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02-01

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The Working Paper Series is made possible by a generous grant from the Alfred P. Sloan Foundation

Deregulation, Consolidation, and Efficiency:
Evidence From the Spanish Insurance Industry

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November 21, 2001

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ABSTRACT

This paper provides new information on the effects of deregulation and consolidation in financial services markets by analyzing the Spanish insurance industry. The sample period 1989-1998 spans the introduction of the European Union's Third Generation Insurance Directives, which deregulated the EU insurance market. Deregulation has led to dramatic changes in the Spanish insurance market; the number of firms declined by 35 percent and average firm size increased by 275 percent. We analyze the causes and effects of consolidation using modern frontier efficiency analysis to estimate cost, technical, and allocative efficiency, as well as using Malmquist analysis to measure total factor productivity change. The results show that many small, inefficient, and financially under-performing firms were eliminated from the market due to insolvency or liquidation and that acquirers in the mergers and acquisitions market prefer relatively efficient target firms. As a result, the market experienced significant growth in total factor productivity over the sample period. Consolidation reduced the number of firms operating with increasing returns to scale but also increased the number operating with decreasing returns to scale. Hence, many large firms should focus on improving efficiency rather than on further growth.

**Deregulation, Consolidation, and Efficiency:
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1. Introduction

Financial services markets have changed significantly over the past two decades, following the deregulation of banking, insurance, and other financial services in major industrialized nations. The implementation of the European Union's (EU's) Second Banking Directive (1993) and Third Generation Insurance Directive (1994) aimed at deregulating the EU banking and insurance markets, respectively. Japan initiated financial system deregulation with the "Big Bang" financial reforms, launched in 1996; and U.S. regulations were relaxed in stages, culminating in the Gramm-Leach-Bliley Act of 1999. Common themes of these deregulatory efforts include the removal of restrictions on ownership of different types of financial services firms, the relaxation of geographical restrictions on branching and sales, and price deregulation.[1]

A principal objective of financial services deregulation is to improve market efficiency and enhance consumer choice through increased competition. Efficiency gains can occur as the result of the market consolidation that has accompanied deregulation, particularly in Europe and the U.S. Consolidation has the potential to improve X-efficiency in an industry if it results in poorly performing firms exiting the market, either through voluntary or involuntary withdrawal or through mergers and acquisitions (M&As). If acquiring firms have superior management and/or better technology, they may be able to improve the performance of merger targets. Consolidation also can positively affect efficiency if it permits firms to take advantage of scale economies to reduce unit costs of production. Consolidation has the potential to reduce income volatility by increasing firm size and diversification. M&As among firms offering different product lines also may permit firms to realize economies of scope. In spite of the significant potential for efficiency gains from consolidation, the research evidence on the efficiency effects of consolidation has been mixed, with some

[1]For further discussion of deregulation of the U.S. banking industry, see Berger, et al. (1995) and Barth, et al. (2000). Deregulation of European banking is discussed in Barth, et al. (1997); and deregulation in the Japanese financial system is discussed in Dekle (1998) and Goto (1999). Deregulation in the European insurance industry is discussed in Hogan (1995), Swiss Re (1996), and Hess and Trauth (1998); and deregulation in the Japanese insurance industry is discussed in Swiss Re (2000a).

studies showing efficiency gains and others showing no efficiency gains or efficiency losses (Berger and Humphrey 1997). Of particular relevance for the present study, researchers have found little or no cost efficiency gains and only modest revenue efficiency gains on average for intra-country consolidation of firms within a particular product category, (Berger, et al. 1999, Berger 2000).

The objective of the present paper is to provide additional information on the effects of deregulation and consolidation on financial services market efficiency by analyzing the Spanish insurance industry. The Spanish 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 Spain because the government began encouraging mergers and acquisitions in the insurance industry even prior to the adoption of the Third Generation Directives, under a 1984 law and a 1985 Royal Decree. The 1980s Spanish deregulation was designed to create insurers that would be more efficient and competitive both nationally and internationally. As a result of these regulatory policy changes, the number of Spanish insurers declined by 35 percent between 1989 and 1998 and average firm size increased by 275 percent.

Government policies encouraging consolidation make sense economically if larger firms tend to be more X-efficient, if there are unrealized scale economies, and/or if consolidation leads to more vigorous competition that increases market efficiency. The purpose of this paper is to analyze scale economies and efficiency in the Spanish insurance industry to determine whether deregulation has had the intended effects.

We analyze the Spanish insurance industry over the ten-year period 1989-1998, which spans the implementation of both the Second and Third Generation Insurance Directives and is subsequent to the adoption of the Spanish government's consolidation policy.[2] To measure efficiency, we estimate "best practice" production and cost frontiers for each year of the sample period, using data envelopment analysis

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[2]The First and Second Generation Insurance Directives, which were more limited in scope than the Third Generation Directives, are discussed briefly in the next section of the paper.

(DEA), a non-parametric technique (see Charnes, et al. 1994). 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 between 0 and 1).

Because the Spanish government's policies and 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 economies of scale. Scale economies might be present in the insurance industry not only because fixed costs are spread over a wider base as firm size increases but also because insurance involves the diversification of risk, which is more effective in larger risk pools. On the other hand, if insurance is primarily a variable cost industry and insurers can use reinsurance to reduce income volatility, significant scale economies may not be present. Policies encouraging growth in firm size make sense on scale efficiency grounds only if there are or were many insurers operating with increasing returns to scale.

To provide additional information on the effects of consolidation, we analyze the characteristics of firms exiting the market due to mergers and acquisitions (M&As), firms exiting for other reasons such as voluntary or involuntary liquidation, and firms participating in M&As as acquirers of other firms. If consolidation has been beneficial, we expect firms exiting the market due to liquidation to be relatively inefficient in comparison with other firms in the market. Consolidation is also likely to improve efficiency if M&A target firms have some desirable characteristics that may benefit the acquiring firm as well as some undesirable areas where their performance can be improved by the acquirers. In addition, for consolidation to be beneficial, acquiring firms are expected to be minimally no less efficient than firms not involved in M&As. In addition to presenting descriptive statistics on firms by M&A status, we estimate probit models to identify in a multi-variate context the firm characteristics associated with the probability of being an acquisition target, exiting the market due to liquidation, or being an acquirer in the M&A market.

If deregulation has had the intended effects, productivity should improve over the sample period.

Accordingly, we also measure total factor productivity growth, where productivity growth is defined as the change in output due to technical efficiency change (the distance of firms from the production frontier) and technical change (movements in the frontier over time). We analyze productivity growth using the Malmquist index approach (see Grosskopf 1993, Färe, et al. 1994), an extension of the DEA methodology.[3]

There is a growing body of literature on efficiency in the insurance industry (for a review see Cummins and Weiss 2001). The role of consolidation, organizational form, and distribution systems in the U.S. insurance industry has been analyzed by Cummins, Tennyson, and Weiss (1998), Cummins, Weiss, and Zi (1999), and Berger, Cummins, and Weiss (1997), among others. The insurance industries in France, Japan, Italy, Austria, and Germany have been studied by Fecher, et al. (1993), Fukuyama (1997), Cummins, Turchetti, and Weiss (1997), and Mahlberg and Url (1998, 2000), respectively. There has been one prior paper on the Spanish insurance industry, by Fuentes, Grifell-Tatjé, and Perelman (2001). We extend their research by conducting a more extensive analysis of insurance industry efficiency, using a different methodology to analyze total factor productivity growth, and studying Spanish insurers that specialize in life or non-life insurance as well as diversified firms writing both types of insurance.

The remainder of the paper is organized as follows: The hypotheses are discussed in section 2. Section 3 describes the database, defines insurance industry inputs and outputs, and provides a brief discussion of the concept of frontier efficiency concepts as well as the DEA and Malmquist methodologies. The results are presented in section 4, and section 5 concludes.

2. Hypotheses

In this section, we discuss the hypotheses to be tested in this study. We begin with an analysis of the expected effects of recent regulatory policy changes on insurance market structure and competition.

[3]We focus the present study on technical and cost efficiency in order to provide a thorough analysis of these topics, including the effects of mergers and acquisitions, as well as conducting the Malmquist productivity analysis. Extending this paper to consider other important issues such as the effect of consolidation on revenue efficiency, profit efficiency, and market power would have significantly lengthened the paper. We elected to present our results on those topics in subsequent papers.

The Third Generation Directives

The insurance industry in Europe traditionally has been subject to stringent regulation affecting pricing, contractual provisions, the establishment of branches, solvency standards, and numerous additional operational details. 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, 2000b).[4]

The implementation of the EU's Third Generation Directives, beginning on July 1, 1994, represented a major step in creating conditions in the EU resembling those in a single deregulated national market.[5] 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 nation. (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 that pricing, contracting, and other aspects of insurer operations are effectively deregulated. Thus, insurers are allowed to engage in true price competition in personal lines markets for the first time and also to compete more freely in terms of products and services.

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[4]Such a result would be consistent with the predictions of Stigler's (1971) capture theory of regulation, which holds that regulation will serve the interests of the regulated industry, and also would be consistent with Peltzman's (1976) interest group pressure theory of regulation under conditions where the insurers are the dominant interest group.

[5]Deregulation began with the First Generation Directives, which were adopted for reinsurance in 1964, for non-life insurance in 1973, and for life insurance in 1979. The First Generation Directives introduced "freedom of establishment" with host country control, giving insurers the right to establish subsidiaries, branch offices, and agencies in each EU member state. However, retention of host country supervision meant that firms were required to be licensed and supervised in each country where they conducted business. Moreover, host countries retained the right to stringently regulate all aspects of market conduct, including prices. The Second Generation Directives, adopted for large commercial risks in 1988 and for auto insurance and some types of life insurance in 1990, established "freedom of services," giving insurers the ability to conduct business outside of their home country without having to establish branches in host countries. However, except for large commercial risks, host country supervision was retained in most EU member nations until the adoption of the Third Generation Directives (Swiss Re 1996, Hess and Trauth 1998) .

Hypothesized Effects of Regulatory Policy Changes

Efficiency. The Third Generation Directives were expected to bring about price and product competition across national boundaries. Given the degree of protectionism that existed in the past, such market liberalization has the potential to increase consumer choice and produce downward pressure on prices. In addition, the level of efficiency in the industry is expected to improve as the result of market share gains by efficient firms, which were previously constrained from exploiting their efficiency advantage due to regulation. Inefficient firms are expected either to become more efficient or to exit the market. Accordingly, the level of efficiency in the Spanish insurance industry is predicted to increase over our sample period, with especially significant improvements after the adoption of the Third Generation Directives in 1994.

Although it seems reasonable to predict that the Third Generation Directives will have beneficial effects on competition, to date this has primarily occurred through more aggressive competition among insurers in their home markets rather than through cross-border competition.[6] Evidence supporting this view with respect to Germany is presented in Mahlberg and Url (2000), who report intensified price competition by German companies but minimal market penetration by other EU insurers. More generally, an analysis by Swiss Re (2000b) finds that personal lines insurance markets have remained localized but the ratio of premiums to losses (a measure of insurance price) has declined since 1994 in ten of fifteen EU member nations. Consequently, it seems reasonable to expect that competition in the Spanish insurance market has intensified since deregulation, leading to efficiency gains.

Economies of Scale. As suggested above, the Spanish government's policy of encouraging

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[6]One reason that cross-border competition has been slow to emerge is that the Directives did not completely eliminate the ability of host countries to influence insurance markets. For example, EU member countries can still utilize taxation to discriminate between domestic companies and those based in other EU countries (Hess and Trauth 1998). In addition, there are significant differences in contract law across European nations (Swiss Re 1996), impeding contract standardization. Domestic insurers also are likely to have an advantage in their home markets because of cultural affinities, established brand names, and buyer perceptions that such firms have higher quality or financial stability than foreign firms. Finally, foreign insurers may be at a disadvantage in comparison with domestic insurers in terms of their knowledge of the underwriting characteristics of buyers, exposing foreign firms to higher informational asymmetry problems and adverse selection relative to domestic firms.

consolidation in the insurance industry was motivated by the presence of large numbers of very small firms in the insurance market. These firms were believed to be scale inefficient and not sufficiently robust to compete effectively as the EU moved towards deregulation. It was argued that larger insurers would provide better value and service to insurance customers in Spain and would be more competitive with other EU insurers. Thus, the policy change was based on the implicit (and untested) assumptions that there were significant unrealized scale economies in the industry and that creating larger firms would lead to more viable insurers and a more competitive market. Our tests are designed to provide information on whether these critical assumptions were correct and whether further consolidation is likely to be beneficial.

Economies of scale are present if average costs per unit of output decline as the volume of output increases. The usual source of scale economies is the spreading of the firm's fixed costs over a larger volume of output. Fixed costs are present for insurers due to the need for relatively fixed factors of production such as computer systems, managerial expertise, and financial capital. Economies of scale also can arise if operating at larger scale permits managers to become more specialized and therefore more proficient in carrying out specific tasks. Operating at larger scale can reduce the firm's cost of capital if income volatility is inversely related to size. This source of scale economies may be particularly applicable to insurers, because the essence of insurance is risk diversification through pooling. These arguments lead to the prediction that insurance operations are likely to encounter ranges of production characterized by increasing returns to scale, permitting some insurers to reduce unit costs by increasing production, at least within limits.

