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Consolidation and Efficiency in the U.S. Life Insurance Industry

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Consolidation and Efficiency in the U.S. Life Insurance Industry [1]

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Abstract: This paper examines the relationship between mergers and acquisitions, efficiency, and scale economies in the US life insurance industry. We estimate cost and revenue efficiency over the period 1988-1995 using data envelopment analysis (DEA). The Malmquist methodology is used to measure changes in efficiency over time. We find that acquired firms achieve greater efficiency gains than firms that have not been involved in mergers or acquisitions. Firms operating with non-decreasing returns to scale and financially vulnerable firms are more likely to be acquisition targets. Overall, mergers and acquisitions in the life insurance industry have had a beneficial effect on efficiency.

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Key Words: Efficiency, life insurance, mergers and acquisitions, scale economies, data envelopment analysis.

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During the past decade, the U.S. life insurance industry has experienced an unprecedented wave of mergers and acquisitions. Traditionally, the industry has been known for its high-cost distribution system and lack of price competition, but insurers are increasingly faced with more intensive competition from non-traditional sources such as banks, mutual funds, and investment advisory firms. These non-traditional competitors have captured a major share of the market for asset accumulation products such as annuities and cash value life insurance.[1] The increased competition has narrowed profit margins and motivated insurers to seek ways to reduce costs. The more stringent solvency standards implemented under the risk-based capital system adopted in 1993 also have put pressure on insurers to strengthen their financial statements. Technological advances in sales, pricing, underwriting, and policyholder services have forced insurers to become more innovative; and the relatively high fixed costs of the new systems may have affected the minimum efficient scale in the industry.

These developments suggest that scale economies and potential efficiency gains may provide a major motivation for the recent mergers and acquisitions in the insurance industry. Indeed, insurers often cite efficiency and scale economies in justifying mergers and acquisitions to regulators.[2] Thus, an important issue in insurance industry consolidation is whether mergers and acquisitions actually succeed in improving efficiency. We investigate this issue by measuring several types of efficiency in the U.S. life insurance industry over the period 1988-1995, using data envelopment analysis (DEA). Malmquist indices are used to measure changes in efficiency and productivity over time. Our analysis focuses primarily on acquisition targets: We compare the efficiency of targets of mergers and acquisitions with firms that have not been targets of consolidation activity.[3]

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[1]The Glass-Steagall Act prevents banks from entering the insurance business as underwriters, but banks can sell annuity and insurance products manufactured by an unaffiliated insurance company.

[2]Discussions of consolidation in the financial press also invariably mention scale economies and efficiency gains as motivating factors in insurer mergers and acquisitions (e.g., Lonkevich, 1995).

[3]We also present a brief analysis of acquiring firms. We place less emphasis on acquiring firms because a significant number of acquirers are not insurance companies and hence do not appear in our data base.

In spite of the magnitude and importance of the consolidation trend in the life insurance industry, ours is the first paper to investigate the effects of life insurer mergers and acquisitions on efficiency. There have been several prior papers on the efficiency of U.S. life insurers, mostly focusing on scale economies (e.g., Grace and Timme, 1992, Yuengert, 1993, Gardner and Grace, 1993, and Cummins and Zi, 1998). These studies tend to find evidence of significant scale economies in the industry, although larger firms generally are found to exhibit decreasing returns to scale. There have been only a few prior papers on mergers and acquisitions in the U.S. insurance industry (BarNiv and Hathorn, 1997; Chamberlain and Tennyson, 1997; Meador, Madden and Johnston, 1986). These papers examine mergers in the property-liability insurance industry and do not consider efficiency effects.

The paper proceeds as follows. Section 2 discusses various motivations for mergers and acquisitions, and specifies the hypotheses to be investigated in this paper. Section 3 presents an empirical overview of concentration trends in the life insurance industry. Section 4 discusses our procedures for identifying life insurance acquisitions and presents summary statistics on mergers and acquisitions in the industry. Our data base and methodology for the efficiency analysis are discussed in section 5. Section 6 presents our estimates of efficiency and scale economies, and section 7 concludes.

2. Hypothesis Formulation

Mergers and acquisitions may be motivated by opportunities to improve firm operating performance; in such circumstances a merger or acquisition may be expected to enhance the efficiency of the target firm and/or the combined post-merger entity. In this paper, we investigate both cost and revenue efficiency. Cost efficiency for a given firm is defined as the ratio of the costs of a fully efficient firm with the same output quantities and input prices (i.e., a firm operating on the efficient cost frontier) to the given firm's actual costs. Cost efficiency varies between zero and 1, with fully efficient firms having cost efficiency equal to 1. Firms achieve cost efficiency by adopting the best practice technology (becoming *technologically* efficient) and by adopting the cost-minimizing mix of inputs (becoming *allocatively* efficient). Revenue efficiency is defined as the ratio of a given firm's revenues to the revenues of a fully efficient firm with the same input quantities and output prices. Fully efficient firms have revenue efficiency equal to 1 while inefficient firms have revenue efficiency less than 1. Revenue efficiency is attained by using the best practice technology and choosing the optimal mix of outputs.

There are a number of reasons to believe that mergers and acquisitions can permit insurance firms to operate more efficiently. 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, following a merger or acquisition. In addition, even relatively efficient firms may experience efficiency gains from affiliating with others. The predominant organizational model in the insurance industry is the insurance group, consisting of several insurers under common ownership. Although members of groups often operate 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 of these operations over a broader base has the potential to improve cost efficiency. Revenue efficiency may be improved as well if consolidation facilitates cross-selling, improves customer satisfaction, and otherwise enhances the firm's ability to produce revenues. Accordingly, we hypothesize that the efficiency of target firms will tend to increase following an acquisition.

Another rationale for mergers and acquisitions – earnings diversification – may provide a particularly strong motivation for mergers in the insurance industry. 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 the 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.

Opportunities for post-merger performance improvements may be greater in firms that are currently relatively inefficient, and thus M&A activity may involve relatively efficient insurers taking over and reforming inefficient firms. This reasoning would imply that life insurance targets should exhibit lower efficiency prior to their acquisition, and/or that less efficient firms should be more likely to be acquired. On the other hand, during our sample period, the life insurance market was undergoing significant changes that offered opportunities for aggressive insurers to gain market share, potentially both reducing costs and enhancing revenues. The changes in marketing systems and technology have been especially dramatic (Carr, 1997). In this type of environment, firms that possess leading-edge competencies in the areas most subject to change may be viewed as attractive acquisition targets. Thus, 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 the rationale for mergers and acquisitions. Under this motive, firms operating with non-decreasing (constant or increasing) returns to scale 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. Another objective frequently given for mergers and acquisitions is to increase market share in a firm's core lines of business or to diversify into new product markets or geographical regions. Under this objective as well, firms characterized by non-decreasing returns to scale would seem to be more attractive as merger or acquisition partners because future growth is less likely to lead to scale diseconomies. Thus, we hypothesize that acquisition targets are more likely than firms not engaging in merger or acquisition activity (non-M&A firms) to be characterized by non-decreasing returns to scale.[4]

We also hypothesize that unaffiliated single companies are less likely to be acquired than members of insurance groups, due to managerial self interest. The managers of an unaffiliated company face an uncertain future if their firm is acquired by another firm and, as a result, are likely to be resistant to takeover offers. Managers of insurance groups, on the other hand, are more likely to view the purchase and

[4]Although not analyzed here, similar reasoning suggests acquiring firms should tend to display either increasing or constant returns to scale. An acquisition offers the opportunity for a firm with increasing returns to scale to attain constant returns to scale more quickly than by normal sales growth. A firm that is already too large (operating with decreasing returns to scale) would not seem to have much to gain from acquisitions, at least from a cost perspective.

sale of companies as important components of their strategic arsenal and as potentially enhancing rather than threatening their personal economic value. Although group managers do have to confront the risk that a purchase or sale may turn out to be unprofitable, this risk to their job security is likely to be much less than the threat that a buy-out poses to managers of an unaffiliated firm.

Insurer mergers and acquisitions also may be motivated by regulatory considerations. Insurers are regulated at the state level, with coordination provided by the National Association of Insurance Commissioners (NAIC). In response to a sharp increase in insolvencies during the 1980s, the NAIC adopted a risk-based capital (RBC) system in 1993 designed to raise capital standards in the industry.

