may display signs of financial vulnerability, target firms have significantly lower assets.

INSERT TABLE 3 ABOUT HERE

By contrast, acquiring firms have significantly higher cost efficiency, allocative efficiency and scale efficiency than non-acquiring firms, suggesting that insurance acquisitions generally involve acquirers buying and reforming inefficient firms. Acquiring firms are also more likely to be mutuals, invest in more risky assets and are larger. Target and acquiring firms companies are slightly less likely to be unaffiliated single firms, supporting the argument that managers of unaffiliated companies are likely to resist takeovers. Target amd acquiring firms are more likely to be British, supporting the evidence that the M&A market is much stronger in the UK than in Continental European insurance markets. Finally, non-acquiring companies are somewhat smaller in terms of premiums earned than acquiring firms and have a significantly lower invested assets as a percentage of premiums, suggesting that acquiring firms have more diversified portfolios.

6.2. Regression Analysis of Efficiency Changes

To analyze efficiency changes while controlling for other differences between target firms and the non-M&A firms, regressions are estimated with efficiency changes as dependent variables and firm characteristics as independent variables. We also conduct regressions where the dependent variable is the ratio KE(t+2)/KE(t-2), where KE stands for efficiency of type K and K=C, A,T,PT, S and R representing, respectively, cost, allocative, technical, pure technical, scale and revenue efficiency. The efficiency change ratios compare a firm's position relative to the frontier for period t+2 to its position relative to the frontier for period t-2.

The analysis of efficiency changes relative to frontiers estimated for two different time periods is consistent with the prior literature and is appropriate because movements in technology and other factors that are not related to mergers and need to be controlled for to isolate the merger effects. By including both targets and non-targets in the regression, we control for potential biases resulting from shifts in the distribution of efficiency scores between periods t-2 and t+2.

The independent variables include size (log of assets), and organizational form (a dummy variable equal to 1 for general insurance and zero for life insurance firms). To determine whether acquisitions improve firm efficiency, we include a dummy variable equal to 1 if the firm was not acquired during the period and zero otherwise.

The sample period for the regressions is 1997-2001. This compares with the five year block used by Cummins et al. (1999). The five year block permits measurement of the change in efficiency over a period beginning from EU harmonisation and monetary convergence rules coming into effect and up to three years prior to the acquisition year (t-2) and ending two years after the acquisition year (t-2). Thus, efficiency changes are measured over the period. Thus, like prior studies, I require firms to be present in all years of the sample period (1997-2001) in order to be included in the analysis. The target firms in our sample are included in the data set only for the five year block surrounding their acquisition; merged or acquired firms that were omitted from the sample based on these selection criteria are excluded from this analysis.

The regressions for changes in efficency for acquirers and non-acquirers (see Table 4a) reveal that acquiring firms experienced significantly higher gains in cost, allocative and pure technical efficiency than non-acquiring firms. There were no significant technical, scale or revenue efficiency differences between these firms.

By contrast target firms experienced significantly larger gains in only allocative efficiency than did non-target firms. The only other systematic differences affecting cost, technical, allocative and pure technical efficiency relate to size, UK presence and line of business effects. This provides further evidence that acquisitions did not have a beneficial effect on efficiency in the European insurance industry, and that the gains affect cost, allocative and technical efficiency rather than scale or revenue efficiency. The lack of improvements in both revenue and scale efficiency suggest that acquisitions did not have a strong positive effect on revenues for target firms, contrary to the equivalent finding of both Cummins et al. (1999) and Cummins and Xie (2005) for the US life insurance industry.

INSERT TABLES 4a and 4b ABOUT HERE

The regressions shown in Table 4a reveal that target firms also experienced significantly larger gains in technical efficiency than did non-target firms, with the cost efficiency gains attributable primarily to gains in technical rather than allocative efficiency. This provides further evidence that acquisitions did not have any beneficial effect on efficiency in the European insurance industry, or that the gains affect revenues as well as costs. The poorer technical and allocative efficiency of non-target firms suggest that acquisitions may have had a strong positive effect on the efficiency of target firms.

The control variables in both sets of regressions reveal that larger firms experienced significantly higher efficiency changes than smaller firms. Life insurance firms achieved significantly higher efficiency growth than general insurance firms, except for allocative efficiency where there is a significantly higher efficiency for general insurers relative to life insurers. The cost efficiency differences between life insurance firms and general insurance firms could be consistent with 'expense preference' behaviour on the part of general insurance firms. The differences in technical efficiency could provide further evidence that general insurance firms operate in less complex and less risky lines of business that may provide fewer opportunities for technological gains.

A consistent finding in both target and acquisition change regressions is that non-UK-based firms experienced higher changes in cost and technical efficiency than did non-UK firms. UK firms also experienced lower allocative efficiency change. A possible explanation for this finding is that technological advances in data transmission and communications may provide more opportunities for improving efficiency for non-UK firms that are relatively less diversified geographically than UK firms.