Entry and Exit. According to microeconomic theory, firms that do not succeed in minimizing costs will not be able to adequately compensate factors of production and will be forced to exit the market. Although several studies of financial institutions have shown that inefficient firms may be able to survive over periods of time as long as five or ten years (e.g., Berger, et al. 2000, Cummins and Weiss 1993), we expect that inefficient firms eventually will be forced either to improve their performance or to exit the market, especially during a period of deregulation and increasing competitive intensity. Likewise, a market where a significant proportion of total output is provided by inefficient firms and where entry barriers have been reduced or eliminated is expected to attract new entrants, potentially improving market efficiency.

Entry and exit have the potential to improve market efficiency in four major ways. First, consolidation has the potential to improve overall market efficiency by enabling acquiring firms to realize economies of scale. This leads to the prediction that consolidation has improved scale efficiency in the Spanish insurance market. Second, there is also likely to be a relationship between efficiency and the probability of being an M&A target. If Spanish M&As primarily aim at increasing the size and market share of acquiring firms, then one would expect acquirers to prefer acquisition targets that are relatively efficient, because the costs of integrating an efficient firm into the acquiring firm are likely to be lower than for an inefficient target. On the other hand, if M&As are motivated because acquiring firms believe they can add value by improving the performance of the target firm's operations, then we might observe an inverse relationship between efficiency and the probability that a firm becomes a merger target, provided that target firms also have some attractive operating characteristics. However, because much of the merger activity in Spain seems to have been motivated by the objectives of increasing size and market share, on balance we expect to observe a positive relationship between firm efficiency and the probability of being a merger target. That is, if numerous efficient and inefficient potential target firms are present in a market, it seems reasonable to predict that the efficient firms are more likely to be acquired.

Third, based on the theoretical prediction that inefficient firms will not be able to survive in the long-run, we expect firms that exit the market due to voluntary or involuntary liquidation to be relatively inefficient and/or to exhibit signs of financial weakness. This leads to the prediction of an inverse relationship between efficiency and the probability of non-merger exit, and we also expect firm financial performance measures such as the equity capital-to-asset ratio to be inversely related to the probability of non-merger exit. Finally, M&As are expected to be efficiency-improving if acquiring firms are more efficient than acquisition targets or, minimally, no less efficient than the average firm in the industry. Accordingly, we hypothesize a non-negative relationship between efficiency and the probability of being an acquirer. We test these predictions by estimating probit models for the probability of a firm's being an acquisition target, exiting the market for other reasons, or participating in the M&A market as an acquirer.

3. Data and Methodology

This section describes our data base and discusses the measurement of the outputs, inputs, and input prices used in estimating efficiency. We then briefly discuss frontier efficiency concepts and explain the data envelopment analysis (DEA) and Malmquist approaches used to measure efficiency and productivity.

The Data, Outputs, and Inputs

The Database. The database for our study consists of financial statements for all insurers operating in Spain over the period 1989-1998 that report to the Spanish regulatory authority, the Dirección General de Seguros, Ministerio de Economía y Hacienda.[7] The data base thus includes all insurers in the Spanish market supervised by the Spanish regulatory authority except for social benefit institutions.[8] Some firms were eliminated from the sample because of data problems such as zero or negative premiums or net worth, i.e., firms that do not appear to be viable operating entities. The firms remaining in the sample account for at least 90 percent of premium volume in the Spanish insurance market in each year of the sample period.

Outputs. Insurers are analogous to other financial firms in that their outputs consist primarily of services, many of which are intangible. Consistent with most of the recent literature on financial institutions, we adopt a modified version of the value-added approach to output measurement, which counts as important outputs those that have significant value added, as judged using operating cost allocations (Berger and Humphrey 1992). Insurers provide three principal services:

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[7]The sample primarily consists of Spanish insurers and Spanish subsidiaries of insurers licensed in other EU countries. As in other EU nations, the primary method for foreign insurers to enter the Spanish market has been through the formation of Spanish-licensed and regulated subsidiaries rather than through branches or agencies (Berger, et al. 2001). Consequently, the sample consists of firms writing the vast majority of insurance sold in Spain. A small number of branches of EU licensed firms are included in the sample from 1989-1994, but such branches did not have to report to the Spanish regulatory authority after 1994. A few branches of non-EU firms, which are required to report to the Spanish regulator, also are included in the sample. Conducting the analysis without the branches does not materially change the results.

[8]Social benefit institutions (mutualidades de prevision social) are non-profit private mutual insurers providing coverage complementary to social security schemes. We omitted these firms because of their specialized objective and because we wanted to focus on the for-profit segment of the insurance market.

! **<u>Risk-pooling and risk-bearing</u>.** Insurance provides a mechanism through which consumers and businesses exposed to losses can engage in risk reduction through pooling. 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.

! **<u>"Real" financial services relating to insured losses</u>.** Insurers provide a variety of real services for policyholders including financial planning, risk management, and the provision of legal defense in liability disputes. By contracting with insurers to provide these services, policyholders take advantage of insurers' specialized expertise to reduce the costs associated with managing risks.

! **<u>Intermediation</u>.** For life insurers, financial intermediation is a principal function, accomplished through the sale of asset accumulation products such as annuities. For non-life insurers, intermediation is an important but incidental function, resulting from the collection of premiums in advance of claim payments. Insurers' value added from intermediation is reflected in the net interest margin between the rate of return earned on invested assets and the rate credited to policyholders.

Transactions flow data such as the number of applications processed, the number of policies issued, the number of claims settled, etc. are not publicly available for insurers. However, a satisfactory proxy for the amount of risk-pooling and real insurance services provided is the value of real losses incurred (Berger, Cummins, and Weiss 1997, Cummins, Weiss, and Zi 1999).[9] Losses incurred are defined as the losses that are expected to be paid as the result of providing insurance coverage during a particular period of time. Because the objective of risk-pooling is to collect funds from the policyholder pool and redistribute them to those who incur losses, proxying output by the amount of losses incurred seems quite appropriate. Losses are also a good proxy for the amount of real services provided, since the amount of claims settlement and risk management services also are highly correlated with loss aggregates. Because the types of services provided differ between the principal types of insurance, we use as separate output measures the value of life and non-life insurance losses incurred. Losses incurred and all other monetary values used in the study are expressed in 1986 monetary units by deflating by the Spanish Consumer Price Index (Indice de Precios al Consumo, from the Instituto Nacional de Estadística (INE)).

Losses incurred are a satisfactory measure of output for coverage provided during any given year.

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[9]The use of premiums generally is not considered appropriate because premiums represent price times quantity of output, i.e., insurance revenues (Yuengert 1993). However, robustness checks conducted in prior studies reveal that the efficiency estimates are not materially affected by the use of alternative output proxies such as premiums (Cummins, et al. 1999).

However, insurers also perform services in connection with claims occurring in prior years that have not yet been settled or, in the case of life insurance, claims resulting from contingent events (e.g., mortality) expected to occur in the future. As a proxy for these services, we use the real value of policy reserves maintained by the industry.[10] Because the types of services provided in the reinsurance market differ from those provided in the primary insurance market, we include as separate outputs the real values of reinsurance reserves and reserves for primary insurance contracts. Our final output variable, which proxies for the intermediation function, is the real value of invested assets.

Inputs and Input Prices. We follow the recent insurance efficiency literature in defining four inputs – labor, business services (including materials and physical capital), financial debt capital, and equity capital. Labor is the most important non-interest expense for the Spanish insurance industry, accounting for about two-thirds of total non-loss expenses. The price of labor is the average monthly wage for employees in the insurance sector, provided by the Instituto Nacional de Estadística (INE). Most of the remainder of insurer expenses are for business services such as legal fees, travel, communications, and materials; and we use business services as a second output.[11] The Spanish business services deflator compiled by the INE is used as the price of business services.

Because data on the number of employees or hours worked in the Spanish insurance industry are not available, we follow other insurance efficiency researchers (e.g, Cummins and Weiss 1993, Berger, Cummins, and Weiss 1997, Cummins and Zi 1998) in measuring the quantity of labor by dividing labor expenditures by the insurance sector wage rate. The quantity of business services is defined similarly.

Our other inputs are the quantity of financial equity capital and debt capital (borrowed funds). Financial equity capital is an important input in insurance because insurers must hold equity to ensure

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[10]Reserves in insurance represent the insurer's best estimate of claims to be paid in the future as a result of past events (non-life insurance) or future contingencies (life insurance).

[11] Only a small fraction of expenses are for physical capital such as computers. Consequently, we do not define physical capital as a separate input but include it in the business services category.

policyholders that they will receive payment if claims exceed expectations and to satisfy regulatory requirements. Debt capital provides another source of funds, consisting of borrowed funds as well as deposits from reinsurance companies to guarantee the reinsurers' promise to pay claims on ceded risks. Capital costs represent a significant expense for insurers. However, measuring the cost of capital in the Spanish insurance industry is difficult because few insurers have traded shares. As a proxy for the cost of equity capital, we use the rate of total return on the Madrid Stock Exchange Index for each year of the sample period; and for debt capital we use the one-year Spanish Treasury bill rate.[12]

Summary. To summarize, we use five outputs and four inputs. The outputs are non-life insurance losses incurred, life insurance losses incurred, reinsurance reserves, reserves for primary insurance contracts, and invested assets. The inputs are labor, business services, debt capital, and equity capital.

Frontier Efficiency Concepts

To measure efficiency in the Spanish insurance industry, we utilize modern frontier efficiency analysis (Lovell 1993, Grosskopf 1993). This technique involves measuring the performance of each firm in the industry relative to "best practice" efficient frontiers. Efficiency scores vary between zero and 1, with fully efficient firms having efficiencies equal to 1 and inefficient firms having efficiencies between zero and 1. This section provides a brief overview of the frontier efficiency methodology.

We estimate efficient production and cost frontiers, providing measures of cost, technical, and allocative efficiency for each firm in our sample. *Cost efficiency* for a given firm is defined as the ratio of the costs of a fully efficient firm (i.e., a firm operating on the efficient cost frontier) with the same output quantities and input prices to the given firm's actual costs. One minus a firm's efficiency ratio provides a

[12]It would be preferable to vary both the cost of equity and the cost of debt capital by insurer depending upon capital structure and portfolio risk. However, the data to do this are not available. As a robustness check, we also estimated efficiency by creating three tiers of insurers, with differing costs of debt capital based upon their capital to asset ratios, giving insurers with lower capital to asset ratios higher costs of debt. The results indicated that the efficiency scores and efficiency rankings are not substantially affected by the choice of interest rate assumption. As additional controls for cost of capital differences in capital structure among firms, we include the ratios of equity and debt capital to assets in our probit regression analysis, as explained below.

measures of the proportion by which costs could be reduced if the firm were operating on the cost frontier. Firms achieve cost efficiency by adopting the best practice technology (becoming *technically* efficient) and choosing the optimal mix of inputs (becoming *allocatively* efficient), conditional on outputs and input prices.

Technical efficiency for a given firm is defined as the ratio of the input usage of a fully efficient firm producing the same output vector to the input usage of the firm under consideration. Technical efficiency can be decomposed into *pure technical efficiency* and *scale efficiency*. Pure technical efficiency is measured relative to a variable returns to scale (VRS) production frontier, i.e., a frontier characterized by increasing, constant, and/or decreasing returns to scale. Firms operating on the VRS frontier are considered fully efficient in the pure technical sense. If the firm is operating with increasing or decreasing returns to scale, it can improve its efficiency by moving to a constant returns to scale frontier, i.e., by becoming scale efficient. Technical efficiency can be shown to equal the product of pure technical and scale efficiency.

Allocative efficiency measures the firm's success in choosing the cost minimizing combination of inputs. Cost efficiency can be shown to equal the product of technical and allocative efficiency. Therefore, to be fully cost efficient, a firm must be both technically and allocatively efficient.

Estimation Methodology

We estimate efficiency using data envelopment analysis (DEA) (Charnes, et al. 1994). DEA is a non-parametric approach that does not require the specification of a production or cost function but rather computes efficient "best practice" production and cost frontiers based on linear combinations of firms in the industry. DEA has been widely used in recent years to estimate efficiency in a variety of industries and national markets. We consider it appropriate to analyze insurance because a paper by Cummins and Zi (1998) provides evidence that DEA estimates of efficiency for U.S. life insurers are more highly correlated with conventional performance measures such as expense to premium ratios and return on assets than are the estimates obtained using econometric production and cost functions.

A second reason for choosing DEA as our estimation methodology is that the Malmquist approach, which has become a standard methodology for estimating the evolution of productivity and efficiency over time, is conveniently implemented using DEA.[13] Thus, relying on DEA permits us to use the same methodology consistently throughout the paper rather than using the non-parametric approach for some of our estimates and the econometric approach for others. A third important reason for using DEA is that it provides a particularly convenient method for decomposing cost efficiency into allocative, pure technical, and scale efficiency, and thus facilitates our analysis of scale economies.