Although many insurers restructured their asset portfolios and made other changes to improve their risk-based capital ratios, the weaker insurers in the industry still face the prospect of having to raise additional equity capital to avoid incurring significant regulatory costs.[5] Raising capital is problematical 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. Moreover, information asymmetries with respect to the quality of the insurer's assets and the accuracy of its reserve estimates may raise the costs of external capital and thus make raising new capital unattractive to many insurers (Chamberlain and Tennyson, 1997). If information asymmetries between acquiring firms and targets are less than between target insurers and the capital markets, 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 favorable returns to scale. Thus, we hypothesize that target firms are likely to display one or more signs of financial vulnerability.

3. Life Insurance Industry Structure

This section provides a brief statistical overview of the structure of the life insurance industry to

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[5]The risk-based capital ratio is the ratio of an insurer's equity capital to its risk-based capital, which is determined by the characteristics of the insurer's asset and liability portfolios. Insurers with risk-based capital ratios below 200 percent receive additional regulatory scrutiny. Regulators are required to take control of companies with risk-based capital ratios below 70 percent.

provide the backdrop for the merger analysis. Consolidation in insurance has taken a different form from that occurring in banking. While consolidation in banking has resulted in the removal of thousands of banks from the market (Amel, 1996), the number of insurers has remained relatively constant. The reason for the difference is that branching and interstate banking restrictions prevented many banks from expanding outside their local areas, whereas the insurance industry has not faced such restrictions. Thus, the insurance market has had greater opportunity to converge to an efficient equilibrium with regard to the number and geographical scope of firms, resulting in a market dominated by firms that operate nationally or regionally.

The numbers of insurers with meaningful data reporting to the NAIC during the period 1988 through 1995 are shown in Table 1. During our sample period the number of companies with a group affiliation remained relatively constant at about 900 (groups control more than 90 percent of industry assets). The number of unaffiliated single companies declined by about 10 percent over the period, from 334 to 303. 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 that 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 life insurance industry primarily tends to involve such strategic objectives as an increased emphasis on core competencies or the expansion into new markets rather than the consolidation of geographically concentrated firms as in banking (Carr, 1997).

There are five major lines of business in the life insurance industry – individual life, individual annuities, group life, group annuities, and accident and health. The most important lines of business in terms of both revenues and profits are those involving asset accumulation products, i.e., individual life and individual and group annuities. Individual life insurance accounted for 24.6 percent of premium revenues in 1995, whereas individual and group annuities accounted for 21.6 and 23.6 percent, respectively. Group life and accident and health insurance, which are mainly indemnity rather than asset accumulation products, account for the remaining 30.2 percent of revenues. The importance of asset accumulation products is particularly noteworthy because this is the market where insurers face the most vigorous competition from banks, mutual fund companies, and investment advisory firms. Because these non-traditional competitors have much lower distribution costs than insurers, insurers face intense pressure to operate more efficiently in order to remain competitive in the asset accumulation market.

Concentration trends in the industry are shown in Figure 1, which presents the Herfindahl indices by line of business over the sample period, based on premium volume. The indices are calculated by decision making unit, i.e., the market share proportions used to construct the indices are for groups and unaffiliated single companies. Consistent with the view that restructuring in the insurance industry primarily involves strategic realignment rather than changes in concentration, the Herfindahl indices are relatively constant over the sample period for the industry as a whole and for all lines except group life and group annuities. Concentration in group life insurance increased significantly over the sample period, consistent with a drive for scale economies. Group life insurance is a highly competitive market with knowledgeable, cost conscious buyers (business firms), many of whom have the alternative of self insuring. Group life insurers thus compete in terms of the efficiency with which they can administer programs for the buyers, resulting in very low expense ratios and profit margins. Being able to spread the fixed costs of operating in the group life insurance business over a broader customer base thus is likely to be a major competitive advantage in this market. In the group annuity market, on the other hand, concentration decreased significantly over the sample period as non-traditional competitors captured market share from the large insurers that traditionally dominated this market.

Four, eight, and twenty-firm concentration ratios for industry assets and premiums are presented in Table 2. The four-firm concentration ratios for assets declined significantly over the sample period, reflecting a loss of market share by the mega-insurers that traditionally have dominated the industry. Although there are undoubtedly a number of factors that have driven this decline, it is consistent with the findings by Yuengert (1993) and Cummins and Zi (1998) that firms in this size class are characterized by decreasing returns to scale and thus likely to offer relatively unattractive policyholder investment yields.

4. Sample Selection

Because there is no single authoritative source for information on mergers and acquisitions in the insurance industry, we consulted a number of different sources to estimate the number of such transactions that occurred during our sample period. The sources we utilized were *Mergers and Acquisitions* magazine, which reports merger transactions across all industries; *Best's Review's,* which provides annual summaries of all mergers, entries, and exits in the insurance industry; and *Best's Insurance Reports*, which reports the composition of life insurance groups. We used this latter source to compile a list of all changes in groups and group composition over our sample period; we then investigated each of these changes to identify those arising from mergers and acquisitions. Finally, we cross-checked our lists of transactions against the list of mergers and acquisitions compiled by Conning and Company, an insurance industry consulting firm. The final list of transactions used in our study represents the union of the transactions reported in the four sources, after screening to remove reported transactions that did not satisfy our sample selection criteria, discussed below.

To focus our study on transactions that involve a change in ownership of an insurance firm, we include in our database only complete acquisitions and acquisitions of a majority interest that were characterized by *Best's Insurance Reports* as resulting in a change in control. We excluded acquisitions of a minority interest and acquisitions of lines of business from our set of transactions. We also excluded all transactions which represented the internal restructuring of an existing insurance group. All potential transactions identified from the above list of sources were then further investigated in the company discussions in the relevant issues of *Best's Insurance Reports;* those transactions which could not be verified in this source were also excluded from our sample.

We initially identified 317 firms that were targets of mergers and acquisitions during the period

1989-1994.[6] The largest number of events involved the purchase of a single company by another company or by a group, where the acquired company continued to operate as a distinct entity after the acquisition. On average, about 25 such targets were involved in acquisitions in each year during the sample period (1989-1994). The number of merger targets we identified, i.e., cases where a company was absorbed by another company, averaged about 7 per year. The number of cases where an entire group is acquired, usually by another group, averaged 8.5 per year. A few companies were involved in more than one transaction during the sample period, for example by being purchased by one group and then later sold to another.

Testing hypotheses regarding the cost and revenue efficiency of firms that were targets of mergers and acquisitions necessitates imposing some further selection criteria. This analysis requires a sample of firms for which reported financial data are a meaningful representation of firm production activities and for which we can isolate the effects of acquisition. Accordingly, we omit from the sample any target firm that was a shell company, in run-off or inactive prior to the acquisition.[7] In addition, we include only those target firms for which there is a two year time horizon, both prior to and following their acquisition, in which they are free of other mergers and acquisitions activity. Activities that led to omission from the sample on this criterion included mergers or acquisitions of other companies (affiliated or unaffiliated), acquisitions of lines of business, a second acquisition of the target, or the acquisition of the target's parent company. Also excluded from the sample were firms that were merged, retired or put into run-off or liquidation at acquisition or within two years thereafter.

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[6]The numbers of firms that were targets for mergers and acquisitions by year were 43, 57, 48, 51, 52, and 66, for the years 1989 through 1994, respectively. This list of target firms does not include those that were found to be internal restructurings of a group or acquisitions of foreign firms.

[7]Because insurers must obtain a license from each state in which they operate, the regulatory costs of starting a new insurer or expanding into new states can be significant. Accordingly, even insurers with no assets or premiums are valuable for their licenses, creating a market in corporate insurance shells. Because the focus of the study is on the acquisition of viable operating entities, shell insurers were omitted from our sample.

These sample selection criteria resulted in a sample size of 137 acquired firms for our primary analysis, of which efficiency scores could be estimated for 106.[8] We were unable to estimate efficiencies for some firms because they do not appear in our data base for one or more years or because they exhibited unusual values for some key variables, such as negative premiums or negative net worth. These problems are symptomatic of firms that are experiencing financial difficulties or firms that were placed in runoff or liquidation but were not identified as such in our earlier screens. We believe our thorough analysis of the characteristics of the mergers and acquisitions in the insurance industry has resulted in a well-defined sample consisting of nearly all acquired firms that continued to operate as viable decision making units following the acquisition.

5. Data and Methodology

This section briefly describes our data base and discusses the measurement of the inputs, outputs, input prices, and output prices used in our analysis. The section concludes with a discussion of the data envelopment analysis (DEA) and Malmquist methodologies used in our analysis.