6.3. Probit analysis of the probability of target and acquisition

The probit analysis of the probability that a firm becomes an acquiring firm is presented in Table 5a; the probability that a firm becomes an acquisition target is presented in Table 5b. Consistent with Cummins and Xie (2005) and Cummins et al. (1999, 354), the dependent analysis in this analysis is equal to 0 for non-acquiring (target) firms and equal to 1 for acquiring (target) firms. The independent variables in the regression are lagged up to two years so that firm characteristics prior to the acquisition year are associated with what occurs during the acquisition year. Acquiring and target firms are included in the probit analysis only in the year of their acquisition. Non-M&A firms are included for all sample years (1997-2001).

INSERT TABLES 5a and 5b ABOUT HERE

The probit models include several explanatory variables to test the hypotheses discussed in Section 2 along with control variables. To test the hypothesis that efficient firms are acquirers or attractive acquisition targets, we include only one type of efficiency ratio in each equation. Positive coefficients on one or more of the efficiency variables would support our hypothesis.

Following the equivalent analysis in Cummins and Xie (2005), several variables are included in the equations to test the hypothesis that financially vulnerable firms are likely to be acquisition targets. The ratio of equity capital to assets is used to measure the adequacy of the firm's capitalization. The ratio of net operating cash flow to assets as a measure of the adequacy of funds to invest in new projects is also included. As a liquidity ratio, we use a ratio of cash and invested assets to liabilities. Additionally, we include the loss reserve as a proprortion of premiums, net income as a percentage of premiums, and the percentage of equity investments. Consistent with Cummins et al. (1999, 355), all of these variables are expected to be positively related to being an acquirer and inversely related to the probability of being an acquisition.

A dummy variable equal to 1 is included for UK-based firms and zero otherwise to test the hypothesis that managers of non-UK firms are more likely to resist buy-out offers to protect their job security. A negative coefficient on this variable would be consistent with this hypothesis. As

control variables, consistent with prior research, the log of assets is used to capture size effects; and a dummy variable equal to 1 if the firm is a general insurance firm and equal to 0 otherwise if it is a life insurance firm or a composite.

Conventional wisdom would predict a negative coefficient for the log of assets. The general insurance firm dummy is also expected to have a negative sign because general insurers are more difficult to acquire than life insurers.

The probit results (see Table 5a and 5b) provide mixed results for the probability of being an acquiring or target firm. The results for the probability of being an acquirer (Table 5a) supports the contention that acquirers are more cost, technical, allocative and revenue efficient than non-acquiring firms. All efficiency variables are positively associated with the probability of being an acquirer. By contrast, the equivalent results in Table 5b does not provide strong support for the hypothesis that more efficient firms are attractive targets. While all efficiency variables are positively related to the probability of acquisition, none are statistically significant. This suggests that, whereas acquiring firms are relatively efficient, such firms are not especially attractive as acquisition targets, a result that is inconsistent with that reported by Cummins et al. (1999, 354).

The results in Table 5a also indicate that acquiring firms are not significantly financially stronger than non-acquiring firms. However the equivalent results reported in Table 5b also contradict the hypothesis that financially vulnerable firms are more likely than stronger firms to become acquisition targets. The log of assets is also positively related to the probability of being an acquirer, supporting the view that acquiring firms tend to be relatively large.

The general insurance dummy variable has a positive coefficient for being a target firm as expected and is statistically significant at the 1% level or better in all of the probit models. This provides strong support for the hypothesis that managers of general insurance firms have a greater incentive to become an acquirer than managers of life insurance firms. As expected, the equations provide evidence that UK firms are more likely to be acquirers than non-UK firms.

The results for the probability of being a target firm as reported in Table 5b are more equivocal. The capital to asset ratio is statistically significant at the 5% level in all efficiency probit regressions, with a negative sign in all cases. The ratio of liquid assets to reserves is also positively related to the probability of being a target, but is not statistically significant. A possible explanation for this result is that the liquidity ratio does not proxy for either financial vulnerability or for the attractiveness of the firms as an acquisition target. That is, controlling for capitalization and cash flow, the acquiring firm is not better off with liquid assets than with assets such as receivables from agents and reinsurers, and this effect offsets the role of this variable as an indicator of financial vulnerability. However by contrast the probability of being a takeover target is positively associated with mutual status and negatively associated with the percentage of investments in equities. This finding is consistent with the earnings diversification/costs of acquisition hypothesis.