Technical Efficiency. To measure technical efficiency we employ the input distance function introduced by Shephard (1970). Suppose producer i uses input vector $x_i = (x_{1i}, x_{2i},..., x_{Ki})^T \in \mathbb{R}_+^K$ to produce output vector $y_i = (y_{1i}, y_{2i},..., y_{Ni})^T \in \mathbb{R}_+^N$, where K is the number of inputs, N is the number of outputs, and T denotes vector transpose. 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. The input-oriented distance function is defined by

$$D(x_i,y_i) = sup\ \{\theta : (\frac{x_i}{\theta}, y_i) \in V(y_i)\} = (inf\ \{\theta : (\theta x_i, y_i) \in V(y_i)\})^{-1} \quad \textbf{(1)}$$

The input-oriented distance function is the reciprocal of the minimum equi-proportional contraction of the input vector x_i, given outputs y_i, i.e., Farrell's (1957) measure of input technical efficiency. Input technical efficiency $TE(x_i,y_i)$ is therefore defined as $TE(x_i,y_i) = 1/D(x_i,y_i)$. Technical efficiency is estimated separately for each firm in the sample by solving the following linear programming problem:

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

subject to: $Y \lambda_i \geq y_i$

[13] Although a parametric distance function approach has been developed by Fuentes, Grifell-Tatjé, and Perelman (2001), their approach is based on the translog functional form. Use of the translog for our data would create problems in dealing with specializing firms that have zero values for some outputs. Zero outputs are not a problem in DEA. The problems of dealing with zero outputs using the translog are discussed in Pulley and Humphrey (1993).

$X \lambda_i \leq \theta_i x_i$

$\lambda_i \geq 0$

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 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 = the number of firms in the sample (i = 1, 2, . . ., I). This estimation produces a constant returns to scale (CRS) frontier. The frontiers are estimated year by year, producing a best practice production frontier for each year of the sample period.

The next step is to decompose technical efficiency into its components, pure technical efficiency and scale efficiency, where $TE(x_i,y_i) = PT(x_i,y_i)*SE(x_i,y_i)$, $PT(x_i,y_i)$ = pure technical efficiency, and $SE(x_i,y_i)$ = scale efficiency. Pure technical and scale efficiency are separated by solving (2) with the additional constraint: $\sum_i \lambda_i = 1$ for a variable returns to scale (VRS) frontier, and again with the constraint $\sum_i \lambda_i \leq 1$for a non-increasing returns to scale (NIRS) frontier. Pure technical efficiency (PT) is the solution to the VRS problem, and scale efficiency is then obtained as $SE(x_i,y_i) = TE(x_i,y_i)/PT(x_i,y_i)$. If $SE(x_i,y_i) = 1$, CRS are indicated. If $S \neq 1$ and NIRS efficiency = PT, decreasing returns to scale (DRS) are present; whereas if $S \neq 1$ and the NIRS efficiency measure $\neq$ PT, then increasing returns to scale (IRS) are indicated.

Cost Efficiency. To estimate cost efficiency for our sample firms, we use a two-step procedure. For firm i, let $w_i = (w_{1i}, w_{2i}, \ldots, w_{Ki})^T$ denote the input price vector corresponding to the input vector x_i. Then, we first solve the following problem:

S $$\min_{x_i} \sum_{k=1}^{K} w_{ki} x_{ki} \qquad \textbf{(3)}$$

u

bject to $Y \lambda_i \geq y_i$

$X \lambda_i \leq x_i$

$\lambda_i \geq 0$

The solution vector x_i* is the cost minimizing input vector for the input price vector w_i and the output vector y_i. Second, calculate the ratio $\eta_i = w_i^T x_i^* / w_i^T x_i$ to obtain the cost efficiency measure for firm i. The measure of cost efficiency for firm i, $0 < \eta_i \leq 1$, is interpreted as the proportion by which the firm could multiply its costs and still produce no less of any output. We solve (3) for each firm in the sample for each year, producing a best practice cost frontier for each year of the sample period.

Cost efficiency is the product of technical and allocative efficiency. Thus, having estimates of cost efficiency and technical efficiency enables us to back out estimates of allocative efficiency using the relationship: $AE(x_i,y_i) = CE(x_i,y_i)/TE(x_i,y_i)$, where $CE(x_i,y_i)$ = cost efficiency, $TE(x_i,y_i)$ = technical efficiency, and $AE(x_i,y_i)$ = allocative efficiency, evaluated at input-output vector (x_i,y_i).

Malmquist Analysis. If consolidation in the Spanish insurance industry has been beneficial, we would expect the Malmquist indices to reveal positive shifts in the production frontier and/or changes in technical efficiency over the sample period. 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 (for further details, see Grosskopf 1993).

Technical change and technical efficiency change cannot be measured accurately using trends in annual average efficiency scores because the average scores are based on separate frontiers estimated for each year of the sample period.[14] The Malmquist approach avoids this problem of interpretation by also measuring each firm's position in year t+j (t) relative to the frontier of period t (t+j). To illustrate the Malmquist approach, consider the production frontiers for a single input, single output firm in Figure 1. 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 any level of output

[14]It would be possible, for example, for year t+j's frontier to dominate that of year t but for the average score to be higher in year t than in year t+j, i.e., firms could be positioned closer to the frontier in period t but that frontier could be dominated by the frontier for period t+j.

using less of the input than was required by technology $0V^t$.

Suppose that the 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 principal 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 experienced technical efficiency change because it is operating closer to the frontier in t+1 than it was in period t. The Malmquist approach measures both improvements in technology and changes in efficiency relative to the frontiers for different time periods.

To define the Malmquist index for the production frontier, we modify equation (1) to incorporate time and define input distance functions with respect to two different time periods as:[15]

$$D^t(x^{t+1}, y^{t+1}) = sup\{\theta : (\frac{x^{t+1}}{\theta}, y^{t+1}) \in V^t(y^{t+1})\} \qquad \textbf{(4)}$$

$$D^{t+1}(x^t, y^t) = sup\{\theta : (\frac{x^t}{\theta}, y^t) \in V^{t+1}(y^t)\} \qquad \textbf{(5)}$$

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). In equation (4) the input-output bundle in time period t+1 is evaluated relative to the technology of period t; while in equation (5) the input-output bundle in period t is evaluated relative to the technology of time t+1. In Figure 1, $D^{t+1}(x_i^t, y_i^t) = 0a/0c$ and $D^t(x_i^{t+1}, y_i^{t+1}) = 0e/0d$.[16] The distance functions (equations (4) and (5)) are estimated by solving linear programming problems similar to problem (2).

Malmquist indices can be defined relative to either the technology in period t or the technology in

[15] We drop the subscript i to conserve notation, but the optimization is still conducted for a specific firm.

[16] 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 ≥ 1. For example, 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.

period t+1, as follows:

$$M^{t} = \frac{D^{t}(x^{t},y^{t})}{D^{t}(x^{t+1},y^{t+1})} \quad or \quad M^{t+1} = \frac{D^{t+1}(x^{t},y^{t})}{D^{t+1}(x^{t+1},y^{t+1})} \tag{6}$$

where M^t measures productivity growth between periods t and t+1 using the technology in period t as the reference technology, while M^{t+1} measures productivity growth with respect to the technology in period t+1. To avoid an arbitrary choice of reference technology, the input-oriented Malmquist index of total factor productivity is defined as the geometric mean of M^t and M^{t+1} (Grosskopf 1993):

$$M(x^{t+1}, y^{t+1}, x^{t}, y^{t}) = [(\frac{D^{t}(x^{t}, y^{t})}{D^{t}(x^{t+1}, y^{t+1})}) (\frac{D^{t+1}(x^{t}, y^{t})}{D^{t+1}(x^{t+1}, y^{t+1})})]^{\frac{1}{2}} \tag{7}$$

In Figure 1, the total factor productivity index is equal to $\{[(0a/0b)/(0e/0d)][(0a/0c)/(0e/0f)]\}^{½}$.

The Malmquist productivity index can be decomposed into measures of technical efficiency change and technical change, by factoring as follows:

$$M(x^{t+1}, y^{t+1}, x^{t}, y^{t}) = (\frac{D^{t}(x^{t}, y^{t})}{D^{t+1}(x^{t+1}, y^{t+1})}) [(\frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t}(x^{t+1}, y^{t+1})})(\frac{D^{t+1}(x^{t}, y^{t})}{D^{t}(x^{t}, y^{t})})]^{\frac{1}{2}} \tag{8}$$

The first ratio in equation (8), in parentheses, represents technical efficiency change, i.e., the relative distance of the input-output bundle from the frontier in periods t and t+1. Recall that both the numerator and denominator of this ratio must be ≥ 1 and that values closer to 1 represent higher efficiency. Thus, if technical efficiency is higher in period t+1 than in period t, the value of this ratio will be > 1; while if efficiency declines between the two periods, the value of the ratio will be < 1. In terms of Figure 1, technical efficiency change is measured as the ratio [(0a/0b)/(0e/0f)].

The second factor in equation (8), in brackets, is a geometric mean representing technical change (shifts in the frontier) between periods t and t+1. Values of the second factor > 1 imply technical progress and values < 1 imply technical regress. Intuitively, the bracketed factor represents the distance between the period t and period t+1 frontiers. The distance between the frontiers at output level y^t is 0b/0c, and the distance between the frontiers at output level y^{t+1} is 0d/0f. The Malmquist index of technical change (the bracketed expression in (8)) is the geometric mean of these two distances, i.e., $[(0b/0c)\ (0d/0f)]^{1/2}$.

4. Results

This section presents our results on the effects of deregulation in the Spanish insurance market. We begin by tracing changes in the numbers of firms and market concentration over the sample period. The efficiency results are then presented, including our analysis of scale economies. We next discuss mergers and acquisitions (M&As) and present probit regressions, with zero-one dependent variables, respectively, for M&A target firms, firms exiting the market for other reasons, and firms participating in the M&A market as acquirers. Finally, we discuss the results of the Malmquist total factor productivity analysis.

Concentration Trends and Efficiency

A statistical summary of market structure in the Spanish insurance industry is presented in Table 1. The table shows four, eight, and twenty-firm concentration ratios for non-life insurers, life insurers, and the entire industry, based on premium revenues. Numbers of firms and Herfindahl indices are also shown. The number of firms in the industry fell dramatically over the sample period, due to firm retirements, insolvencies, mergers, and acquisitions. The number of companies offering non-life insurance fell from 436 to 280, and the number offering life insurance declined from 159 to 116. The total number of firms in the industry fell by 35 percent (from 508 to 331) over the sample period.[17]

Concentration generally increased in the non-life insurance segment of the Spanish insurance industry. The twenty-firm concentration ratio increased from 47.3 percent in 1989 to 59.6 percent in 1998; and the Herfindahl index rose from 163.0 to 237.9. In contrast, concentration declined in the life insurance segment of the Spanish insurance industry, with the four-firm concentration ratio falling from 40.9 percent in 1990 to

[17]The number of firms in the "Total Premiums" section of the table does not equal the sum of the number of firms in the life and non-life sections of the table because the number of firms in the latter two sections of the table includes specialist firms as well as diversified firms offering both types of insurance. The table omits six "depository" firms, a somewhat unusual organizational form which disappeared from the market by 1994.

21.4 percent in 1998 and the Herfindahl index falling from 669.9 in 1990 to 290.1 in 1998.[18] The decline is attributable to smaller firms and new entrants gaining market share at the expense of the large firms that traditionally dominated the industry. Because the industry totals represent the aggregation of the life and non-life results, overall concentration remained relatively constant over the sample period.

Summary statistics on outputs, inputs, and input prices are shown in Table 2.[19] Average firm size in terms of invested assets grew by 275.5 percent, from 5.2 billion to 19.5 billion pesetas. The output category with the highest growth rate was invested assets, which increased by 124.7 percent over the sample period. As percentages of total input expenditures, labor, debt capital expenditures, and equity capital expenditures declined and business services expenditures increased. This is suggestive of technological advances, because information technology expenditures are included in the business services category. As a first indication of market productivity gains, we find that the total value of outputs increased by 91.9 percent over the sample period, while total input expenditures increased by only 56.6 percent.

The efficiency results are presented in Table 3, which shows average efficiencies for the entire sample as well as by asset size quartile. Averages are shown for cost efficiency and its components – pure technical, allocative, and scale efficiency. At this stage, we focus on the efficiency results for the entire sample. The size quartile results are discussed below as part of the analysis of economies of scale.

Cost efficiencies for Spanish insurers are low relative to those estimated by prior researchers for non-life and life insurers in the United States (Cummins and Weiss 1993, Cummins and Zi 1998).[20] The

[18]The life insurance and total concentration statistics are affected in 1989 and 1994 by large amounts of single premium (prima única) life insurance policies issued in those years. Single premium policies are purchased with one up-front premium rather than periodical premiums as in most types of insurance. The surge in 1989 was caused by the removal of a tax advantage for life insurance purchases in the last half of the year, and the surge in 1994 followed the externalization of internal employee funds to insurance or pension funds.

[19]All monetary valued variables are expressed in millions of constant 1986 pesetas based on the Spanish consumer price index.