The Data

The data used in our study are drawn from the regulatory annual statements filed by insurers with the National Association of Insurance Commissioners (NAIC). Because all insurers of any significant size are required to report to the NAIC, our data base initially consisted of virtually the entire industry. We eliminated firms with unusual characteristics such as zero or negative net worth, premiums, or inputs. We also eliminated firms with extreme or unusual financial ratios such as returns on equity greater or less than 100 percent because such firms are clearly experiencing financial difficulties. The final sample used to estimate efficiency consists of approximately 750 firms per year, representing about 80 percent of industry

[8]Of the 317 M&A targets identified from our examination of *Mergers and Acquisitions, Best's,* and the Conning and Company reports, 59 were eliminated from the sample because they were inactive companies, shell companies, or in runoff when acquired; 68 were eliminated because they were merged or retired within two years after the acquisition; 45 were eliminated because they were involved in one or more additional M&A transactions within two years before or two years after the transaction; and 8 were eliminated because the transaction could not be verified in *Best's Insurance Reports.*

assets. Because the Malmquist analysis requires that firms be present in each year of several overlapping blocks of five contiguous years, the sample size in the Malmquist estimation is smaller, consisting of about 550 companies per five year block. Output prices were also calculated using NAIC data, while data to calculate input prices were obtained from governmental sources (see below).

Outputs and Inputs

This section briefly discusses several measurement issues in constructing the data set. We first describe the process for choosing the services to measure as outputs in life insurance and explain how we measure outputs and output prices. We next turn to a discussion of input quantities and the input prices.

Outputs and Output Prices. Consistent with most of the recent financial institutions literature, we measure output using a modified version of the value-added approach, which counts as outputs activities that have significant value added, as judged using operating cost allocations (see Berger and Humphrey 1992b). Life insurers provide three principal services:

- **Financial Intermediation.** As discussed above, asset accumulation products account for about 70 percent of revenues in the industry. Insurers issue insurance and annuity contracts and invest in traded securities as well as assets that are not available to most investors, such as privately placed bonds and structured securities. Insurers' principal source of value added is reflected in the net interest margin between the rate of return earned on invested assets and the rate credited to policyholders.

- **Risk-pooling and risk-bearing.** Insurance provides a mechanism through which consumers and businesses exposed to losses can engage in risk reduction through pooling. In life insurance the principal risks are the risk of death (life insurance), the risk of longevity (annuities), and risk of loss from accidents or illness (accident and health insurance). The actuarial, underwriting, and related expenses incurred in risk pooling are important components of value added in the industry. Insurers also add value by holding equity capital to bear the residual risk of the pool.

- **"Real" financial services relating to insured losses.** Insurers provide a variety of real services for policyholders including personal financial planning and the administration of group life, annuity, and health insurance plans. By contracting with insurers to provide these services, policyholders can take advantage of insurers' specialized expertise in managing insurable risks.

We follow Yuengert (1993) in using incurred benefits plus additions to reserves to measure life insurance output.[9] Incurred benefits represent payments received by policyholders in the current year and are useful proxies for the risk-pooling and risk-bearing functions because they measure the amount of funds pooled by insurers and redistributed to policyholders as compensation for insured events.

Most life insurance and annuity products involve the accumulation of assets, either to pay future death benefits or to be received as income through an annuity. The funds received by insurers that are not needed for benefit payments and expenses are added to policyholder reserves, which are analogous to bank deposits. The funds backing the reserves are invested by insurers in financial instruments. Additions to reserve thus should be highly correlated with the intermediation output. Both incurred benefits and additions to reserves are correlated with real services provided by insurers, such as benefit administration in the case of group insurance and financial planning in the case of retail products.

Because the major lines of insurance differ in the types of contingent events that are covered and in the relative importance of the risk-pooling, intermediation, and real service components of output, we define five output variables, equal to the sum of incurred benefits and additions to reserves for the five major lines of business offered by life insurers – individual life insurance, individual annuities, group life insurance, group annuities, and accident and health insurance. All outputs are expressed in real terms by deflating to 1982 using the Consumer Price Index (CPI).

In keeping with the value-added approach to output measurement, we define the price of each insurance output as the sum of premiums and investment income minus output for the line divided by output.[10] The approach is consistent with that used by Berger, et al. (1997) and other researchers. All quantities are expressed in real terms by deflating by the CPI prior to calculating the output prices.

Inputs and Input Prices. Insurance inputs can be classified into four groups — home office labor,

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[9]In the past, researchers often used premiums as a measure of insurance output. However, this is incorrect, because premiums represent revenues, that is, price times quantity, rather than quantity (Yuengert, 1993).

[10]Insurers are required to allocate investment income by line in their regulatory annual reports, and we use the reported allocations in defining output prices.

agent labor, business services (including physical capital), and financial capital. We treat home office and agent labor separately because the two types of labor have different prices and are used in different proportions by firms in the industry.[11] We measure the price of home office labor using U.S. Department of Labor data on average weekly wages for Standard Industrial Classification (SIC) Class 6311, life insurance companies. The wages for the state in which the company maintains its home office are used in the analysis to proxy for the price of home office labor.[12]

The price of agent labor is measured using U.S. Department of Labor data on average weekly wages for SIC class 6411, insurance agents. A weighted average wage variable is used, with weights equal to the proportion of an insurer's premiums written in each state. The weighted average approach is more appropriate for agent labor than for home office labor because agency services are provided at the local level, whereas most of the other tasks performed by insurance company employees take place at the home office or in regional offices. The home office and agent wage variables are expressed in 1982 dollars by deflating by the CPI.

Labor is the most important non-interest expense for the insurance industry, accounting for about two-thirds of total non-loss expenses. The remaining insurer expenses are for real capital such as computers and real estate and business services such as legal fees, travel, communications and advertising. Expenditures for these items are aggregated together into our business services input. Including this input allows the estimation to account for variations across insurers in expenditures on computers, communications, and other technology-related items. The price of business services is the average weekly

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[11]Some companies rely exclusively on agents to distribute their products, others have no agents and market their products through the mail or using telemarketing, while still others use a combination of agents and other distribution techniques.

[12]A potential problem with this approach is that larger insurers often maintain regional branch offices that perform various administrative tasks. Consequently, as a robustness check, we also conducted the analysis using two additional definitions of the price of home office labor — national average weekly wages for SIC class 6311 and state weighted-average weekly wages, using as weights the proportion of an insurer's premium writings in each state. The use of these alternative labor price variables did not materially affect the results.

wage in SIC sector 7300, business services, deflated to 1982 dollars using the CPI.

Data on the number of employees or hours worked in the insurance industry are not available. Accordingly, we follow other insurance efficiency researchers (e.g, Berger, Cummins, and Weiss, 1997, Cummins and Zi, 1998) in measuring the quantity of agent and home office labor by dividing real dollar expenditures on these two expense categories by the agent and home office wage variables discussed above. The quantity of business services is defined similarly.

Our final input is financial capital. Financial capital is an important input in insurance because insurers must maintain equity capital to ensure policyholders that they will receive payment if claims exceed expectations and to satisfy regulatory requirements. Capital costs represent a significant expense for insurers. The financial capital input is defined as the amount of equity capital reported by the insurer to the NAIC, deflated to 1982 dollars using the CPI.

The cost of capital in the insurance industry is difficult to measure because only a small fraction of life insurers are publicly traded. We adopt a three-tier approach to measuring the cost of capital, based on financial ratings assigned by the A.M. Best Company, the leading financial rating firm for insurers. Best's uses a fifteen tier letter-coded rating system ranging from A++ for the strongest insurers to F for insurers in liquidation. The three tiers we adopt consist of the four ratings in the "A" range, the four ratings in the "B" range, and all other rating categories. Based on an examination of the equity cost of capital for traded life insurers, we assign a cost of capital of 12 percent to the top tier, 15 percent for the middle tier, and 18 percent for insurers in the lowest quality-tier. [13]

Estimation Methodology

We estimate efficiency using data envelopment analysis (DEA), a non-parametric approach that computes "best practice" efficient frontiers based on convex combinations of firms in the industry. DEA

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[13]As a robustness check, we also conducted the analysis using the insurers' reported average return on book equity over the three years prior to each sample year. Using this alternative cost of capital measure did not materially affect the results.

has been used extensively in estimating efficiency for a wide variety of industries (see Charnes, et al., 1994, and Berger and Humphrey, 1997). We adopt DEA in this study for two major reasons: (1) It provides a particularly convenient method for decomposing cost efficiency into its components — technical and allocative efficiency – as well as for decomposing technical efficiency into pure technical and scale efficiency. And (2) the Malmquist approach, which is the standard technique for measuring the evolution of productivity and efficiency over time, is DEA-based. Thus, the use of DEA permits us to use the same methodology consistently throughout the paper.