7. Conclusion

The European Union justified the imposition of uniform solvency, financial reporting and cross-registration rules in the mid-1990s order to enhance the competitiveness of the European life insurance industry. This paper tests whether the regulations enhanced competitiveness by examining the relationship between acquisitions and efficiency in the major European insurance markets that presumably had most to benefit from the regulations. Efficiency for life insurers operating in the major European insurance markets over the period of consolidation and regulatory harmonisation in 1997-2001, using DEA analysis. Following Cummins et al. (1999) and Cummins and Xie (2005), this paper investigates four principal hypotheses relating efficiency gains that firms are expected to garner associated with the probability of engaging in merger and acquisition activity; (1) that acquisitions lead to improvements in efficiency for the acquired firm; (2) that efficient firms are more likely to be acquired than inefficient ones; (3) that financially vulnerable firms are more likely to be acquired; and (4) that life insurers are less likely to be acquired than general insurers.

To test the hypothesis that acquisitions lead to improvements in efficiency, we regress the change in efficiency two years after acquisition vs. two years prior to acquisition on a dummy variable set equal to 1 for acquisition targets and to 0 for non-M&A firms as well as a set of control variables. We find that acquiring firms are more likely to be efficient than non-acquiring firms. However, contrary to the equivalent findings of Cummins et al. (1999) for the US life insurance industry and Cummins and Xie (2005) for the life and general insurance industry, respectively, the results do not provide strong evidence that target firms achieve greater gains in technical, cost and revenue efficiency than non-target firms, suggesting that the recent restructuring of the life insurance industry has not produced significant efficiency gains and improved profitability for target firms.

Probit models are used to investigate hypotheses (2) through (4). The results confirm that the relatively efficiency of acquirer to non-acquirer firms, but we find no evidence that target firms are more efficient relative to non-target firms. Contrary to expectations, life insurance firms are more likely to garner efficiency gains from M&A activity and are less likely to be an acquirer than general insurance firms. There is tentative evidence that financially vulnerable insurers are more likely to be an acquisition target than financially stronger firms, and that UK firms are more likely to be engaged in M&A activity but gain relatively less efficiency gains than do insurance firms operating Continental European markets. Thus, European-wide solvency regulation also appears to have driven consolidation among insurers.

The overall conclusion is that mergers and acquisitions in the major European insurance markets during a period of monetary convergence and harmonisation in regulation appears to be driven for the most part by solvency objectives. Acquiring firms are more likely to benefit from efficiency gains associated with takeover activity than target firms. This activity has not however in general had a beneficial effect on efficiency of target firms in the industry.

Further harmonisation in EU solvency directives may lead to more mergers and acquisitions, and the competitive landscape would change even more profoundly if the EU treaty was revised to

prevent certain jurisdictions from offering tax-free products relative to other countries. Finally, many firms in the industry still have not been able to use technology effectively to create value for shareholders and policyholders, providing a further motivation for consolidation.

Footnotes

1. Cummins et al. (1999) is the first study to investigate the effects of life insurer merger and acquisitions activity on efficiency. They use DEA to estimate the cost and revenue efficiency of the US life insurance industry over the period 1988-1995. They find that acquired firms achieve greater efficiency gains than firms that have not been involved in mergers or acquisitions. Firms operating with NDRS and financially vulnerable firms are more likely to be acquisition targets. They also find that mergers and acquisitions in the US life insurance industry had a beneficial effect on efficiency.
2. The extent of cross-border activity is limited because of national considerations and differences in the scoping of cross-border activity. Countries such as France, Germany and Netherlands have mature markets and thus tend to export in other countries. However countries such as Italy, Spain with less developed markets have been subject to greater infiltration by overseas companies. Common themes across countries include the consolidation of the insurance industry, the integration of supervision between banks and insurers, and the increasing emphasis on retirement savings and policy effects on the development of insurance. There has been a gradual shift from traditional distribution channels toward brokers and banks and Internet channels. The life insurance industry has been subject to the effects of an aging population, as well as increased emphasis on equity-related investments. This has resulted in greater volatility in reported performance over time. The general insurance industry has been subject to greater claims and consequent underperformance of investments. On the regulation side, the reduction of the tariff mechanism in many countries and deregulation of investments have increased the business cycle over time. In most countries, financial strength has gradually weakened over time, possibly due to the adverse capital market conditions combined with increased numbers of claims incurred.
3. However recently a Spanish bank, Banco Hispano Santander recently entered the UK banking market in order to achieve perceived efficiency gains.

4. Neither approach has emerged as the dominant estimation method. Berger and Humphrey (1997) review studies on efficiency in financial institutions and report roughly an equal split between the applications of the mathematical techniques and the econometric methods.
5. The merger into groups of companies is not a trivial issue. Recently Aviva plc's subsidiary Norwich Union announced that it was to merge 10 subsidiaries into 4. This move, while apparently rational in pooling resources, attracted stringent financial press criticism for potentially confusing and shifting wealth among various policyholders (Financial Times, 21 August 2004).