[20]However, it would not be correct to conclude that Spanish insurers are less efficient than insurers in the U.S., because the efficiency scores are taken from different frontiers. It would be possible, for example, for most Spanish insurers to be inefficient relative to the Spanish frontier and simultaneously for the Spanish frontier

(unweighted) average cost efficiency was 15.5% in 1989 and 22.7% in 1998. The results imply that the average Spanish insurer could have reduced its costs by 77.3% in 1998 by operating on the efficient frontier. Clearly, there are significant opportunities for efficiency gains in this market, and it is doubtful that the least efficient firms will be able to survive in the long-run unless they significantly improve their performance.

The average technical efficiency (the product of pure technical and scale efficiency) for Spanish insurers in 1998 is 53.6%. This is about the same as the technical efficiency of insurers in France and Austria, higher than for insurers in Germany, and lower than for insurers in Italy (Fecher, et al. 1993; Mahlberg and Url 1998, 2000; and Cummins, et al. 1997, respectively). Scale efficiency for Spanish insurers in 1998 averages 89.3%, which is somewhat higher than scale efficiencies for Austrian and German insurers reported in Mahlberg and Url (1998, 2000). Therefore, the dispersion of Spanish insurers relatively to the Spanish best practice frontiers is generally comparable to that found by prior researchers for other EU insurers, relative to their own national frontiers. Prior researchers have not provided estimates of cost or allocative efficiency for European insurance firms.

The decomposition of Spanish insurers' cost efficiency reveals that the most severe efficiency loss occurs as a result of allocative inefficiency, which averages only 41.2% in 1998, suggesting that Spanish insurers on average do not do a very good job in choosing the cost minimizing combination of inputs. This is characteristic of a market that has been sheltered from competition. The second major source of efficiency loss among Spanish insurers arises from pure technical inefficiency, i.e., the failure of the average insurer to operate on the production frontier. This type of efficiency averaged 60.0% in 1998. Technical inefficiency is an especially serious limitation in a period of rapid technological change, suggesting that many Spanish insurers must improve their technical performance dramatically to remain in the market. Scale efficiency, discussed in more detail below, is relatively high, averaging 89.3% percent in 1998.

Economies of Scale

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to dominate frontiers formed by insurers in other countries. A correct conclusion is that Spanish insurers on average are less efficient relative to their own best practice frontier than are U.S. insurers relative to their frontier.

If a market contains firms operating with increasing and decreasing returns to scale, market efficiency can be increased if more firms attain constant returns to scale because fewer resources are wasted due to firms being either too small or too large. Accordingly, if the Spanish government's policy of encouraging M&As has been beneficial, we expect the proportion of firms operating with increasing returns to scale to decrease (IRS) over the sample period, the proportion operating with constant returns to scale (CRS) to increase, and/or the proportion operating with decreasing returns to scale (DRS) to decline.

To explore the issue of scale economies, we first consider the average efficiency scores by firm size quartile, shown in Table 3. The size quartiles in the table are based on total assets, with quartile 1 (Q1) containing the smallest firms and quartile 4 (Q4) the largest.

In eight of the ten years in the sample period and for the period as a whole, there is a monotonic relationship between cost efficiency and size quartile, with larger firms tending to be more cost efficient. E.g., in 1998, cost efficiency averaged 19.7% for quartile 1 insurers and 30.0% for quartile 4 insurers. The decomposition of cost efficiency into allocative, pure technical, and scale efficiency reveals that the large-firm cost efficiency advantage is primarily attributable to pure technical efficiency, which averages nearly 25 percentage points higher for Q4 insurers than for insurers in the next most efficient quartile for the sample period as a whole, and is no less than 17 percentage points higher for each individual year. Thus, large insurers primarily define the production frontier, suggesting a significant advantage in employing technology. At least in this important dimension, bigger is better in the Spanish insurance industry.

However, further analysis of efficiency by size quartile shows that a high proportion of the large insurers' advantage in pure technical efficiency is lost due to allocative and scale inefficiency. The Q4 insurers have about the same average allocative efficiencies as insurers in the other three size quartiles, suggesting that any advantages conveyed by larger scale in terms of selecting optimal input quantities tend to be offset by the difficulties of allocating resources in larger and more complex organizations.

The scale efficiencies by size quartile, plotted in Figure 2, provide important information regarding the Spanish government's policy of encouraging insurance industry consolidation. The figure shows that firms in the smallest quartile (Q1) are clearly much less scale efficient than firms in the three larger quartiles (Q2, Q3, and Q4), suggesting that many Q1 firms are operating with increasing returns to scale. Thus, the government policy makes sense if it enables small firms to attain more efficient scale, encourages the merger of such firms into larger entities, or gives small firms the incentive to exit the market. However, Figure 2 also suggests that there are limits to the efficiency gains from consolidation. Firms in Q4 are less scale efficient than firms in Q2 and Q3, suggesting that many large firms may be operating with DRS.

Further analysis of scale economies is provided in Figure 3, which shows the proportions of insurers operating with IRS, CRS, and DRS by year from 1989-1998. The proportion of firms in the IRS region declined significantly over the sample period, from 68 percent in 1989 to about 47 percent in 1998. The proportion of firms in the CRS region increased only slightly over the period, from 11 percent in 1989 to 15 percent in 1998, but the proportion in the DRS region increased from 21 percent to 38 percent over the sample period. Thus, although consolidation has reduced the proportion of firms characterized by unrealized scale economies, it has also increased the proportion of firms realizing scale diseconomies.

Analysis of scale economies in 1998 provides some guidance regarding the size categories where IRS tend to be replaced by DRS. Figures 4 and 5 show economies of scale by asset size decile for non-life and life insurers, respectively. The average firm size in each size decile is shown on the horizontal axis. For non-life insurers (Figure 4), the majority of firms tend to encounter DRS at about decile 8 (decile 1 is the smallest), where the average firm size is 3.4 billion pesetas. In decile 9, for example, only 10 percent of non-life insurers operate with IRS and 78 percent operate with DRS. For life insurers (Figure 5), the proportion of firms with IRS drops to zero following decile 7, where the average firm size is 45.7 billion pesetas, and at least half the firms in deciles 8, 9, and 10 operate with DRS. The results also suggest that the minimum efficient scale of operations is considerably larger for life insurers than for non-life insurers. However, about 30 percent of non-life and 40 percent of life insurers in the largest size decile operate with CRS, suggesting that a significant proportion of the largest firms have attained the optimal scale for their operations.

The policy implication to be drawn from the scale economy analysis is that the Spanish government should reassess the viability of encouraging further consolidation in the insurance industry for firms in the largest size deciles. However, there are still many small firms operating in the increasing returns to scale segment of the cost curve, so that continued consolidation of smaller firms may yield efficiency gains.

Entry and Exit

Our analysis of entry and exit breaks down the firms in the industry into five categories – (1) Firms acquired by other firms (M&A target firms), (2) firms withdrawing from the market for other reasons such as insolvency or voluntary liquidation ("other exiting" firms), (3) firms entering the market, (4) firms participating in the M&A market as acquirers, and (5) firms remaining in the market that have not engaged in M&A activity (non-M&A firms).[21] As discussed above, M&A target firms are expected to display some favorable characteristics that attract acquirers. Firms withdrawing from the market for non-M&A reasons are expected to be less efficient than average and also to have other undesirable financial characteristics. Entering firms are expected to be relatively inefficient to the extent that there are unusual fixed costs, a steep learning curve, or other start-up costs that are incurred before the firm becomes fully competitive. Such costs are likely to diminish over time. Thus, entrants might be expected to achieve larger productivity gains than incumbent firms. If consolidation is motivated by efficiency considerations, acquirers should be no less efficient than average and ideally would be more efficient than average. Finally, non-M&A firms are expected to be more efficient than entering firms and "other exiting" firms.

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[21]The total number of entering and exiting firms in the Spanish market is larger than the number in our sample because data were unavailable for some of the firms, e.g., branches of EU firms that do not have to report to the Spanish regulatory authorities after 1994, or because the firms were eliminated from the sample due to data quality problems, such as having zero or negative net worth or premiums. However, other than EU branches after 1994, the sample firms are the most significant firms operating in the Spanish market. The categories of firms by M&A status are not necessarily mutually exclusive. E.g., an entering firm could acquire other firms after entering the market or a firm could engage in acquisitions and then later be acquired by another firm or exit the market for other reasons. For purposes of computing summary statistics, firms that entered or exited the market were categorized as entering and exiting firms, respectively, even if they engaged in M&A activity as acquirers. For purposes of regression analysis, dummy variables were specified, coded as "1" for each category applicable to a given firm for the transaction year and all subsequent years. Thus, firms were allowed to be in more than one category. E.g., a firm that entered the market in 1994 and acquired another firm in 1996 would be given a "1" for the entry dummy variable in 1994-1998 and also a "1" for the acquirer dummy variable in 1996-1998. Non-exclusivity affects only 91 out of 3831 observations in our data base.

The entry and exit experience for the firms in our sample is summarized in Table 4A.[22] The sample includes one hundred thirty-two insurers that exited the market from 1989-1997 – 100 due to M&A activity and 32 for other reasons. The sample also includes 30 firms that entered the market during the sample period. The total number of firms in the sample declined from 447 in 1989 to 328 in 1997.

Pair-wise t-tests for differences between average efficiency scores for the categories of firms in Table 4A are shown in Table 4B. Table 4B shows that M&A targets tend to have higher cost and scale efficiencies than “other exiting” firms, higher cost and pure technical efficiency than entering firms, higher allocative efficiency than acquiring firms, and higher scale efficiency than non-M&A firms. This suggests that Spanish M&As occur primarily because acquiring firms are seeking scale economies and market share rather than trying to add value by rehabilitating inefficient targets. Besides being less cost and scale efficient than M&A targets, “other exiting” firms are also less scale efficient than acquirers and less cost and scale efficient than non-M&A firms. Thus, consolidation has resulted in the removal of inefficient firms from the market.

Entering firms have significantly lower cost and pure technical efficiency but higher allocative efficiency than acquirers and non-M&A firms, and lower cost and pure technical efficiency than target firms. Thus, there appears to be a learning curve for new entrants in implementing technology, but such firms perform relatively well in choosing the cost minimizing combination of inputs. These univariate results must be interpreted with some caution, however, because they do not control other potentially influential factors, providing the rationale for the multi-variate probit analysis discussed below.

Summary statistics and t-tests by entry-exit status are shown in Tables 5A and 5B. Firms exiting the market for non-M&A reasons are significantly smaller in terms of total assets than the other four groups of firms. Such firms are also significantly smaller in terms of premiums than targets, acquiring firms, and non-M&A firms. Target firms are significantly smaller than acquirers, as expected if firms with more financial resources tend to succeed in the acquisitions market. The results thus provide evidence the Spanish

[22]Even though our overall sample period is 1989-1998, data on market entry and exit for 1998 were not readily available, so the entry and exit analysis ends with 1997.

government's consolidation policy has succeeded in removing relatively small firms from the market.

There are also a number of indications that "other exiting" firms were weaker financially than M&A target firms and firms remaining in the market. The other exiting firms had the highest average debt capital-to-asset ratio among the five categories of firms, and the difference is statistically significant with respect to new entrants, acquirers, and non-M&A firms. The other exiting firms also had significantly lower return on equity (ROE) than target firms, acquirers, and non-M&A firms and are the only category for which average ROE is negative. The other exiting firms also had significantly lower ratios of invested assets to total assets than acquirers and non-M&A firms, suggesting poor cash management and/or credit problems with receivables. These results provide evidence that consolidation in the Spanish insurance market has raised the average level of financial quality of the firms in the industry by eliminating relatively weak insurers.

M&A Probit Regressions

Probit regressions to identify the characteristics of M&A target firms, "other exiting" firms, and acquirers are presented in Table 6. In each probit model, the dependent variable is equal to 1 for the firms falling in the category under analysis and equal to zero otherwise.

Efficiency scores are included as explanatory variables in the equations to provide information on the relationship between efficiency and a firm's status as a target, other exiting firm, or acquirer. Several control variables are also included in the equations. These include a dummy variable for organizational form, set equal to 1 for stock firms and to zero otherwise. Because the Spanish insurance market includes specializing in life and non-life insurance as well as diversified firms offering both types of insurance, we include dummy variables set equal to one, respectively, for life and non-life specialist firms and to zero otherwise. The natural log of premiums is used to control for firm size, and the ratios of equity capital and debt capital to assets are included to control for capital structure. Return on equity is included to control for profitability. Year dummy variables are also included in the equations to provide information on differences in M&A status probabilities over time.

The M&A target firm equation shows that firms which are more allocatively and scale efficient are significantly more likely to be M&A targets. The pure technical efficiency variable is negative but not statistically significant. The results thus suggest that acquiring firms seek targets that are allocatively and/or scale efficient but not necessarily technically efficient. Considering that acquirers tend to be large (Table 5) and that large firms in Spain are much more technically efficient than smaller firms (Table 3), acquirers may believe they can deal with technical efficiency problems of target firms but prefer targets to be relatively efficient along other dimensions. There is an inverse relationship between the probability of being an M&A target and the debt capital-to-assets ratio, i.e., suggesting that acquirers tend to avoid highly leveraged firms. The findings that allocative and scale efficiency are positively related to the probability of being acquired and that leverage is negatively related supports the view that acquisitions in Spain tend to be focused on scale and market share gains rather than adding value by improving the performance of inefficient firms.