The alternative to DEA is the econometric approach. The principal advantage of the econometric approach is that it allows firms to deviate from the frontier due to purely random shocks as well as through inefficiency, whereas DEA measures all deviations from the frontier as inefficiency. The disadvantage of the econometric approach is that it requires the specification of a cost or revenue function as well as (in most variants) distributional assumptions about the error term, thus potentially confounding the efficiency estimates with specification error. We do not consider the lack of a random error component in DEA to be a serious problem in studying the life insurance industry because a recent paper by Cummins and Zi (1998) finds that econometric methods and DEA produce efficiency estimates for US life insurers that are highly correlated and quite consistent.[14] 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. Based on the Cummins and Zi results, we consider DEA to be an appropriate methodology for measuring efficiency in the life insurance industry.

DEA Efficiency Estimation. Detailed explanations of the DEA methodology are provided in Aly, et al., 1990, Ali and Seiford, 1993, Charnes, et al., 1994, and other cited references. Here we discuss the technical efficiency optimization problem as an example of the approach and provide a brief intuitive explanation of the other types of efficiency.

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[14]Cummins and Zi (1998) find rank correlations or around 0.67 between the efficiency scores produced by DEA and those obtained from econometric models.

DEA technical efficiency is measured by estimating "best practice" production frontiers, employing the input distance function introduced by Shephard (1970). Suppose producers use input vector x = (x_1, x_2,... x_k) $\in \mathbb{R}_+^k$ to produce output vector y = (y_1, y_2, ..y_n) $\in \mathbb{R}_+^n$. A production technology which transforms inputs into outputs can be modeled by an input correspondence $y \rightarrow V(y) \subseteq \mathbb{R}_+^k$. For any $y \in \mathbb{R}_+^n$, V(y) denotes the subset of *all* input vectors $x \in \mathbb{R}_+^k$ which yield at least y (Färe, 1988). The input oriented distance function D(x,y) is defined as follows:

$$\begin{aligned} D(x,y) &= sup\{\, \theta : (\frac{x}{\theta}, y) \in V(y) \,\} \\ &= (\, inf\{\, \theta : (\theta x, y) \in V(y) \,\}\,)^{-1} \end{aligned} \qquad \textbf{(1)}$$

The input distance function is the reciprocal of the minimum equi-proportional contraction of the input vector x, given outputs y, i.e., Farrell's measure of input technical efficiency. Input technical efficiency TE(x,y) is therefore defined as TE(x,y) = 1/D(x,y).

Technical efficiency for each year is estimated separately for each firm in the sample by solving linear programming problems. The linear programming problem for firm i is:

$$(\, D(x_i, y_i)\,)^{-1} = TE(x_i, y_i) = \min \theta_i \qquad \textbf{(2)}$$

Subject to: $Y \lambda_i \geq Y_i$, $X \lambda_i \leq \theta_i X_i$, and $\lambda_i \geq 0$

where **X** is a K x I input matrix and **Y** an N x I output matrix for all sample firms, $\mathbf{X}_i$ is a K x 1 input vector and $\mathbf{Y}_i$ an N x 1 output vector of firm i, λ_i is an I x 1 intensity vector (the inequalities are interpreted as applying to each row of the relevant matrix), and i = 1, 2, . . ., I. This estimation produces a constant returns to scale (CRS) frontier. Variable returns to scale (VRS) and non-increasing returns to scale (NIRS) frontiers can also be estimated by changing the constraint on the λ_i (Aly, et al., 1990).

DEA cost efficiency is also estimated by solving linear programming problems. In this case, the problem is to choose input quantities to minimize costs holding constant input prices and output quantities.

The solution for firm i is the cost minimizing input vector X_i*. Cost efficiency for firm i is then calculated as the ratio $\eta_i = w_i^T X_i^* / w_i^T X_i$, where w_i^T is the transpose of firm i's input price vector, and X_i is its actual input quantity vector. Thus, cost efficiency η_i is the ratio of frontier costs for insurer i's output vector and input prices to its actual costs, where $0 \leq \eta_i \leq 1$, and $\eta_i = 1$ for fully efficient firms.

Cost efficiency is the product of technical efficiency and allocative efficiency, i.e., firms can have higher costs than represented by the frontier because they are not using the most efficient technology (technical inefficiency) and/or because they are not using the cost minimizing input mix (allocative inefficiency). Having cost and technical efficiency enables us to back out estimates of allocative efficiency using the relationship: CE = TE*AE, where CE = cost efficiency, TE = technical efficiency, and AE = allocative efficiency. Both technical and allocative efficiency are bounded by 0 and 1, with fully efficient firms having efficiencies equal to 1.

Technical efficiency can be decomposed into pure technical efficiency (PTE) and scale efficiency (SE), where TE = PTE*SE, by solving additional linear programming problems. Pure technical efficiency is measured relative to a variable returns to scale (VRS) frontier, which may have segments where best practice firms operate with increasing returns to scale (IRS), constant returns to scale (CRS), and/or decreasing returns to scale (DRS). Pure technical efficiency is the reciprocal of the distance of firm i from the VRS frontier. Thus, the firm could achieve pure technical efficiency by moving to the VRS frontier. If the firm is operating in an IRS or DRS region of the frontier, it could further improve its efficiency by attaining CRS. Both pure technical and scale efficiency are bounded by 0 and 1. Firms with pure technical efficiency equal to 1 are operating on the VRS frontier, and a scale efficiency score equal to 1 indicates that a firm is operating with CRS. The methodology also reveals whether a non-CRS firm is operating with IRS or DRS (Aly, et al., 1990).

The final type of efficiency estimated in this study is revenue efficiency, also estimated by linear programming. The problem in this case is to choose output quantities to maximize revenues, taking as given input quantities and output prices (see Lovell, 1993). The solution for firm i is the revenue maximizing output vector Y_i^*, and revenue efficiency is defined as the ratio $\kappa_i = p_i^T Y_i / p_i^T Y_i^*$, where p_i^T = the transpose of the output price vector for firm i and Y_i = the vector of actual output quantities for firm i. Revenue efficiency κ_i also satisfies the inequality, $0 \leq \kappa_i \leq 1$, with a score of 1 indicating that the firm is fully revenue efficient.

Malmquist Analysis. We utilize the Malmquist index approach to analyze changes in efficiency and productivity over time. If technology is changing over time, we will observe shifts in the best practice technical frontier. Malmquist analysis permits us to separate shifts in the frontier (technical change) from improvements in efficiency relative to the frontier (technical efficiency change). The product of technical change and technical efficiency change, total factor productivity change, is measured by the Malmquist index (see Grosskopf, 1993).

To illustrate the Malmquist concept, consider the single-input, single-output case represented in Figure 2. The line labeled $0V^t$ in the figure represents the production frontier in period t, whereas $0V^{t+1}$ represents the frontier in period t+1. The improved technology represented by $0V^{t+1}$ enables efficient firms to produce the output using less of the input than was required by technology $0V^t$. Suppose that our hypothetical firm has input-output combination (x_i^t, y_i^t) in period t and (x_i^{t+1}, y_i^{t+1}) in period t+1. Two changes have occurred between period t and period t+1. First, because of technical progress, the firm produces more output per unit of input in period t+1 than in period t. In fact, its input-output combination in period t+1 would have been infeasible using period t technology. Thus, technical change has taken place. Second, the firm has also experienced technical efficiency change because its operating point is closer to the frontier in t+1 than it was in period t.

Malmquist analysis also is based on distance functions. To define the Malmquist index, we modify the distance function notation to incorporate time and define distance functions with respect to two different time periods as $D^{t+1}(x_i^t, y_i^t)$ and $D^t(x_i^{t+1}, y_i^{t+1})$, where D^t (D^{t+1}) represents the distance function relative to the frontier at time t (t+1), and x^t and y^t (x^{t+1} and y^{t+1}) are the input and output vectors at time t (t+1). The function $D^{t+1}(x_i^t,y_i^t)$ evaluates the input-output bundle in time period t relative to the technology of time period t+1; while the function $D^t(x_i^{t+1},y_i^{t+1})$ evaluates the input-output bundle observed in period t+1 relative to the technology of time t. The distance functions for a given year's input-output vector relative to the frontier for the same year are similarly denoted $D^t(x_i^t,y_i^t)$ and $D^{t+1}(x_i^{t+1},y_i^{t+1})$, for years t and t+1, respectively. In Figure 2, $D^{t+1}(x_i^t,y_i^t)$ = 0a/0c, $D^t(x_i^{t+1},y_i^{t+1})$ = 0e/0d, $D^t(x_i^t,y_i^t)$ = 0a/0b, and $D^{t+1}(x_i^{t+1},y_i^{t+1})$ = 0e/0f. Notice that cross-frontier distance function estimates can be less than 1, whereas distance function estimates for a given year's input-output bundle relative to the frontier for the same year must be $\geq$ 1. E.g., a distance function value less than one for $D^t(x_i^{t+1},y_i^{t+1})$ implies that the specified input-output combination is infeasible using the technology of period t.