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Table 1
Summary statistics for European insurance firms by M&A status, 2002

Panel A: Active versus non-active firms

Country	M&A Active	Other Exiting	Non-M&A
France	25	6	118
Germany	48	30	234
Italy	37	29	79
Netherlands	7	7	57
Spain	29	12	32
Switzerland	8	2	31
United Kingdom	60	100	273
Total	206	184	793

Panel B: Number of deals (1999-2000; takeover and acquirer are insurance firms)

	Value (in euros millions)	Share percent	Number of deals
United Kindgom	47,517	60.6	105
Italy	11,956	15.3	17
Netherlands	7,063	9.0	19
Norway	4,804	6.1	5
Germany	3,332	4.3	24
Spain	972	1.2	16
France	718	1.0	17
Switzerland	72	0.1	8
Other	76,272	2.5	41
Total	78,391	100	245

Source: Thomson First Source

Table 2
Concentration ratios for the European insurance industry, 2002

	France	Germany	Italy	Netherlands	Spain	Switzerland	UK
Life	48.2	33.0	31.3	67.1	43.8	42.5	42.5
Non-life	56.0	27.9	38.1	47.8	27.8	43.9	43.9

Note: Refers to the top 5 insurance companies operating in both sectors.
* The output prices are insurance 'unit prices' equal to the ratio of premiums to losses incurred. The ratio is < 1 for life insurance because losses incurred include loss payments plus additions to reserves, reflecting investment income earned on asset accumulation (cash value) life insurance policies.

Table 3

Average Efficiency Scores for M&A and Survivor firms, 1996-2002

	Target firms		Non-Target firms		Acquiring firms		Non-acquiring firms	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev	Mean	Std dev.
Observations	172		1508		296		1384	
Total assets (Euro million)	8428	18113***	4960	9354	7432	13250***	4863	1384
Capital/total assets	0.09	0.10***	0.12	0.10	0.12	0.09	0.12	0.096
Liquidity ratio	0.04	0.05***	0.06	0.15	0.07	0.12	0.06	0.144
Operating cash flow /total assets	0.04	0.06	0.05	0.18	0.04	0.07	0.05	0.188
Premium/surplus	-0.67	36.59	2.93	40.17	4.72	41.01	2.09	39.56
Loss reserves /surplus	-1.41	50.59	3.71	59.70	4.77	61.32	2.84	58.29
Return on assets	0.05	0.27	0.08	0.29	0.07	0.08	0.08	0.317
Return on equity	3.48	5.53	3.51	16.50	3.10	5.65	3.59	17.12
Net income before tax/premium earned	0.42	0.51	0.42	0.60	0.43	0.74	0.41	0.55
Loss reserves /premium earned	1.44	2.17	1.70	4.67	1.60	7.26	1.69	3.63
Invested income/premium earned	0.33	0.34	0.34	0.43	0.39	0.45***	0.33	0.42
Invested assets/total assets	0.99	0.08	0.80	2.40	0.82	0.26	0.82	2.50
Percent of invested assets in real estate	4.65	4.74	4.47	6.30	5.52	6.51***	4.27	6.06
Percent of invested assets in stocks	20.68	21.79	22.40	23.02	25.59	24.53***	21.50	22.48
Percent of invested assets in bonds	44.75	21.61***	39.68	23.01	36.97	23.11***	40.89	22.82
Percent of invested assets in risky assets	26.21	18.21	33.64	302.39	59.94	680.47*	27.10	27.01
General insurance, premiums written	0.84	0.755	0.81	0.654	0.89	0.72**	0.80	0.65
UK firms, premiums written	0.00	0.00***	0.24	0.43	0.36	0.48***	0.19	0.39
Total premiums (Euro millions)	1089	1787	862	1316	1568	1970***	739.5	1157.85
Percent unaffiliated companies	0.12	0.32	0.19	0.39	0.16	0.37	0.19	0.392
Percent of firms with NDRS (nondecreasing return to scale)	10.94	0.341***	89.05	0.353	18.70	0.393***	81.30	0.339
Percent mutual companies	0.32	0.92	0.20	0.39	0.26	0.44**	0.20	0.48
Percent companies with A+ rating	0.09	0.29*	0.13	0.34	0.18	0.38***	0.12	0.32
Percent companies with A or A- rating	0.44	0.49	0.42	0.49	0.47	0.50*	0.41	0.49
Percent companies with B+ or B rating	0.26	0.44	0.32	0.46	0.20	0.33***	0.40	0.47
Efficiency scores								
Cost efficiency	0.17	0.14	0.15	0.15	0.17	0.17***	0.15	0.15
Technical efficiency	0.30	0.24*	0.27	0.23	0.28	0.23	0.27	0.23
Allocative efficiency	0.56	0.17	0.55	0.17	0.59	0.21***	0.55	0.17
Pure Technical efficiency	0.37	0.27	0.35	0.27	0.38	0.31*	0.35	0.26
Scale efficiency	0.80	0.20	0.77	0.24	0.81	0.22***	0.77	0.25
Revenue efficiency	0.05	0.09*	0.05	0.09	0.05	0.08	0.05	0.09
Malmquist Indices								
Observations								
Technical efficiency change	8.62	75.01***	1.86	4.50	1.73	5.10	2.74	26.90
Technical change	1.43	0.72	1.50	0.69	1.55	0.74	1.48	0.69
Total factor productivity change	7.04	52.73***	2.32	5.38	2.19	6.38	2.94	19.29