Both the life and non-life specialist dummy variables are positive and statistically significant in the M&A target equation, suggesting that specialist firms are more likely to be acquired than diversified firms. Not surprisingly, stock firms are more likely to be acquired than mutuals because the existence of stock provides a relatively low-cost mechanism for acquiring a target firm.[23] Finally, there is a monotonically decreasing relationship between the probability of acquisition and the year dummy variables. This makes sense if there are fewer firms with desirable M&A characteristics after the most attractive targets have been acquired and/or if acquirers begin to encounter decreasing returns to scale.

Turning next to the probit model for the probability of exiting the market for non-M&A reasons, such as insolvency or voluntary liquidation, we find that a firm's allocative, pure technical, and scale efficiency are inversely related to the probability of this type of market exit. This provides further evidence that market exit has led to efficiency gains in the Spanish insurance market by removing inefficient firms from the market. The probability of non-M&A exit has a significant negative relationship with the equity capital-to-asset ratio and

[23]It is possible for mutuals to be acquired, even though they do not have ownership shares that can be bought and sold. Mutual acquisitions are more expensive because regulators must be convinced that the rights of the policyholders, who at least nominally own the firm, are protected.

ROE, providing further evidence that non-M&A exits have eliminated under-performing firms. The probability of non-M&A exit also is inversely related to firm size, showing that exit is more probable for small firms. The life and non-life specialist dummy variables are significant and negative, implying that diversified firms are more likely to exit for non-M&A reasons than specialists. The coefficients of the year dummy variables are negative, monotonically decreasing, and significant in the last six years of the sample period. This suggests that the probability of non-M&A exit has declined over time as the smallest and weakest firms have been eliminated.

The final probit regression in Table 6 is for the probability of being an acquiring firm. The results imply that acquiring firms tend to be larger (based on the log of premiums variable) and financially stronger (based on the equity capital-to-assets variable) than non-acquirers. Stock firms also are more likely to be acquirers than mutuals. These relationships suggest that firms with more overall resources, higher capitalization, and superior access to capital markets are more likely to participate in the acquisitions market. The significant negative coefficients of the life and non-life specialist dummy variables provide evidence that diversified firms are more likely to be acquirers than specialists. The year dummy variables are monotonically increasing and significant for the last three years of the sample period. A Wald test rejects the hypothesis that the coefficients for 1994-1997 are equal to those in 1990-1993, providing evidence that the Third Generation Insurance Directives increased the probability of Spanish insurer participation in the acquisitions market.

Although the results in Table 6 provide several indications that consolidation has improved market efficiency, there is also evidence that consolidation may not be wholly beneficial. Specifically, the scale efficiency variable is negative and statistically significant in the acquirer equation, suggesting that scale inefficient firms are more likely to be acquirers. This is perhaps not surprising, given that acquirers tend to be relatively large firms, which are more likely to operate with decreasing returns to scale than smaller firms. Thus, efficiency gains resulting from acquisitions may be at least partially offset by scale inefficiencies.

Malmquist Analysis

We next turn to the Malmquist analysis of technical change and technical efficiency change over the sample period. Recall that Malmquist indices measure total factor productivity growth by considering performance relative to production frontiers for two different years. This requires that the identical sample of firms be available in both comparison years, i.e., firms that entered or exited the market in one of the two comparison years are excluded. Because there has been significant entry and exit in this market over our sample period, we conduct the Malmquist analysis using two samples – (1) the complete panel of firms that were present in all of the years 1989 through 1998 (called the *complete-panel sample*); and (2) all firms that were present in each of the adjacent two-year comparison periods (called the *adjacent-year sample*).[24] The adjacent-year sample is likely to be important if the firms exiting or entering the market show different productivity growth patterns than firms that were in the market for the entire period. Conducting the analysis using both samples thus enables us to minimize any effects of survivor bias.

For each sample, we estimate Malmquist indices by firm for each two-year comparison period and calculate the geometric mean of the resulting estimates to represent market-wide technical efficiency change (TEC), technical change (TC), and total factor productivity change (TFPC) for each comparison period. We also present the arithmetic and geometric averages across the nine two-year comparison periods, 1989-1990, . . . , 1997-1998.[25] For the complete panel sample, we also calculate Malmquist indices that compare the beginning and ending years of the sample period, 1989 versus 1998.[26]

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[24]For example, in the adjacent-year sample, the 1990-1991 Malmquist analysis includes all firms that were present in both 1990 and 1991 irrespective of whether they are present in the other years of the sample period (1989 and 1992-1998).

[25]The averages should be viewed as summary statistics because Malmquist indices do not "chain," i.e., the geometric mean of the nine two-year indices is not mathematically equivalent to the Malmquist index comparing the beginning and ending years of the sample period.

[26]In computing the averages for each two-year Malmquist index comparison, we omit observations above the 99th and below the 1st percentile of Malmquist scores based on the complete panel annual estimates, i.e., we pooled the individual firm results from the nine two-year comparison periods and then use the 99th and 1st percentiles of this pooled sample as trimming criteria applied to each individual two-year comparison set. The complete panel was used because it consists of relatively mature, stable firms that are less likely to be affected by unusual financial results associated with market entry, exit, or unusual growth. This was done because some of the scores were too high or too low to be credible. The effect of this trimming of the results is to slightly increase the estimates of TFP growth in the complete panel sample and to reduce somewhat the implied annual

The Malmquist results are summarized in Table 7. The results are broken out separately for stocks and mutuals because organizational form is likely to have a particularly significant effect on productivity and efficiency growth (Grifel-Tatje and Lovell 1996, Cummins, Weiss, and Zi 1999). This is based on the hypothesis that mutual managers have less incentive than managers of stock insurers to improve the productive performance of the firm, because of the more limited mechanisms for managerial discipline and control available in the mutual ownership form (Fama and Jensen 1983). Thus, we hypothesize that stock insurers will achieve larger productivity and efficiency growth than mutuals.[27]

The top section of Table 7 presents the Malmquist analysis based on the complete panel sample. Immediately below this panel, we present the Malmquist indices for the complete panel 1989 vs. 1998 comparison. The next panel of the table presents the results for the adjacent-year sample. The Malmquist results are summarized as implied annual rates of productivity growth in the final panel of Table 7.

The first important conclusion based on Table 7 is that the Spanish insurance market as a whole experienced productivity growth over the sample period. Focusing on the total factor productivity (TFP) change column in the "All Stocks and Mutuals" section in the final panel of the table, we see that total factor productivity grew at 0.7 percent per year based on the annual geometric mean complete panel results and by 0.6 percent per year based on the 1989 versus 1998 comparison for the complete panel. These annual growth rates imply that total productivity growth over the sample period averaged 6.0 percent based on the annual complete panel comparisons and 5.1 percent based on the 1989 versus 1998 comparison. We emphasize that these are average results and that some insurers achieved higher and lower productivity gains.

The second inference to be drawn from Table 7 is that productivity growth estimates based on the adjacent-year sample are higher on average than for the complete panel sample, e.g., 2.6 percent per year versus 0.7 percent, based on geometric means. This is because the complete panel firms are relatively mature

TFP growth in the adjacent year sample.

[27]For a more complete theoretical and empirical analysis of organizational form, other organizational design choices, and efficiency in the Spanish insurance industry, see Cummins and Rubio-Misas (2001).

firms with less opportunity to make dramatic productivity gains. In fact, these firms were more tightly clustered around the complete panel frontiers in seven of the nine two-year comparison periods than were the adjacent year sample firms around the adjacent year sample frontiers, suggesting that the complete panel firms are more homogeneous.[28] Among firms not present for the entire period, entering firms and target firms in particular experienced relatively large productivity gains.[29]

The third important conclusion based on Table 7 is that Spanish insurers on average experienced positive technical efficiency change during the sample period. For all stocks and mutuals, technical efficiency change was 4.1 percent per year based on the annual complete panel estimates, 3.6 percent based on the 1989 versus 1998 analysis, and 3.9 percent per year based on the adjacent year sample. This suggests that firms were "catching up" to the frontier on average and provides further evidence that consolidation has generally been beneficial in the Spanish insurance industry. However, Spanish firms on average experienced technical regress (negative technical change) during the sample period, implying that production frontiers generally did not achieve favorable shifts over the period. This finding, which mirrors that of Grifel-Tatje and Lovell (1996) for Spanish savings banks, may indicate that costs of adjusting to the new regulatory environment led to some slippage in the production frontier.

The fourth conclusion based on Table 7 is that productivity gains in the Spanish insurance market are generally in the same range as those for Austria but smaller than productivity gains in Germany. For the Spanish industry, total factor productivity grew at 0.7 percent per year for the sample period as a whole based on the complete panel annual results and 2.6 percent per year based on the adjacent year sample. These results are generally comparable with Mahlberg and Url's (1998, 2000) estimates showing an average productivity

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[28]The productivity scores for the complete panel firms differ in the two samples because in the complete panel analysis, the comparison set includes only the complete panel firms, whereas in the adjacent year analysis the set of comparison firms includes both the complete panel firms and firms not present for the entire period.

[29]Regression analysis with total factor productivity growth as the dependent variable and firm characteristics as independent variables confirms that new entrants and target firms had significantly higher total factor productivity growth than other exiting, acquiring, and non-M&A firms. However, the other three entry-exit categories of firms were not significantly different on average in their productivity growth.

gain of 3.25 percent per year in Austria for 1992-1996 but less than their estimated productivity gains of 8.25 percent per year in Germany, also for the period 1992-1996. Thus, all three markets have experienced significant productivity gains in the period encompassing the introduction of the Third Generation Directives.

The fifth important finding based on Table 7 is that stock insurers experienced positive total factor productivity growth over the sample period, whereas productivity growth was negative on average for mutuals. The results thus support the hypothesis that incentives to improve performance are stronger under the stock organizational form than under the mutual organizational form. E.g., the total factor productivity of stocks grew at a rate of 1.3 percent per year based on the geometric mean annual results for the complete panel, 1.1 percent per year based on the 1989 versus 1998 complete panel comparison, and 3.3 percent based on the annual results for the adjacent year sample. The corresponding TFP growth rates for mutuals were -2.6 percent, -2.2 percent, and -1.7 percent, respectively. Overall, the results suggest that stock firms are primarily defining the technical frontier and that mutuals on average were falling behind technologically. Thus, stock firms appear to have responded more effectively to changing market conditions, consistent with the view that stock managers have stronger incentives to optimize performance than do mutual managers.

5. Conclusions

This paper provides new information on the effects of deregulation and consolidation on financial services markets by analyzing the Spanish insurance industry. We analyze a sample consisting of nearly all insurers reporting to the Spanish regulatory authority over the period 1989-1998, which spans the introduction of the European Union's Third Generation Insurance Directives in 1994. The Directives effectively deregulated the insurance industry except for solvency controls. During the 1980s, the Spanish government also introduced policy measures designed to encourage consolidation in the insurance industry, the effects of which are still apparent during our sample period.

We use modern frontier efficiency analysis to measure firm and industry performance over our sample period. "Best practice" production and cost frontiers are estimated using data envelopment analysis (DEA). The cost frontier provides evidence on cost efficiency, which is decomposed into allocative efficiency, pure technical efficiency, and scale efficiency estimates for each firm in the sample in each year. Total factor productivity growth is analyzed using the Malmquist index methodology.

Our analysis of deregulation and consolidation has four major components: (1) We trace the changes in the structure of the Spanish insurance market by analyzing concentration trends in the industry and also analyze the primary sources of inefficiency in the industry. (2) We analyze economies of scale to gauge the appropriateness of the Spanish government's policy of encouraging mergers and acquisitions (M&As) in the insurance industry. (3) We analyze the characteristics of firms involved in entry, exit, and M&As in the industry to determine whether consolidation has removed inefficient and poorly performing firms from the market. We also estimate probit models to identify variables related to the probability of a firm's being an M&A target, a non-M&A exiting firm, and an acquiring firm in the M&A market. (4) Finally, we estimate total factor productivity growth using Malmquist indices to draw inferences about the relationship between consolidation and productivity gains or losses in the industry.

Deregulation has led to dramatic changes in the Spanish insurance market. The number of insurers in the market declined by 35 percent during our sample period, as firms exited the market due to mergers, acquisitions, and liquidations, and average firm size increased by 275 percent. Market concentration increased in the non-life segment of the market and declined in the life insurance market segment, suggesting different competitive conditions and efficient scales of operation in the two market segments.

Cost efficiency is relatively low in the Spanish insurance market, averaging only 22.7 percent in 1998. Thus, Spanish insurers are widely dispersed relative to the Spanish cost frontier, and there are still significant opportunities for efficiency improvements in Spain. The primary source of efficiency loss is allocative inefficiency, i.e., the failure to choose the optimal mix of inputs. Average allocative efficiency in 1998 was only 41.2 percent, whereas pure technical efficiency averaged 60 percent. Thus, Spanish firms on average are more successful in employing technology than in choosing optimal inputs.