Malmquist indices can be defined relative to either the technology in period t or the technology in period t+1, as follows:

$$M^t = \frac{D^t(x^t,y^t)}{D^t(x^{t+1},y^{t+1})} \quad or \quad M^{t+1} = \frac{D^{t+1}(x^t,y^t)}{D^{t+1}(x^{t+1},y^{t+1})} \tag{2}$$

where M^t measures productivity growth between periods t and t+1 using the technology in period t as the reference technology, and M^{t+1} uses the technology in period t+1 as the reference technology. To avoid an arbitrary choice of reference technology, the Malmquist index of total factor productivity is defined as the geometric mean of M^t and M^{t+1}: $M_t^{t+1} = [M^t M^{t+1}]^{0.5}$. In Figure 2, the total factor productivity index is equal to $[\{(0a/0b)/(0e/0d)][(0a/0c)/(0e/0f)\}]^{½}$. A Malmquist index greater than 1 implies that total factor productivity progress has occurred, while an index less than 1 implies technical regress. The Malmquist productivity index can be decomposed into measures of technical efficiency change and technical change with values greater than 1 again indicating improvements.

In our analysis, we are interested in the change in efficiency for firms that are acquisition targets between the period prior to the acquisition and the period after the acquisition. The year immediately prior to the acquisition year and the year immediately afterwards may be unrepresentative of the past and future efficiency of the acquisition target. To filter out any abnormal activities associated with the acquisition, we measure technical efficiency change and technical change between the year two years prior to acquisition (t-2) and the year two years after acquisition (t+2). The analysis thus involves a sequence of overlapping five-year blocks of data centered on the acquisition years 1990 through 1993.

6. Estimation Results

This section presents the results of our analysis of the relationship between mergers and acquisitions and efficiency in the life insurance industry. We focus primarily on firms that were acquired during the period 1990-1993 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.

We first present summary statistics on the characteristics of the firms in the sample and the results of the DEA and Malmquist analyses. We next conduct a regression analysis where the dependent variables represent changes in various types of efficiency over a period ranging from two years prior to the year of acquistion to two 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 principal issue addressed in this paper, i.e., whether acquisitions lead to improvements 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 no 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.

Summary Statistics

The summary statistics (see Table 3) show several statistically significant differences between the target and non-M&A firms. Consistent with our hypothesis that firms characterized by non-decreasing returns to scale (NDRS) are more attractive as acquisition targets, the proportion of target firms operating with NDRS (73.3%) is significantly higher than for non-M&A firms (60.3%); and targets on average have significantly higher scale efficiencies than non-targets (93% versus 89%). Target firms also have significantly higher technical, pure technical, and scale efficiency than non-M&A firms, suggesting that insurance acquisitions generally do not involve acquirers buying and reforming inefficient firms. The Malmquist indices show that target firms experienced significantly larger gains in technical efficiency and in total factor productivity over the sample period than did the non-M&A firms, consistent with the argument that acquisitions lead to efficiency gains.[15]

Consistent with our hypothesis that acquisition targets may display signs of financial vulnerability, target firms have significantly lower ratios of operating cash flow to assets and are significantly less likely to be rated A+ by the A.M. Best Company. As expected, target firms are also less likely to be mutuals.[16] Target companies are significantly less likely to be unaffiliated single firms, supporting the argument that managers of unaffiliated companies are likely to resist takeovers. Finally, target companies are somewhat smaller in terms of assets than non-M&A firms and are significantly less concentrated geographically, suggesting that acquiring firms prefer geographically diversified targets.

Regression Analysis of Efficiency Changes

To analyze efficiency changes while controlling for other differences between target firms and the non-M&A firms, we estimate regressions with efficiency changes as dependent variables and firm characteristics as independent variables. The Malmquist analysis provides estimates of technical efficiency change, technical change, and total factor productivity change; and these three indices are used

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[15]We also analyzed the data using a benchmarking approach, which consisted of matching each target firm with ten firms from the non-M&A sample that were similar to the target firm in terms of size. Differences between the mean efficiencies and efficiency changes of the target and non-M&A benchmark samples generally were not statistically significant. We conclude from this result that the benchmarking approach does not adequately control for differences among firms, emphasizing the importance of conducting our multiple regression analysis.

[16]Because mutuals are owned by their policyholders and do not issue stock, mutual acquisitions are usually accomplished using surplus notes, which are debt instruments subordinated to the insurance liabilities of the company but treated as equity for regulatory purposes.

separately as dependent 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.

Our analysis of efficiency changes relative to frontiers estimated for two different time periods is consistent with the prior literature (e.g., Akhavein, Berger, and Humphrey, 1997) and is appropriate because movements in the frontier are caused primarily by improvements in technology and other factors that are not related to mergers and need to be controlled for to isolate the merger effects. The comparison measures whether the firm has moved closer to or further from the frontier over the period of comparison and is similar to the efficiency change component of the Malmquist index, which also compares the firm to two separate frontiers. 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), organizational form (a dummy variable equal to 1 for mutuals and zero for stocks), ownership type (a dummy variable equal to 1 if the firm is an unaffiliated company and zero otherwise), and business mix (the proportions of the firm's premiums in group life, group annuities, individual annuities, and accident and health insurance, with individual life insurance as the excluded category). To control for geographical concentration, we include the firm's geographical Herfindahl index, based on the proportions of premium revenues by state. A firm with a high geographical Herfindahl index has a substantial share of its business concentrated in one or a few states, while firms with lower Herfindahl indices tend to be more geographically diversified. To determine whether acquisitions improve firm efficiency, we include a dummy variable equal to 1 if the firm was acquired during the period and zero otherwise.

As explained above, the sample period for the regressions is 1990 through 1993 to permit us to measure the change in efficiency over a period beginning two years prior to the acquisition year (t-2) and ending two years after the acquisition year (t+2). Thus, efficiency changes are measured across overlapping five-year periods centered on acquisition years. In order to be included in a five-year block, firms are required to be present in all years represented by the block. However, we do not require firms to be present in all years of the sample period (1988-1995) in order to be included in the analysis. Thus, the firms included in the five-year blocks (1988-1992, 1989-1993, 1990-1994, and 1991-1995) differ somewhat over time. 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 our sample based on our selection criteria are excluded from this analysis. The same sample is used for both the Malmquist regressions and the regressions where the ratios KE(t+2)/KE(t-2) are the dependent variables.

The regressions (see Table 4) reveal that the Malmquist indices of technical change and total factor productivity change are significantly larger for target firms than for non M&A firms. Because the Malmquist index of technical change does not differ significantly between the two groups of firms, the difference in total factor productivity change is due almost exclusively to technical efficiency change. The target company variable in the regression with the ratio TE(t+2)/TE(t-2) as the dependent variable is also statistically significant, primarily due to pure technical efficiency gains rather than changes in scale efficiency. The regression results thus provide strong evidence that target firms experienced significantly larger gains in technical efficiency than firms that were not involved in M&A activity.

The other regressions shown in Table 4 reveal that target firms also experienced significantly larger gains in both cost and revenue efficiency than did non-M&A firms, with the cost efficiency gains attributable primarily to gains in technical rather than allocative efficiency. This provides further evidence that acquisitions have had a beneficial effect on efficiency in the life insurance industry, and that the gains affect revenues as well as costs. The improvements in both revenue and cost efficiency suggest that acquisitions may have a strong positive effect on profits for target firms.[19]

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[19]Our analysis of efficiency changes differs somewhat from that in Akhavein, Berger, and Humphrey (1997) in that our dependent variable is the ratio of efficiency after the transaction to efficiency prior to the

The control variables in the regressions reveal that larger firms experienced significantly lower efficiency changes than smaller firms. Mutual firms achieved significantly lower efficiency growth than stock firms, except for scale and revenue efficiency where there is no significant difference between stocks and mutuals. The technical and cost efficiency differences between stocks and mutuals could be consistent with "expense preference" behavior on the part of mutuals (e.g., Mester, 1989) and/or could provide further evidence that mutuals operate in less complex and less risky lines of business that may provide fewer opportunities for technological gains.[20] Geographically concentrated firms experienced smaller changes in technical, cost, and revenue efficiency than geographically diversified firms. The more concentrated firms also experienced lower total factor productivity change, in spite of having somewhat higher technical change than more diversified firms. A possible explanation for this finding is that technological advances in data transmission and communications may provide more opportunities for improving efficiency for firms that are relatively diversified geographically.