*** Significant at 10% level; ** Significant at 5% level; * Significant at 10% level

Table 4a
Regression Models of Changes in Efficiency for Acquirers and Non-Acquirers

	Malmquist Indices, 5 year window			Efficiency change, 5 year window					
	TEM	Tech	TFP	CE	TE	AE	PTE	SE	RE
Intercept	-0.694	1.589	-0.274	-0.034	0.004	0.436	0.297	0.252	-0.008
	(3.618)	(0.022)***	(2.615)	(0.017)**	(0.027)	(0.021	(0.033)***	(0.027)***	(0.011)
Acquirer coy dummy	-1.057	0.058	-0.874	0.024	0.009	0.058	0.043	0.011	0.000
	(1.842)	(0.052)	(1.331)	(0.024)***	(0.014)	(0.010)	(0.017)***	(0.014)	(0.006)
Ln(assets)	0.584	-0.016	0.501	0.032	0.047	0.018	0.021	0.071	0.009
	(0.426)	(0.012)	(0.308)*	(0.012)***	(0.003)***	(0.002)***	(0.021)***	(0.033)***	(0.001)***
Mutual	-0.535	-0.015	-0.456	0.001	-0.002	0.004	-0.012	0.013	0.003
	(1.368)	(0.039)	(0.989)	(0.001)	(0.011)	(0.008)	(0.013)	(0.010)	(0.004)
UK dummy	-0.504	0.075	-0.065	-0.053	-0.039	-0.154	-0.058	0.005	-0.004
	(1.721)	(0.049)	(1.244)	(-0.053)***	(0.013)***	(0.010)***	(0.016)***	(0.013)	(0.005)
Line of Bus dummy	-0.667	0.003	-0.313	-0.047	-0.082	0.012	-0.109	0.008	-0.005
	(-0.667)	(0.031)	(0.786)	(-0.047)***	(0.008)	(0.006)*	(0.010)**	(0.008)	(0.003)
Premium/surplus ratio	-0.002	0.000	-0.006	0.000	0.000	0.000	0.000	0.000	0.000
	(-0.002)	(0.000)	(0.012)	(0.000)	(0.000)	(0.000)***	(0.000)	(0.000)	(0.000)
AdjustedR^2	0.002	0.006	0.004	0.274	0.238	0.198	0.127	0.262	0.036
No. of obs.	1316	1316	1316	1316	1316	1316	1316	1316	1316

Note: The dependent variable in the equations is TEM = Technical efficiency change, Tech = Technical change. TFP = total factor productivity change, KE(t) = efficiency of type K in year t, K = C = cost efficiency; K = A = allocative efficiency; K = T = technical efficiency; K = PT = pure technical efficiency; K = S = scale efficiency; and K = R = revenue efficiency. Standard errors are presented below the estimated coefficients.

***Significant at 1% level

** Significant at 5% level

* Significant at 10% level

Table 4b
Regression Models of Changes in Efficiency for Targets and Non-Targets

	Malmquist Indices, 5 year window			Efficiency change, 5 year window					
	TEM	Tech	TFP	CE	TE	AE	PTE	SE	RE
Intercept	-1.011	1.582	-0.474	-0.038	0.002	0.436	0.289	0.251	-0.009
	(3.596)	(0.102)***	(2.599)	(0.017)**	(0.027)	(0.021)***	(0.033)***	(0.027)	(0.011)
Target coy dummy	6.734	-0.045	-0.443	-0.010	0.004	0.058	0.005	-0.008	0.008
	(2.261)**	(0.065)	(1.634)	(0.011)	(0.017)	(0.013)***	(0.021)	(0.017	(0.007)
Ln(assets)	0.506	-0.014	-0.707	0.033	0.047	0.018	0.023	0.071	0.009
	(0.420)	(0.012)	(0.304)	(0.002)***	(0.003)***	(0.002)***	(0.021)	(0.003	(0.001)***
Mutual	-0.887	-0.011	0.378	0.002	-0.002	0.004	-0.011	0.014	0.002
	(1.367)	(0.039)	(0.988)	(0.007)	(0.011)	(0.007)	(0.013	(0.011	(0.004)
UK dummy	0.163	0.080	0.378	-0.050	-0.036	-0.154	-0.049	0.006	-0.002
	(1.705)	(0.048)	(1.232)	(0.008)***	(0.013)***	(0.015)**	(0.016	(0.013)	(0.005)
Line of Bus dummy	-0.773	0.007	-0.395	-0.045	-0.081	0.012	-0.106	0.009	-0.005
	(1.079)	(0.031)	(0.780)	(0.005)***	(0.008)**	(0.006)*	(0.010	(0.008)	(0.003)
Premium/surplus ratio	-0.001	0.000	-0.006	0.000	0.000	0.000	0.000	0.000	0.000
	(0.016)	(0.000)	(0.012)	(0.000)	(0.000)	(0.000)***	(0.000)	(0.000)	(0.000)
AdjustedR^2	0.005	0.006	0.005	0.270	0.238	0.198	0.124	0.262	0.036
No. of obs.	1316	1316	1316	1316	1316	1316	1316	1316	1316