In eight of ten years of the sample period and for the period as a whole, there is a monotonic relationship between cost efficiency and firm size quartile in the Spanish insurance industry. Firms in the largest size quartile are more cost efficient primarily because they have higher pure technical efficiencies than firms in the three smaller size quartiles. In 1998, average pure technical efficiency in the largest size quartile (quartile 4) was 78.2 percent, compared to 50.4 percent, 50.2 percent, and 61.1 percent in quartiles 3, 2, and 1. However, the quartile 4 insurers have about the same allocative efficiency as firms in the other three size quartiles and lower scale efficiencies than firms in quartiles 2 and 3. Hence, many large firms would be better off focusing managerial attention on minimizing costs rather than emphasizing growth.

Consolidation has reduced the proportion of firms operating with increasing returns to scale from 68 percent in 1989 to 47 percent in 1998. The proportion of firms operating with constant returns to scale increased only slightly over the sample period, while the proportion operating with decreasing returns to scale increased from 21 to 38 percent. The majority of firms in the top three size deciles operate with decreasing returns to scale, but 30 percent of non-life and 40 percent of life insurers in the largest size decile have achieved constant returns to scale. Thus, it is possible for large firms to be scale efficient, but for many large insurers further efficiency gains from consolidation are likely to be degraded by scale inefficiency.

The probit analysis provides evidence that the probability of being an M&A target firm is positively related to scale and allocative efficiency and inversely related to the debt-capital-to-asset ratio, suggesting that acquisitions have been driven by a quest for size and market share rather than the goal of rehabilitating under-performing firms. The probability of exiting the market for non-M&A reasons is inversely related to allocative, pure technical, and scale efficiency, firm size, the equity capital-to-assets ratio, and return on equity, providing strong evidence that non-M&A exits have eliminated relatively small, inefficient, and otherwise poorly performing firms. Acquiring firms tend to be larger and better capitalized than non-acquirers and are more likely to be stock firms, as expected if firms with more financial resources and access to capital markets tend to succeed in the M&A market. However, there is a significant inverse relationship between scale efficiency and the probability of being an acquirer, again providing a cautionary note about future gains from consolidation among large firms.

The Malmquist analysis shows that Spanish insurers experienced average total factor productivity growth over the sample period ranging from 0.6 to 2.6 percent per year, depending upon whether the analysis is limited to firms that were present during the entire sample period or also included firms that entered or exited the market. The change in total factor productivity was attributable primarily to technical efficiency growth rather than favorable technical change. Thus, consolidation has improved efficiency in the Spanish insurance market, but on average firms have not succeeded in achieving technical improvements. The productivity gains for the market as a whole are primarily driven by stock insurers, implying that this organizational form defines the production frontier, and supporting the hypothesis that the stock organizational form gives managers more incentives to improve firm performance.

Overall, there is substantial evidence that deregulation and consolidation have had beneficial effects on efficiency in the Spanish insurance industry. Many inefficient and otherwise poorly performing firms have exited the market, and acquiring firms in the M&A market have targeted relatively efficient firms with better than average financial performance. On average, insurers registered significant total factor productivity gains over the sample period. The primary caveat in this otherwise favorable picture is that the majority of firms in the three largest size deciles are operating with decreasing returns to scale, suggesting that policy makers should exercise caution in encouraging further M&A activity involving the largest firms in the industry. In addition, many firms continue to operate with low allocative and technical efficiency, suggesting that a shift in emphasis from growth to cost minimization and technology is the best path to further performance improvements.

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Figure 1: Productivity Change and Efficiency Change