Firms with higher proportions of their premiums in group life insurance experienced significantly lower growth in all types of efficiency except scale efficiency but experienced significantly more technical change than firms that are less active in group life insurance. This is consistent with the view that group life insurance is a highly efficient line of business, because the opportunity for efficiency gains would be lower in a relatively efficient line. However, because the line is already highly efficient and competitive, firms have a strong incentive to adopt new technology in order to remain viable and/or gain competitive advantages over their rivals. Efficiency gains were also significantly lower in the accident and health line of

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transaction, while theirs is the difference in the firm's post and pre-transaction efficiency rank, where the rank is defined as the proportion of firms with efficiency scores lower than that of a given firm. As a robustness check, we also ran our regressions, using the change in efficiency rank as the dependent variable. The results are essentially the same as those reported in Table 4 except that the target firm dummy variable is insignificant in the revenue change regression. Thus, some caution is in order in drawing conclusions about the effects of acquisitions on revenue efficiency.

[20]Evidence that mutual property-liability insurers are involved in less complex and less risky activities is provided by Mayers and Smith (1988) and Lamm-Tennant and Starks (1993).

business, perhaps because this line is already relatively efficient due to the intensive pressure to control costs in the health care industry.

Analyzing the effects of acquisitions on acquiring firms proved to be more difficult than for target firms. We have efficiency data for only 46 acquirers because some are not insurance companies and hence do not appear in our database, and several acquirers engaged in more than one transaction during the sample period. In addition, since our database reports data by company, we lack consolidated statements for insurance groups. Nevertheless, we created efficiency scores for acquiring insurance organizations and for non-M&A insurers at the group level, calculating group efficiency scores by taking weighted averages of the efficiencies of the companies that were members of the group, with weights equal to total insurance output. We looked at the three-year window extending from the year prior to an acquisition to the year after the acquisition, matching non-M&A firms and acquirers by year.[21]

There are no significant differences in efficiency between acquirers and non-M&A firms in the year prior to an acquisition, although non-M&A firms had slightly higher efficiencies than acquirers. The average efficiencies of both acquirers and non-M&A firms increased between the pre- and post-acquisition years. With the exception of scale efficiency, the efficiency gains were larger for acquirers; and acquirer efficiencies exceed those of non-M&A firms in the year following an acquisition, although only the difference in pure technical efficiency is statistically significant. Based on a regression analysis similar to that shown in Table 4, acquirers experience significantly larger gains in cost efficiency than non-M&A firms in the three year window surrounding the acquisition year. Thus, we also find some evidence that acquisitions have a beneficial effect on the efficiency of acquiring insurance groups.

Probit Analysis of the Probability of Acquisition

The probit analysis of the probability that a firm becomes an acquisition target is presented in Table 5. The dependent variable in this analysis is equal to 1 for firms that were acquired and equal to zero for

[21]We compared one rather than two years pre- and post-acquisition because the degrees of freedom for a five-year window are even more limited.

non-M&A firms. The independent variables in the regression are lagged one year so that firm characteristics prior to the acquisition year are associated with what occurs during the acquisition year. Acquired firms are included in the probit analysis only in the year of their acquisition. Targets of merger activity or acquisition targets that were omitted from our sample based on other selection criteria are eliminated from the data set entirely.[22] Non-M&A firms are included for all sample years (1989-1994).

The probit models include several explanatory variables to test the hypotheses discussed in section 2 along with control variables. To test the hypothesis that firms exhibiting increasing or constant returns to scale are more attractive acquisition targets than firms exhibiting decreasing returns to scale, we include a dummy variable set equal to 1 if the firm exhibits non-decreasing (increasing or constant) returns to scale and to zero otherwise. A positive coefficient on this variable would support the hypothesis. To test the hypothesis that efficient firms are attractive acquisition targets, we include efficiency ratios in the regressions. Because these ratios tend to be highly correlated, 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.

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. We also include the ratio of net operating cash flow to assets as a measure of the adequacy of funds to invest in new projects, and the one-year growth rate in premiums to measure growth opportunities. As a liquidity ratio, we use the ratio of cash and invested assets to liabilities. We expect all of these variables to be inversely related to the probability of acquisition.

We include a dummy variable equal to 1 for unaffiliated single firms and zero otherwise to test the hypothesis that managers of unaffiliated single firms are likely to resist buy-out offers to protect their job

[22] We conducted robustness checks by estimating models based on a sample that also included firms that were merged or retired following the transaction. The results were not materially affected by pooling the merged and acquired firms. The number of merged firms for which we have valid data (18 in total) is too small to support any separate conclusions.

security. A negative coefficient on this variable would be consistent with the hypothesis.

As control variables, we include the log of assets to capture size effects; and a dummy variable equal to 1 if the firm is a mutual and equal to zero otherwise. Conventional wisdom would predict a negative coefficient for the log of assets, and the mutual dummy is also expected to have a negative sign because mutuals are more difficult to acquire than stocks. The geographical Herfindahl index is included to control for the degree of geographical diversification. We do not have a strong prediction regarding the sign of this variable. It might make sense for firms seeking to expand into new markets to acquire firms that specialize in particular states and regions because of their knowledge of the market. On the other hand, firms seeking earnings diversification may find it cost effective to acquire one or two firms whose operations cover broader geographical areas rather than acquiring several single state firms, both in terms of the fixed costs of an acquisition and the costs of post-acquisition integration. Our final control variables consist of business mix percentages and year dummies.

The probit results (see Table 5) provide strong support for the hypothesis that firms exhibiting non-decreasing returns to scale (NDRS) are more likely to be acquisition targets. The non-decreasing returns to scale dummy variable has a positive and significant coefficient in every equation.[23] We also find some support for the hypothesis that more efficient firms are attractive merger targets. All efficiency variables with the exception of allocative efficiency are positively related to the probability of acquisition, although only revenue efficiency is statistically significant. This suggest that firms with relatively high revenue efficiency are especially attractive as acquisition targets.

The results also support the hypothesis that financially vulnerable firms are more likely than stronger firms to become acquisition targets. The capital-to-asset ratio is statistically significant at the 5 percent level in all of the probit regressions, with the expected negative sign in all cases. The ratio of net

[23]We also tested scale efficiency as an alternative to the NDRS dummy variable and as an additional variable to measure the effects of scale. This variable was not statistically significant, and it did not affect the significance of the NDRS variable when both were included in the equation. This strengthens our argument that acquiring firms tend to prefer targets operating with increasing or constant returns to scale.

operating cash flow to liabilities is significant at the 5 percent level or better in all models, also with the expected negative sign. The premium growth variable also has the expected negative sign but is not statistically significant. The only financial strength variable that has an unexpected sign is the ratio of liquid assets to reserves, which is positively related to the probability of acquisition, although not statistically significant. A possible explanation for this result is that the liquidity ratio may proxy both for financial vulnerability (suggesting a negative coefficient) and for the attractiveness of the firms as an acquisition target (suggesting a positive coefficient). That is, controlling for capitalization and cash flow, the acquiring firm is 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.

The unaffiliated single firm dummy variable has a negative coefficient as expected and is statistically significant at the 1 percent level or better in all of the probit models. This provides strong support for the hypothesis that managers of unaffiliated single firms have an incentive to resist takeovers. As expected, the equations provide evidence that mutuals are less likely to be acquired than stocks. Geographically diversified firms are more likely to be acquired than firms operating more narrowly, consistent with the earnings diversification/costs of acquisition hypothesis. The log of assets is inversely related to acquisition probability, supporting the view that acquisition targets tend to be relatively small. .

7. Conclusions

This paper examines the relationship between acquisitions and efficiency in the US life insurance industry. We estimate efficiency for life insurers representing 80 percent of industry assets over the period 1988-1995 using data envelopment analysis (DEA). Malmquist indices are used to measure technical efficiency change, technical change, and total factor productivity change over time.

We investigate five principal hypotheses: (1) that acquisitions lead to improvements in efficiency for the acquired firm; (2) that firms operating with non-decreasing returns to scale are more attractive acquisition targets than firms operating with decreasing returns to scale; (3) that efficient firms are more likely to be acquired than inefficient ones; (4) that financially vulnerable firms are more likely to be acquired; and (5) that unaffiliated single insurers are less likely to be acquired than members of groups.