Note: The dependent variable in the equations is TEM = Technical efficiency change, Tech = Technical change. TFP = total factor productivity change, KE(t) = efficiency of type K in year t, K = C = cost efficiency; K = A = allocative efficiency; K = T = technical efficiency; K = PT = pure technical efficiency; K = S = scale efficiency; and K = R = revenue efficiency. Standard errors are presented below the estimated coefficients.

***Significant at 1% level

** Significant at 5% level

* Significant at 10% level

Table 5a
Probit Models of the Probability of Being an Acquirer in year t

	Efficiency variable				
	CE	TE	PTE	AE	RE
NDRS (non-decreasing returns to scale) dummy	0.329	0.313	0.385	0.394	0.384
	0.192	0.193	0.190**	0.190**	0.190**
Pct changes in premiums	0.000	0.000	0.000	0.000	0.000
	0.001***	0.000***	0.000***	0.000***	0.000***
$Efficiency_{t-1}$	2.111	0.935	0.803	1.976	0.635
	0.547	0.391**	0.286***	0.438***	0.757
$Capital_{t-1}/assets_{t-1}$	2.286	2.082	1.920	1.371	1.528
	0.875***	0.884**	0.857**	0.883	0.861
Liquidity $ratio_{t-1}$	0.038	0.084	0.060	0.099	0.080
	0.465	0.424	0.431	0.457	0.411
Mutual status	0.296	0.302	0.301	0.287	0.285
	0.138	0.138**	0.137**	0.135**	0.137**
Unaffiliated	-0.516	-0.532	-0.515	-0.508	-0.535
	0.200***	0.199***	0.199***	0.200***	0.199***
Net income/premium $ratio_{t-1}$	-0.255	-0.224	-0.217	-0.098	-0.115
	0.144	0.145	0.141	0.131	0.131
Loss reserve/premium $ratio_{t-1}$	-0.008	-0.012	-0.015	0.000	-0.009
	0.015	0.016*	0.016	0.014	0.015
Equity investments	0.003	0.004	0.003	0.003	0.003
	0.003	0.003	0.003	0.003	0.003
$Ln(assets_{t-1})$	-0.001	0.017	0.058	0.024	0.040
	0.061	0.061***	0.060	0.060	0.059
Business class dummy	0.262	0.271	0.308	0.211	0.233
	0.109***	0.108***	0.110***	0.110**	0.109***
UK dummy	1.167	1.104	1.126	1.403	1.077
	0.167***	0.165***	0.166***	0.183***	0.164***
Intercept	-3.018	-3.068	-3.388	-3.932	-2.933
	0.476***	0.478***	0.503***	0.529	0.473
Log-likelihood	1393.5	1407.9	1405.9	1392.89	1412.95

Note: Standard errors are presented below the estimated coefficients

***Significant at the 1% level
** Significant at the 5% level
*Significant at the 1% level

Table 5b
Probit Models of the Probability of being a Target in year t

	Efficiency variable				
	CE	TE	PTE	AE	RE
NDRS (non-decreasing returns to scale) dummy	-0.354	-0.309	-0.284	-0.319	-0.309
	0.284	0.276	0.272	0.274	0.274
Pct changes in premiums	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
$Efficiency_{t-1}$	-0.764	0.294	0.035	-1.464	1.179
	0.813	0.548	0.400	0.547***	0.919
$Capital_{t-1}/assets_{t-1}$	-5.180	-4.349	-4.551	-4.168	-4.300
	1.360***	1.349***	1.317***	1.268***	1.294***
Liquidity $ratio_{t-1}$	-0.200	-0.154	-0.159	-0.213	-0.157
	10.484	0.464	0.463	0.454	0.467
Mutual status	0.410	0.478	0.477	0.500	0.465
	0.183**	0.193**	0.193**	0.198**	0.192***
Unaffiliated	-0.068	-0.146	-0.146	-0.186	-0.142
	0.269	0.269	0.269	0.270	0.269
Net $income/premium\ ratio_{t-1}$	-0.295	-0.460	-0.399	-0.331	-0.444
	0.246	0.258*	0.241*	0.217*	0.225**
Loss $reserve/premium\ ratio_{t-1}$	0.006	-0.012	-0.008	-0.022	-0.013
	0.047	0.048	0.049	0.049	0.048
Equity investments	-0.010	-0.010	-0.010	-0.010	-0.010
	0.004**	0.004**	0.004**	0.004	0.004**
$Ln(assets_{t-1})$	0.039	0.033	0.041	0.071	0.043
	0.076	0.075	0.075	0.075**	0.074
Business class dummy	0.036	0.090	0.087	0.144	0.096
	0.145	0.142	0.144	0.144	0.142
UK dummy	-19.214	-19.232	-19.201	-19.352	-19.225
	2073.6	2061.3	2068.81	2072.41	2062.1
Intercept	-1.518	-1.550	-1.538	-1.020	-1.610
	0.582***	0.586***	0.624	0.615	0.587
Log-likelihood	969.54	984.1	984.91	977.12	982.92