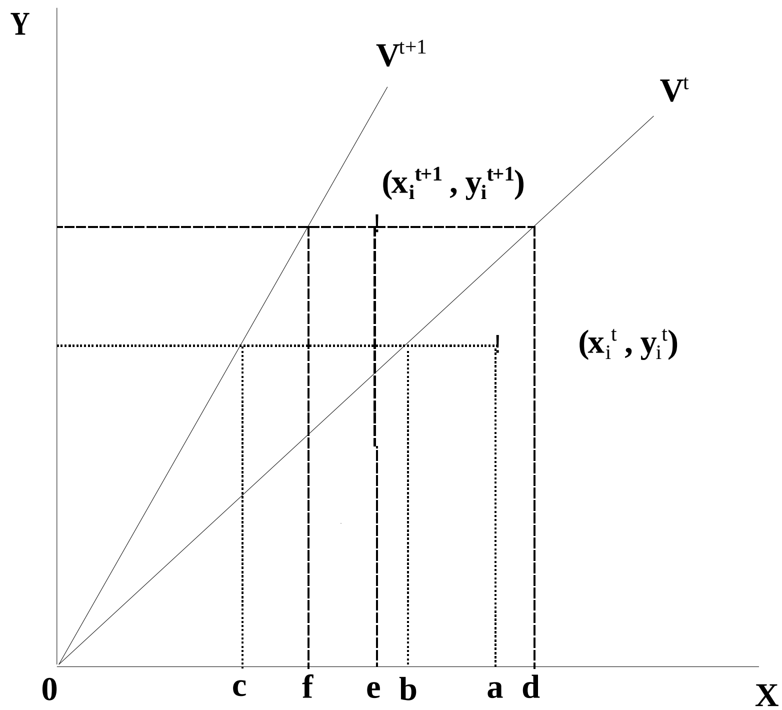

Figure 2: Scale Efficiency By Size Quartile

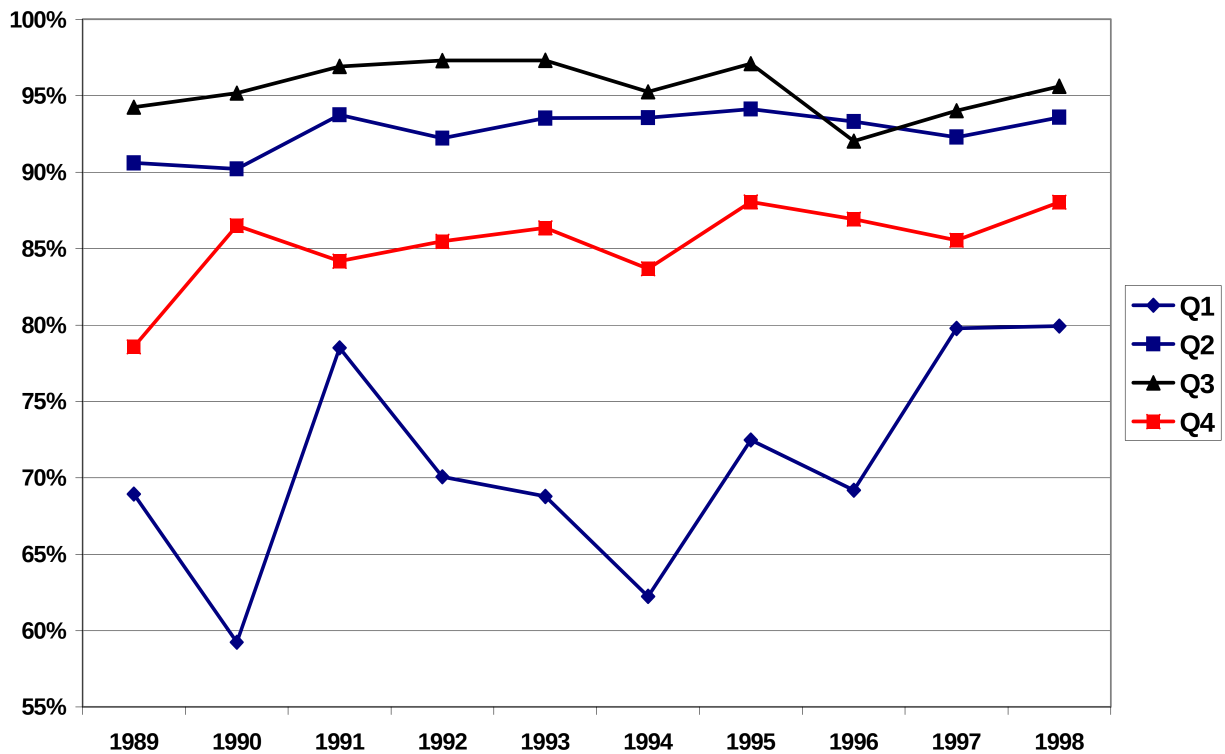

Figure 3: Economies of Scale: All Spanish Firms 1989-1998

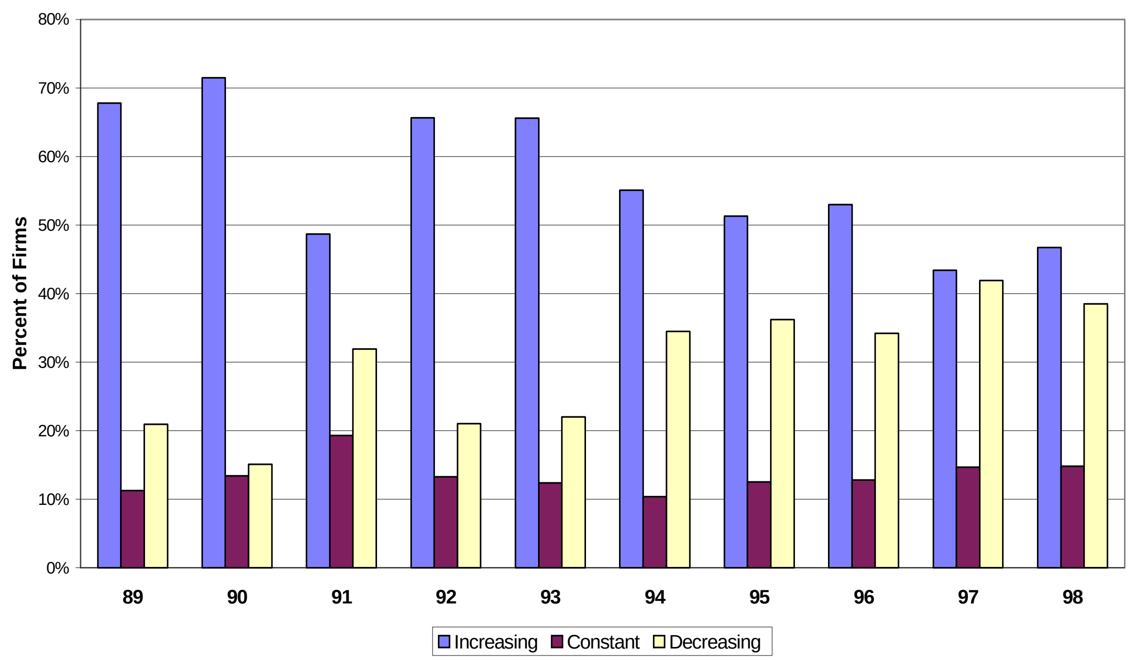

Figure 4: Economies of Scale: Non-Life Insurers 1998

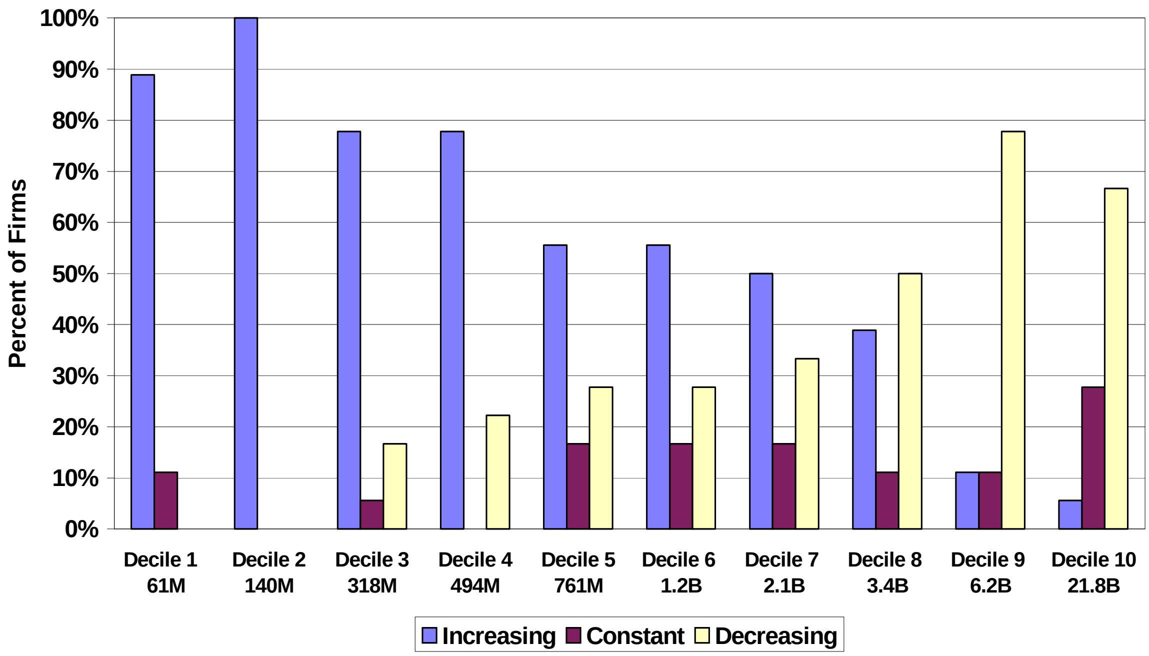

Figure 5: Economies of Scale: Life Insurers 1998

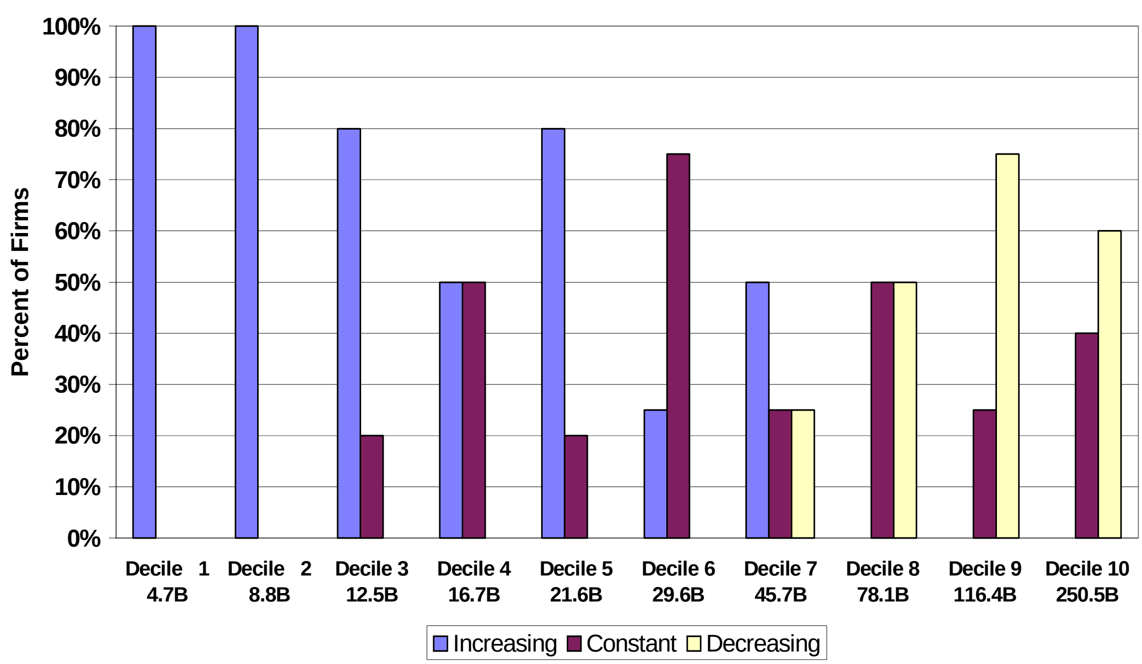

Table 1
Concentration Ratios for the Spanish Insurance Industry

	Non Life Premiums				Life Premiums				Total Premiums			
Year	**4-Firm**	**8-Firm**	**20-Firm**	**Herf**	**4-Firm**	**8-Firm**	**20-Firm**	**Herf**	**4-Firm**	**8-Firm**	**20-Firm**	**Herf**
89	17.0%	27.2% (436 firms)	47.3%	163.0	57.7%	69.7% (159 firms)	84.2%	1183.0	28.8%	37.3% (508 firms)	54.5%	332.3
90	16.0%	26% (419 firms)	46.2%	157.5	40.9%	56.1% (163 firms)	75.5%	669.9	17.2%	26.9% (493 firms)	45.8%	164.1
91	16.0%	26.5% (421 firms)	48.4%	164.3	40.2%	56.0% (156 firms)	78.1%	576.1	18.3%	29.0% (497 firms)	48.6%	176.8
92	17.2%	26.5% (396 firms)	47.6%	169.0	40.3%	56.2% (153 firms)	75.6%	547.3	17.5%	27.8% (471 firms)	46.7%	162.7
93	17.9%	27.0% (380 firms)	48.2%	180.1	31.4%	49.4% (146 firms)	70.7%	412.0	15.1%	24.6% (449 firms)	43.8%	144.7
94	18.8%	28.87% (355 firms)	50.6%	195.2	43.4%	57.8% (135 firms)	78.1%	639.6	22.2%	31.4% (423 firms)	50.5%	206.1
95	18.7%	29.21% (316 firms)	52.7%	203.7	26.3%	41.2% (132 firms)	68.4%	331.0	14.9%	24.8% (380 firms)	45.6%	150.2
96	20.0%	30.90% (302 firms)	54.6%	212.9	25.6%	40.3% (126 firms)	66.8%	318.1	15.0%	24.3% (365 firms)	45.7%	149.4
97	19.4%	30.8% (299 firms)	55.4%	212.4	24.2%	39.4% (120 firms)	64.8%	295.4	13.4%	22.5% (355 firms)	44.5%	142.9
98	20.5%	33.9% (280 firms)	59.6%	237.9	21.4%	37.1% (116 firms)	68.0%	290.1	12.3%	21.7% (331 firms)	45.3%	149.0

Note: Six firms with the "depository" organizational forms are omitted from the table. This organizational form disappeared from the market by 1994.

Table 2: Outputs, Inputs, and Input Prices for Spanish Insurance Firms, 1989-1998

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Outputs										
Non-life Losses Incurred										
Total	536,341	605,792	651,514	672,960	696,462	710,570	743,733	776,458	787,031	839,528
Arithmetic mean	1,181	1,393	1,484	1,653	1,728	1,915	2,125	2,231	2,378	2,865
Standard deviation	3,303	3,882	4,081	4,366	4,675	5,133	5,589	5,786	6,075	7,546
Life Losses Incurred										
Total	1,520,200	505,590	670,942	668,157	691,221	1,025,434	979,464	1,132,373	1,278,255	1,306,342
Arithmetic mean	3,348	1,162	1,528	1,642	1,715	2,764	2,798	3,254	3,862	4,459
Standard deviation	30,171	6,591	7,239	7,338	6,802	13,111	9,128	10,416	11,559	12,453
Reinsurance Reserves										
Total	219,794	238,170	237,517	241,452	239,789	231,395	217,083	214,796	215,950	230,986
Arithmetic mean	484	548	541	593	595	624	620	617	652	788
Standard deviation	1,461	1,548	1,497	1,547	1,588	1,552	1,599	1,624	1,771	2,178
Non-Reinsurance Reserves										
Total	2,461,682	2,199,207	2,423,687	2,622,105	2,854,308	3,475,460	4,016,591	4,592,439	5,144,954	5,530,462
Arithmetic mean	5,422	5,056	5,521	6,443	7,083	9,368	11,476	13,197	15,544	18,875
Standard deviation	26,080	20,916	18,985	19,331	20,824	26,713	30,589	34,742	39,112	45,600
Invested Assets										
Total	2,356,321	2,168,652	2,282,134	2,441,355	2,767,209	3,542,359	4,231,598	4,880,899	5,468,130	5,709,576
Arithmetic mean	5,190	4,985	5,198	5,998	6,867	9,548	12,090	14,026	16,520	19,487
Standard deviation	25,776	20,727	18,236	18,028	19,274	25,516	30,267	34,370	39,386	44,945
Inputs										
Labor										
Total	274,447	294,926	313,467	326,683	324,430	320,522	324,473	338,074	342,794	315,363
Arithmetic mean	605	678	714	803	805	864	927	971	1,036	1,076
Standard deviation	1,374	1,473	1,560	1,700	1,698	1,817	1,991	2,136	2,254	2,399
Business Services										
Total	103,234	109,975	118,177	122,999	122,470	123,110	131,396	140,979	145,441	173,758
Arithmetic mean	227	253	269	302	304	332	375	405	439	593
Standard deviation	543	547	569	627	608	680	791	847	893	1,241
Debt Capital										
Total	466,910	335,859	352,417	363,748	338,577	346,725	339,358	349,962	380,347	609,951
Arithmetic mean	1,028	772	803	894	840	935	970	1,006	1,149	2,082
Standard deviation	5,455	2,068	1,941	2,159	1,869	1,989	2,102	2,131	2,650	8,631
Equity Capital										
Total	500,476	519,818	578,758	565,192	602,525	577,429	649,964	759,880	787,596	771,317
Arithmetic mean	1,102	1,195	1,318	1,389	1,495	1,556	1,857	2,184	2,379	2,632
Standard deviation	3,120	3,123	3,355	3,477	3,625	3,767	4,176	5,035	5,432	5,406
Input Prices										
Labor	1.670	1.751	1.846	1.892	1.941	1.964	1.984	2.034	2.078	2.191
Business Services	1.216	1.329	1.446	1.572	1.678	1.740	1.824	1.884	1.928	1.999
Debt Capital	0.131	0.138	0.123	0.121	0.105	0.079	0.097	0.072	0.050	0.038
Equity Capital	0.290	0.307	0.312	0.294	0.274	0.274	0.238	0.226	0.218	0.228
Number	454	435	439	407	403	371	350	348	331	293

Note: Monetary variables are expressed in constant million 1986 ptas, based on the Spanish consumer price index.

Table 3: Efficiency of Spanish Insurance Firms, 1989-1998

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average 1989-98
Quartile 1											
Cost Efficiency	0.112	0.108	0.091	0.109	0.120	0.105	0.107	0.105	0.123	0.197	0.118
Pure Technical Efficiency	0.392	0.312	0.349	0.409	0.410	0.418	0.436	0.465	0.462	0.611	0.426
Allocative Efficiency	0.435	0.652	0.364	0.426	0.427	0.407	0.350	0.325	0.345	0.398	0.413
Scale Efficiency	0.689	0.592	0.785	0.701	0.688	0.622	0.725	0.692	0.798	0.799	0.709
Quartile 2											
Cost Efficiency	0.152	0.180	0.145	0.155	0.146	0.137	0.140	0.144	0.181	0.202	0.158
Pure Technical Efficiency	0.286	0.298	0.336	0.311	0.323	0.338	0.351	0.362	0.470	0.502	0.358
Allocative Efficiency	0.557	0.653	0.459	0.517	0.474	0.443	0.423	0.421	0.409	0.412	0.477
Scale Efficiency	0.906	0.902	0.937	0.922	0.935	0.936	0.941	0.933	0.923	0.936	0.927
Quartile 3											
Cost Efficiency	0.153	0.171	0.136	0.157	0.160	0.184	0.163	0.199	0.211	0.208	0.174
Pure Technical Efficiency	0.357	0.340	0.345	0.393	0.405	0.443	0.403	0.444	0.457	0.504	0.409
Allocative Efficiency	0.488	0.570	0.466	0.472	0.436	0.439	0.423	0.447	0.453	0.407	0.460
Scale Efficiency	0.942	0.952	0.969	0.973	0.973	0.953	0.971	0.920	0.940	0.956	0.955
Quartile 4											
Cost Efficiency	0.203	0.252	0.201	0.263	0.245	0.238	0.234	0.241	0.299	0.300	0.248
Pure Technical Efficiency	0.640	0.608	0.594	0.646	0.646	0.676	0.694	0.731	0.719	0.782	0.674
Allocative Efficiency	0.441	0.505	0.433	0.473	0.429	0.421	0.372	0.365	0.458	0.431	0.433
Scale Efficiency	0.786	0.865	0.842	0.855	0.863	0.837	0.880	0.869	0.855	0.880	0.853
All Firms											
Cost Efficiency	0.155	0.178	0.143	0.171	0.168	0.166	0.161	0.172	0.204	0.227	0.174
Pure Technical Efficiency	0.419	0.390	0.406	0.440	0.446	0.469	0.472	0.501	0.527	0.600	0.467
Allocative Efficiency	0.480	0.595	0.431	0.472	0.441	0.427	0.392	0.389	0.417	0.412	0.446
Scale Efficiency	0.830	0.827	0.883	0.862	0.865	0.836	0.879	0.854	0.879	0.893	0.861