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 zero for non-M&A firms as well as a set of control variables. The results provide strong evidence that acquired firms achieve greater gains in technical, cost, and revenue efficiency than non-M&A firms, suggesting that the recent restructuring of the life insurance industry has produced significant efficiency gains and improved profitability for target firms.

Probit models are used to investigate hypotheses (2) through (5). We provide support for the hypothesis that firms characterized by non-decreasing returns to scale are significantly more likely to become acquisition targets than firms operating with decreasing returns to scale. This suggests that insurers have generally acted rationally by avoiding acquisitions of firms that are already too large. We also provide evidence that financially vulnerable insurers are more likely to be acquired than financially stronger firms. Thus, regulation also appears to have driven consolidation among life insurers. Although firm efficiency is generally positively related to the probability of acquisition, this relationship is statistically significant only for revenue efficiency. Thus, acquiring firms may consider a target's success in the product market to be more important than cost or technical efficiency, perhaps because making internal improvements is easier than replicating a competitive advantage in generating revenue.

The overall conclusion is that mergers and acquisitions in the life insurance industry appear to be driven for the most part by economically viable objectives and have had a beneficial effect on efficiency in the industry. We expect to see more consolidation in the industry in the future because many insurers are burdened with costly agency distribution systems that in the long-run will lose out to non-traditional competitors. Glass-Steagall repeal also would lead more mergers and acquisitions, and the competitive landscape would change even more profoundly if the Federal income tax code were revised to reduce the tax deferral on interest earnings accumulated in life insurance and annuity contracts. 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.

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Figure 1: Herfindahl Indices By Line For the US Life Insurance Industry

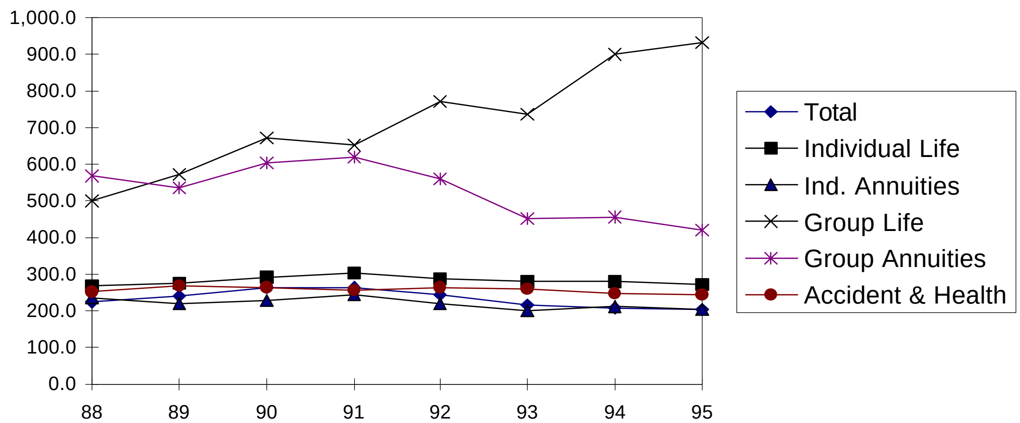

Figure 2: Productivity and Efficiency Change

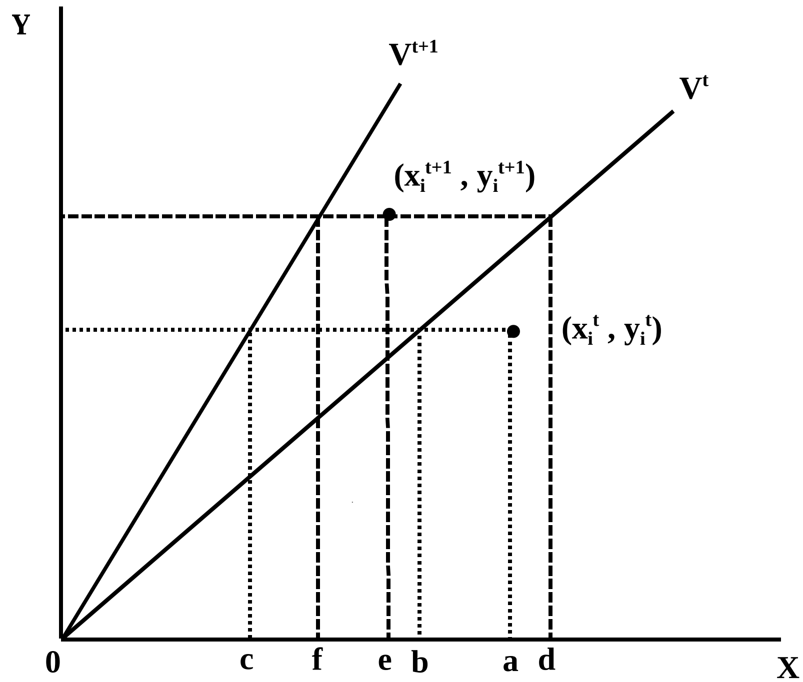

Table 1
US Life Insurance Industry: Number of Firms

Year	Groups	Affiliated Companies	Unaffiliated Companies	Companies	DMUs
88	379	891	334	1,225	713
89	379	907	337	1,244	716
90	379	916	341	1,257	720
91	381	941	363	1,304	744
92	381	936	352	1,288	733
93	369	902	339	1,241	708
94	357	899	334	1,233	691
95	341	884	303	1,187	644

Table 2
Concentration Ratios for the U.S. Life Insurance Industry

	Assets			Total Premiums		
Year	**4-Firm**	**8-Firm**	**20-Firm**	**4-Firm**	**8-Firm**	**20-Firm**
88	27.4%	39.4%	56.5%	21.0%	29.8%	45.0%
89	26.2%	37.9%	55.2%	22.2%	31.1%	46.6%
90	24.7%	36.4%	53.9%	23.8%	32.6%	49.4%
91	24.4%	35.7%	53.9%	23.1%	33.0%	50.1%
92	23.6%	34.4%	52.9%	22.4%	31.7%	48.7%
93	22.8%	33.3%	51.9%	20.6%	29.7%	47.5%
94	21.9%	31.8%	50.9%	19.9%	29.1%	46.1%
95	21.4%	31.4%	51.1%	19.6%	29.0%	45.7%

Table 3
Summary Statistics on Target and Non-M&A Firms
1989-1994 Averages

	Target Firms			Non M&A Firms	
Variable	**Mean**	**Std. Dev.**		**Mean**	**Std. Dev.**
Company Characteristics:					
Total assets (millions)	$1,876.14	$203.21	*	$1,904.65	$206.84
Capital/Total assets	0.203	0.182		0.213	0.170
Liquidity ratio	1.606	2.380		1.348	1.451
Operating cash flow/Total assets	0.029	0.210	***	0.087	0.137
Invested assets/Total assets	0.940	0.060		0.940	0.068
Percent of invested assets in real estate	1.7%	3.0%		1.7%	3.2%
Percent of invested assets in stocks	4.3%	6.2%	***	6.4%	9.4%
Percent of invested assets in bonds	72.3%	20.1%	*	68.9%	20.1%
Percent of invested assets in mortgages	6.7%	9.6%	**	8.7%	11.7%
Total premiums (millions)	$238.55	$762.52	*	$361.74	$1,468.28
Percent change in premiums, t-1 to t	104.9%	89.6%	*	117.3%	93.3%
Percent of premiums in group life	9.9%	18.6%		11.0%	20.7%
Percent of premiums in group annuities	4.5%	15.6%		4.8%	13.8%
Percent of premiums in accident/health	26.5%	32.6%		29.0%	35.6%
Percent of premiums in indiv. annuities	20.2%	31.0%		17.4%	26.9%
Percent of cos with non-decr. rets to scale	73.3%	44.5%	***	60.3%	48.9%
Geographic Herfindahl, premiums	2890.76	3065.9	**	3551.32	3364.62
Percent unaffiliated companies	14.0%	34.9%	***	25.1%	43.4%
Percent mutual companies	2.3%	15.2%	***	13.6%	34.3%
Percent companies with A+ rating	15.1%	36.0%	***	29.8%	45.7%
Percent companies with A or A- rating	38.4%	48.9%	*	29.9%	45.8%
Percent companies with B+ or B rating	18.6%	39.1%		18.0%	38.5%
Efficiency Scores:					
Cost efficiency	0.3890	0.2520		0.3569	0.2198
Technical efficiency	0.6310	0.2950	**	0.5680	0.2865
Allocative efficiency	0.6266	0.2280		0.6415	0.2141
Pure technical efficiency	0.6809	0.2861	**	0.6324	0.2702
Scale Efficiency	0.9267	0.1424	**	0.8944	0.1483
Revenue Efficiency	0.3765	0.3155		0.3357	0.2705
Malmquist Index:					
Technical Efficiency Change	2.7250	4.1765	**	1.2728	0.8816
Technical Change	0.9606	0.4240		0.9625	0.3586
Total Factor Productivity Change	2.0450	3.3344	**	1.1594	0.9106