Note: Standard errors are presented below the estimated coefficients

***Significant at the 1% level
** Significant at the 5% level
*Significant at the 1% level

Appendix A. Input and Output Definitions and Measures

Study	*Input type*	*Input volume*	*Price of inputs*	*Output volume*	*Lines of insurance*	*Price of outputs*
Yuengert (1993)	Labor Physical capital		Avg. yearly pay by state of home office Avg. replacement cost of non-residential capital in home office state	Reserves Additions to reserves	Accident and health Individual life Group life Individual annuity Group annuity Deposit funds Other	
Berger, et al. (1997)	Labor Business services (Fixed Netputs: Debt capital (including policyholder funds) Equity capital)	Labor expense/input price All non-labor expense/input price Real loss reserves and unearned prem. reserves Real equity capital	Real premium weighted state avg. weekly wages - wage index SIC 6331. Real premium weighted state avg. weekly wages – wage index SIC7399 - business services.	Total real invested assets PV of real losses incurred	- Short-tail personal Short-tail commercial Long-tail personal Long-tail commercial	Portfolio share-weighted average of expected returns on stocks and bonds $p_i=(PREM_i-PV(L_i))/PV(L_i)$ where $PREM_i$ is the real premium for output category i, L_i is the real losses for output category i.
Hardwick (1997)	Labor Financial capital		Avg. gross weekly earnings of full-time non-manual workers in the ins. sector. Long-term interest rate + annual depreciation rate in the life ins. industry - the expected annual rate of capital gain.	Real premium income	Life Pension and annuity Permanent health	
Cummins and Zi (1998)	Labor Financial capital Materials	Total labor expense/input price Real equity capital All non labor expense/input price	Real premium weighted avg. weekly wages for employees and agents in the life sector (SIC6311). 3-year avg. net income/ equity capital. Divisia index of the deflators for the components	Real additions to reserves Real incurred benefits	- Ordinary life Group life Individual annuity Group annuity Accident and health	

			representing the major non-labor inputs purchased by insurers			
Cummins (1999)	Home office labor Agent labor Business services Financial capital	Real home office labor expenditures/input price Real agent labor expenditures/input price Real business services expenditures/input price Real equity capital	Real avg. weekly wages SIC 6311, life insurance, home office. Real premium weighted state avg. weekly wages SIC 6411, insurance agents. Real avg. weekly wages SIC 7300, business services. Based on the equity cost of capital for traded life insurers (3- tiers based on financial ratings).	Incurred benefits + additions to reserves	Individual life Individual annuity Group life Group annuity Accident and health.	Price for each line: Price=(Premiums+Investment Income-Incurred Benefits-Additions to Reserves)/Incurred Benefits+Additions to Reserves
Cummins, et al. (1999)	Labor Business services Debt capital Equity capital	Labor costs/input price All non labor expense/input price Real loss reserves and unearned premium reserves Real equity capital	Real avg. weekly wages SIC 6331, Fire, Marine, and Casualty Insurers Real avg. weekly wages SIC 7399, business services Total expected investment income-investment income attributed to equity capital /avg. debt capital Expected net income/ avg. equity capital.	Real invested assets PV of real losses incurred	 Short-tail personal Short-tail commercial Long-tail personal Long-tail commercial	
Berger, at al. (2000)	Labor Business services (Fixed Netputs:		Real labor price indices for wages for life (SIC 6311) and	Invested assets PV of real losses incurred	 Personal P-L Commercial P-L	

	Reserves Equity capital)		P-L (SIC 6311). Real business services price index.	Incurred benefits	Personal life Commercial life	
Mahlberg and Url (2000)	Expenditures on labor+material+ energy+depreciation+ marketing+ commissions+etc.			Claims+ net changes in technical provisions+ allocated investment returns+ bonuses+ returned premium.	Life Health P-L	
Ryan and Schellhorn (2000)	Labor Financial capital Materials		Weighted avg. of the price of adm. labor (avg. weekly wage SIC6311) and the price of agent labor (avg. weekly wage in SIC6411) 3-year average of the rate of return on capital (avg. income/ sum of equity and borrowed funds) Weighted avg. of component price indices for eleven items identified by Cummins and Zi (1997).	Real additions-to-reserves Real incurred benefit payments	 Individual life Group life Individual annuity Group annuity Accident and health	
Fuentes, et al. (2001)	Labor Composite input	Wage bill and commissions paid to intermediaries Total of various outlays such as capital consumption and the purchase of		Total annual premiums	Health Life Non-life	

		supplies and equipment				
Noulas, et al. (2001)	Sum of payments to the insured and expenses incurred in the production of services Salaries and expenses			Revenue from insurance related activities (premium income) Revenue from investment activities		
Cummins and Rubio-Misas (2001)	Labor Business services Debt capital Equity capital	Labor expenditures/input price Business services expenses/input price Real debt capital Real equity capital	Avg. monthly wage for employees in the insurance sector Spanish business services deflator One-year Spanish Treasury bill rate Rate of total return on the Madrid Stock Exchange Index	Real losses incurred Real reserves Real invested assets	Life Non-life Reinsurance Primary insurance	
Cummins and Nini (2002)	Labor Materials and business services Financial capital	Total labor expenditures/input price Total expenses incurred less all labor costs/ input price Real statutory policyholder surplus augmented by reserves required by statutory (regulatory) accounting but not recognized by GAAP	Weighted avg. of prices of the administrative labor (SIC6331) and agent labor (SIC6411) National price index for business services 90 day T-bill rate at the end of the preceding year plus the long-term market risk premium on large firm stocks	PV of real losses incurred Avg. real invested assets	Personal short-tail Personal long-tail Commercial short-tail Commercial long-tail	$p_i=(PREM_i-PV(L_i))/PV(L_i)$ where $PREM_i$ is the real premium for output category i, L_i is the real losses for output category i. Portfolio share-weighted average of the actual rate of return on debt components (Actual investment income/holdings of debt instruments), and expected rate of return on stocks (90-day T-bill rate at the end of the preceding year plus the long-term average market risk premium on large company stocks)
Ward (2002)	Labor Capital		Real avg. gross weekly earnings of a nonmanual worker in	Real claims+ additions to reserves	Life Pension PHI	

			the ins. industry Risk adjusted rate of capital			
Diacon, et al. (2002)	Total operating expenses net of reinsurance commissions Total capital Total technical reserves Total borrowings from creditors			Net earned premiums less rebates and refunds Total investment income net of investment expenses and charges	General insurance L-T	
Worthinghton and Hurley (2002)	Labor Information technology Physical capital Financial capital	Sum of expenses on commissions on premiums, salaries, wages and benefits and management fees Sum of expenses on computers and computer software Expenses on furniture, fittings, furniture and equipment Borrowing expense	Avg. gross weekly earnings of all persons employed in the finance and insurance industry Prime cost depreciation rate over 5 years for computers Prime cost depreciation rate over 15 years Long-term rate of return on Australian equity	Invested assets Net premium income	Housing-related Transport-related Indemnity-related Mortgage-related Other	
Hardwick, et al. (2003)	Labor Capital	Number of full-time equivalent employees Total capital expenses/price of capital	Avg. wage rate in 'banking, finance, insurance, business services and leasing' in the UK region where the company's main office is located Cost per square meter of office space in the UK region, city or town where the company's main office is located	Additions to reserves Incurred benefits	Life Pensions Permanent health and other policies	
Ennsfellner, et al. (2004)	Net operating expenses			Claims incurred net of	Non-life	

	Equity capital Technical provisions net of reinsurance			reinsurance, Total invested assets Incurred benefits net of reinsurance Changes in reserves net of reinsurance Total invested assets	Life and Health	
Klumpes (2004)	Home office labor Agent labor Business services Financial capital.		Price= (Premiums + investment income - output for the line)/output.	Claims	Standard business line Individual life and savings plans Endowment policies Pension policies Real invested assets	
Brockett, et al. (2004)	Surplus previous year Change in capital and surplus Underwriting and investment expenses Real policyholders supplied debt capital	Total of capital and unassigned funds Net income+ net realized capital gain or loss+change in excess of statutory reserve over statement reserves, etc. Unpaid net losses+ unpaid loss adjustment expenses+ unearned premium reserves		Rate of return on investments Liquid assets to liabilities Solvency score	Net investment income/avg. of cash and invested assets for current and prior year Cash and short term investments in securities/ probable future sacrifices of economic benefits A single scalar measure estimating the prob. that a company will remain solvent (Produced by a neural network model by Brockett et al. (1994))	