Note: Variable values are for one year prior to transaction. Percent change in premiums, t-1 to t is defined as premiums,t divided by premiums, t-1.
***Significant at 1 percent level; ** significant at 5 percent level; * significant at 10 percent level

Table 4
Regression Models of Changes in Efficiency

	Malmquist Indices			Efficiency Two Years After/Two Years Before Acquistion					
Variable	**TE Change**	**Tech. Chg**	**TFP Change**	**CE**	**TE**	**AE**	**PTE**	**SE**	**RE**
Intercept	3.7256 ***	0.7736 ***	3.1859 ***	3.2757 ***	3.6868 ***	1.1701 ***	3.3447 ***	1.1955 ***	5.5823 ***
	0.3868	0.1107	0.3548	0.2737	0.2582	0.1590	0.2188	0.0923	0.7132
Target Company Dummy	0.7154 ***	0.0295	0.6990 ***	0.4422 ***	0.3811 ***	0.0226	0.3279 ***	0.0145	0.8673 ***
	0.1620	0.0463	0.1486	0.1152	0.1086	0.0669	0.0920	0.0388	0.2995
Ln(Assets)	-0.0884 ***	-0.0025	-0.0894 ***	-0.0842 ***	-0.1080 ***	-0.0005	-0.0956 ***	-0.0058	-0.1727 ***
	0.0191	0.0055	0.0175	0.0135	0.0128	0.0079	0.0108	0.0046	0.0352
Mutual	-0.1253 *	-0.0337 *	-0.1387 **	-0.1341 ***	-0.0873 *	-0.0753 **	-0.0857 **	0.0026	0.0185
	0.0696	0.0199	0.0639	0.0517	0.0488	0.0300	0.0413	0.0174	0.1345
Geographic Herfindahl (<0)	-0.4368 ***	0.0875 ***	-0.2933 ***	-0.2829 ***	-0.4007 ***	0.0131	-0.3791 ***	-0.0001	-0.6734 ***
	0.0916	0.0262	0.0841	0.0663	0.0626	0.0385	0.0530	0.9224	0.1728
Unaffiliated Company	0.0144	-0.0430 **	-0.0767	-0.0872 *	-0.0642	-0.0303	-0.0674 *	0.0134	-0.1466
	0.0654	0.0187	0.0600	0.0473	0.0446	0.0275	0.0378	0.0159	0.1233
Pct Group Life Premiums	-0.9877 ***	0.5170 ***	-0.3179 **	-0.5033 ***	-0.4004 ***	-0.1948 ***	-0.4813 ***	0.0433	-0.6748 **
	0.1786	0.0511	0.1639	0.1314	0.1239	0.0763	0.1050	0.0443	0.3419
Pct Group Annuity	-0.3994 **	-0.1091 *	-0.2919	-0.1633	-0.1369	0.0302	-0.1257	0.0149	-0.5965 *
	0.2064	0.0591	0.1894	0.1390	0.1311	0.0807	0.1111	0.0468	0.3617
Pct Indiv.l Annuity Premiums	-0.3907 ***	0.0442	-0.2672 **	-0.0162	0.1077	-0.0986 **	0.1018	-0.0103	0.2419
	0.1192	0.0341	0.1093	0.0860	0.0812	0.0500	0.0688	0.0290	0.2240
Pct Acc&Health Premiums	-0.3965 ***	-0.0744 ***	-0.3291 ***	-0.5795 ***	-0.4751 ***	-0.0997 ***	-0.3920 ***	-0.0476 **	-0.6576 ***
	0.0842	0.0241	0.0772	0.0615	0.0581	0.0357	0.0492	0.0207	0.1605
1991 Dummy	-0.4725 ***	0.3072 ***	0.0043	-0.1358 ***	0.1375 ***	-0.1944 ***	0.0635	0.0614 ***	-0.2348 *
	0.0698	0.0120	0.0641	0.0511	0.0482	0.0297	0.0408	0.0172	0.1330
1992 Dummy	-0.2531 ***	0.1432 ***	0.0037	0.2417 ***	-0.0441	0.1950 ***	0.0144	-0.0388 ***	0.5803 ***
	0.0701	0.0200	0.0643	0.0514	0.0485	0.0299	0.0411	0.0173	0.1342
1993 Dummy	-0.6105 ***	0.4073 ***	-0.0240	0.1739 ***	0.1782 ***	-0.0272	0.1728 ***	-0.0187	-0.7014 ***
	0.0706	0.0202	0.0648	0.0512	0.0483	0.0298	0.0410	0.0173	0.1335
Adjusted R^2	0.1097	0.2740	0.0507	0.1104	0.1040	0.0923	0.1086	0.0213	0.0785
No. of obs.	1688	1688	1688	1798	1798	1798	1798	1798	1792

Note: TE Change, and Technical Change are components of the Malmquist Index of TFP. The dependent variable in the remaining equations is 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 5
Probit Models of the Probability of Acquisition in Year t

	Efficiency Variable									
	CE		TE		PTE		AE		RE	
Intercept	0.7738		0.5690		0.5786		0.4786		0.9821	
	0.9690		0.9403		0.9363		0.9418		0.9532	
Non-decreasing rts dummy$_{t-1}$	0.2456	*	0.2541	**	0.2722	**	0.2727	**	0.2290	*
	0.1317		0.1304		0.1300		0.1305		0.1309	
Efficiency$_{t-1}$	0.3092		0.2277		0.3073		-0.0399		0.4836	**
	0.2708		0.1985		0.1959		0.2472		0.1999	
Pct Change in Premiums(t/(t-1))	-0.1134		-0.1102		-0.1116		-0.1162		-0.1068	
	0.0724		0.0722		0.0725		0.0731		0.0709	
Net Cash Flow$_{t-1}$/Assets$_{t-1}$	-0.9080	**	-0.8977	***	-0.8799	***	-0.9319	***	-0.9376	***
	0.2189		0.2186		0.2198		0.2182		0.2171	
Capital$_{t-1}$/Assets$_{t-1}$	-0.9026	**	-0.8837	**	-0.8881	**	-0.9380	**	-0.8673	**
	0.4127		0.4083		0.4067		0.4096		0.4081	
Liquidity Ratio$_{t-1}$	0.0376		0.0375		0.0374		0.0373		0.0356	
	0.0242		0.0240		0.0240		0.0241		0.0244	
Ln(Assets$_{t-1}$)	-0.1288	***	-0.1217	***	-0.1253	***	-0.1104	**	-0.1434	***
	0.0474		0.0455		0.0453		0.0457		0.0462	
Mutual Dummy	-0.7205	***	-0.7123	***	-0.7162	***	-0.7017	***	-0.6868	***
	0.2692		0.2679		0.2680		0.2666		0.2705	
Geographic Herfindahl$_{t-1}$	-0.0001	***	-0.0001	***	-0.0001	***	-0.0001	***	-0.0001	***
	0.0000		0.0000		0.0000		0.0000		0.0000	
Unaffiliated Company Dummy	-0.3783	***	-0.3827	***	-0.3951	***	-0.3877	***	-0.3907	***
	0.1408		0.1406		0.1413		0.1408		0.1418	
% Group Life Premiums$_{t-1}$	-0.0539		-0.0271		-0.0429		0.0251		0.0307	
	0.2829		0.2769		0.2764		0.2673		0.2740	
% Group Annuity Premiums$_{t-1}$	0.3620		0.3510		0.3243		0.4239		0.2746	
	0.3905		0.3911		0.3911		0.3855		0.3912	
%Indiv Annuity Premiums$_{t-1}$	0.2627		0.2621		0.2573		0.2895		0.2492	
	0.2126		0.2126		0.2119		0.2103		0.2105	
Pct Acc&Health Premiums$_{t-1}$	-0.1017		-0.1195		-0.1228		-0.0996		-0.1864	
	0.1634		0.1657		0.1647		0.1634		0.1708	
Log-Likelihood	-364.19		-364.17		-363.60		-364.81		-361.75	

Note: Standard errors are presented below the estimated coefficients. *** Significant at 1% level; **significant at the 5% level; *significant at the 1% level.