Table 4A: Efficiency and Consolidation: 1989-1997

	M&A Target			Other Exiting			Entering			Acquiring			Non-M&A		
Efficiency Type	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**	**N**
1989-1997															
Cost	0.170	0.137	100	0.120	0.112	32	0.097	0.093	30	0.150	0.111	85	0.157	0.148	484
Pure Technical	0.452	0.270	100	0.449	0.299	32	0.260	0.271	30	0.504	0.298	85	0.428	0.263	484
Allocative	0.463	0.213	100	0.454	0.207	32	0.523	0.200	30	0.397	0.155	85	0.459	0.164	484
Scale	0.879	0.176	100	0.751	0.303	32	0.871	0.177	30	0.861	0.148	85	0.842	0.202	484
1989															
Cost	0.246	0.168	24	0.111	0.035	5	0.023	0.017	3	0.129	0.079	26	0.148	0.148	389
Pure Technical	0.449	0.229	24	0.383	0.303	5	0.357	0.557	3	0.484	0.345	26	0.407	0.296	389
Allocative	0.608	0.196	24	0.514	0.166	5	0.389	0.162	3	0.481	0.191	26	0.472	0.198	389
Scale	0.905	0.155	24	0.780	0.245	5	0.570	0.332	3	0.726	0.244	26	0.836	0.215	389
1990															
Cost	0.184	0.052	6	0.180	0.191	7	0.064	0.065	11	0.195	0.182	29	0.177	0.180	379
Pure Technical	0.450	0.290	6	0.406	0.304	7	0.099	0.080	11	0.472	0.325	29	0.386	0.285	379
Allocative	0.538	0.172	6	0.583	0.200	7	0.688	0.128	11	0.614	0.245	29	0.593	0.219	379
Scale	0.895	0.088	6	0.830	0.277	7	0.842	0.151	11	0.804	0.193	29	0.826	0.226	379
1991															
Cost	0.086	0.029	11	0.079	0.047	7	0.107	0.100	5	0.131	0.088	39	0.148	0.161	375
Pure Technical	0.185	0.122	11	0.509	0.257	7	0.206	0.161	5	0.496	0.339	39	0.402	0.295	375
Allocative	0.591	0.156	11	0.267	0.159	7	0.509	0.090	5	0.403	0.165	39	0.431	0.192	375
Scale	0.915	0.141	11	0.738	0.347	7	0.966	0.045	5	0.843	0.190	39	0.889	0.183	375
1992															
Cost	0.228	0.160	4	0.053	0.036	3			0	0.136	0.082	40	0.175	0.185	359
Pure Technical	0.659	0.253	4	0.244	0.204	3			0	0.489	0.331	40	0.432	0.293	359
Allocative	0.376	0.255	4	0.492	0.142	3			0	0.416	0.166	40	0.479	0.205	359
Scale	0.968	0.032	4	0.656	0.394	3			0	0.840	0.179	40	0.865	0.195	359
1993															
Cost	0.119	0.071	12	0.082	0.039	7	0.300	0	1	0.128	0.081	45	0.177	0.179	335
Pure Technical	0.403	0.220	12	0.468	0.371	7	0.461	0	1	0.483	0.327	45	0.443	0.287	335
Allocative	0.368	0.165	12	0.418	0.240	7	0.651	0	1	0.383	0.153	45	0.452	0.178	335
Scale	0.862	0.170	12	0.688	0.353	7	1.000	0	1	0.858	0.158	45	0.869	0.191	335
1994															
Cost	0.142	0.143	12	0.184	0.045	2	0.128	0	1	0.144	0.118	51	0.171	0.172	299
Pure Technical	0.477	0.305	12	0.512	0.221	2	0.246	0	1	0.493	0.301	51	0.466	0.292	299
Allocative	0.337	0.120	12	0.610	0.006	2	0.586	0	1	0.371	0.132	51	0.439	0.188	299
Scale	0.822	0.185	12	0.684	0.436	2	0.890	0	1	0.841	0.179	51	0.839	0.218	299
1995															
Cost	0.105	0.055	10			0	0.102	0.059	4	0.146	0.130	53	0.168	0.175	279
Pure Technical	0.481	0.308	10			0	0.520	0.336	4	0.498	0.310	53	0.468	0.294	279
Allocative	0.324	0.200	10			0	0.259	0.107	4	0.352	0.186	53	0.405	0.193	279
Scale	0.928	0.088	10			0	0.883	0.130	4	0.889	0.124	53	0.876	0.197	279
1996															
Cost	0.178	0.185	11			0	0.083	0.018	2	0.152	0.127	60	0.177	0.192	273
Pure Technical	0.596	0.294	11			0	0.174	0.078	2	0.524	0.288	60	0.493	0.295	273
Allocative	0.360	0.241	11			0	0.513	0.124	2	0.351	0.184	60	0.399	0.198	273
Scale	0.791	0.292	11			0	0.981	0.003	2	0.864	0.147	60	0.853	0.198	273
1997															
Cost	0.195	0.124	10	0.380	0.000	1	0.198	0.163	3	0.174	0.157	59	0.211	0.211	255
Pure Technical	0.516	0.281	10	1.000	0.000	1	0.491	0.299	3	0.531	0.295	59	0.522	0.290	255
Allocative	0.478	0.167	10	0.380	0.000	1	0.373	0.270	3	0.367	0.155	59	0.428	0.198	255
Scale	0.872	0.225	10	1.000	0.000	1	0.982	0.008	3	0.876	0.161	59	0.881	0.163	255

Table 4B: t-Tests for Differences Between Mean Efficiencies (1989-1997 Averages)

Type of Efficiency	Target vs. Other Exiting t-Value		Target vs. Entering t-Value		Target vs. Acquiring t-Value		Target vs. Non-M&A t-Value		Other Exiting vs. Entering t-Value	
Cost	2.06	**	3.35	***	1.10		0.82		0.07	
Pure Technical	0.06		3.41	***	-1.23		0.82		0.38	
Allocative	0.21		-1.44		2.42	**	0.17		-0.06	
Scale	2.28	**	0.23		0.78		1.87	*	-0.06	

Type of Efficiency	Other Exiting vs. Acquiring t-Value		OtherExit vs. Non-M&A t-Value		Entering vs. Acquiring t-Value		Entering vs. Non-M&A t-Value	Value	Acquiring vs. Non-M&A t-Value	
Cost	-1.27		-1.78	*	-2.54	**	-3.32	***	-0.55	
Pure Technical	-0.89		0.38		-4.13	***	-3.31	***	2.20	**
Allocative	1.41		-0.14		3.14	***	1.73	*	-3.36	***
Scale	-1.97	**	-1.69	*	0.28		0.85		1.00	

Note: Pairwise comparisons are based on average efficiencies for each category of firm for the entire sample period, 1989-1997. In each comparison, the average efficiency for the second type of firm is subtracted from the average efficiency for the first type of firm to conduct the test. E.g., the test statistics in the Target vs. Other Exiting tests are equal to the average efficiencies of the Target firms minus the average efficiencies of the Other Exiting Firms.
*** Significant at the 1 percent level, ** significant at the 5 percent level, * significant at the 10 percent level.

Table 5A: Summary Statistics for Spanish Insurance Firms, 1989-1997

	Targets	Other Exiting	Entering	Acquirer	Non-M&A
Number of firms	100	32	30	85	484
Total Assets					
Mean	6,879	1,852	8,166	26,965	8,252
Std. Dev	20,046	2,531	18,268	50,694	21,987
Median	624	856	1,439	9,233	1,123
Total Premiums					
Mean	2,825	1,038	2,267	10,222	3,154
Std. Dev	7,040	2,078	6,896	14,695	8,042
Median	511	162	290	5,067	615
Equity capital to assets ratio					
Mean	0.392	0.433	0.588	0.290	0.430
Std. Dev	0.265	0.305	0.336	0.236	0.272
Median	0.384	0.340	0.609	0.184	0.401
Debt capital to assets ratio					
Mean	0.135	0.182	0.100	0.115	0.128
Std. Dev	0.105	0.178	0.119	0.100	0.104
Median	0.118	0.133	0.044	0.089	0.101
Invested assets to assets ratio					
Mean	0.449	0.387	0.489	0.580	0.479
Std. Dev	0.252	0.214	0.342	0.208	0.213
Median	0.455	0.384	0.441	0.575	0.477
Return on equity before tax*					
Mean	0.107	-0.040	0.028	0.065	0.076
Std. Dev	0.212	0.216	0.137	0.183	0.143
Median	0.083	-0.022	0.015	0.069	0.081
Reins reserves/Total reserves					
Mean	0.083	0.127	0.093	0.123	0.135
Std. Dev	0.150	0.210	0.199	0.183	0.216
Median	0.002	0.014	0.002	0.059	0.014
Life insurance premiums					
Mean	4388	392	1340	5699	4502
Std. Dev	11096	682	3099	12495	10072
N	25	7	15	50	161
Median	743	123	214	1053	996
Non-life insurance premiums					
Mean	2033	1054	2661	8342	1927
Std. Dev	4512	2162	8487	10665	5169
N	85	29	18	70	416
Median	494	180	397	4345	460
Life specialists	12.0%	9.4%	40.0%	17.7%	14.3%
Non-life specialists	74.0%	75.0%	50.0%	40.0%	64.7%
Joint firms	14.0%	15.6%	10.0%	42.4%	21.1%
Stocks	87.0%	81.3%	90.0%	94.1%	78.3%
Mutuals	4.0%	12.5%	10.0%	3.5%	14.3%
Other organizational forms	9.0%	6.2%	0.0%	2.4%	7.4%

Note: Monetary variables are expressed in constant million 1986 ptas.
*Firms with return on equity>0.5 and <-0.5 are excluded in calculating means and medians.

Table 5B: t-Tests for Differences Between Mean Summary Statistics (1989-1997 Averages)

	Target vs. Other Exiting	Target vs. Entering	Target vs. Acquiring	Target vs. Non-M&A	Other Exiting vs. Entering	Other Exiting vs. Acquiring	Other Exiting vs. Non-M&A	Entering vs. Acquiring	Entering vs. Non-M&A	Acquiring vs. Non-M&A
Total Assets	2.45 **	-0.33	-3.43 ***	-0.61	-1.88 *	-4.55 ***	-5.84 ***	-2.92 ***	-0.02	3.35 ***
Total Premiums	2.25 **	0.39	-4.25 ***	-0.42	-0.94	-5.61 ***	-4.08 ***	-3.92 ***	-0.68	4.32 ***
Equity capital-to-assets	-0.69	-2.94 ***	2.78 ***	-1.30	-1.90 *	2.40 **	0.06	4.50 ***	2.53 **	-4.94 ***
Debt capital-to-assets	-1.40	1.46	1.30	0.63	2.14 **	1.99 **	1.69 *	-0.64	-1.25	-1.05
Invested assets-to-assets	1.36	-0.60	-3.87 ***	-1.10	-1.40	-4.38 ***	-2.35 **	-1.37	0.17	4.12 ***
Return on Equity before tax	3.35 ***	2.40 **	1.43	1.39	-1.49	-2.43 **	-2.98 ***	-1.16	-1.85 *	-0.52
Reins reserves-to-total reserves	-1.08	-0.25	-1.61	-2.90 ***	0.65	0.08	-0.22	-0.73	-1.12	-0.54
Life premiums	3.58 ***	2.45 **	-0.75	-0.10	-1.64	-3.90 ***	-8.68 ***	-2.97 ***	-4.34 ***	0.84
Non-life premiums	1.66 *	-0.39	-5.08 ***	0.21	-1.01	-5.98 ***	-1.95 *	-2.94 ***	0.47	5.43 ***

Note: Pairwise comparisons are based on average efficiencies for each category of firm for the entire sample period, 1989-1997. In each comparison, the average efficiency for the second type of firm is subtracted from the average efficiency for the first type of firm to conduct the test. E.g., the test statistics in the Target vs. Other Exiting comparisons are equal to the average efficiencies of the Target Firms minus the average efficiencies of the Other Exiting Firms.

*** Significant at the 1 percent level, ** significant at the 5 percent level, * significant at the 10 percent level.

Table 6
Probit Analysis: Acquisiton Targets, Other Exiting, and Acquiring Firms
Spanish Insurers: 1989-1997

	Dependent Variable								
	M&A Target			Other Exiting			Acquiring		
Independent Variables	**Coefficient**	**z-Stat**		**Coefficient**	**z-Stat**		**Coefficient**	**z-Stat**	
C	-3.052	-8.10	***	1.928	6.24	***	-2.920	-8.22	***
Allocative Efficiency	0.462	2.90	***	-0.715	-3.99	***	-0.155	-0.81	
Pure Technical Efficiency	-0.198	-1.51		-0.224	-1.75	*	-0.197	-1.41	
Scale Efficiency	0.733	3.44	***	-1.130	-6.80	***	-0.574	-3.13	***
Stock Firm	0.730	5.80	***	-0.019	-0.22		0.465	3.66	***
Life Insurance Only Specialist Dummy	0.221	1.85	*	-0.366	-2.99	***	-0.737	-5.65	***
Non-Life Insurance Specialist Dummy	0.403	3.80	***	-0.152	-1.69	*	-0.617	-6.83	***
Log of Total Premiums	0.036	1.34		-0.106	-4.44	***	0.240	8.50	***
Equity Capital/Assets	0.281	1.38		-1.380	-6.68	***	0.838	3.58	***
Debt Capital/Assets	-0.944	-3.08	***	-0.051	-0.17		0.157	0.35	
Return on Equity	-0.208	-0.86		-0.823	-3.28	***	0.032	0.12	
D90	0.189	1.69	*	-0.008	-0.07		-0.193	-1.15	
D91	-0.022	-0.19		-0.156	-1.38		0.052	0.33	
D92	-0.158	-1.29		-0.251	-2.17	**	0.088	0.57	
D93	-0.186	-1.49		-0.337	-2.84	***	0.101	0.65	
D94	-0.312	-2.32	**	-0.587	-4.53	***	0.244	1.63	
D95	-0.494	-3.34	***	-0.853	-5.65	***	0.323	2.11	**
D96	-0.742	-4.50	***	-1.109	-6.41	***	0.278	1.79	*
D97	-1.110	-5.57	***	-1.143	-6.11	***	0.346	2.26	**
N	3346			3346			3346		
Log Likelihood	-957.52			-1011.55			-781.45		
Restricted Log likelihood	-1073.15			-1155.13			-952.94		
Psuedo R^2	0.108			0.124			0.180		

Note: The dependent variable in the M&A Target regression equals 1 for M&A target firms and 0 otherwise. The dependent variable in the Other Exiting regression equals 1 for firms that exited the market due to insolvency or voluntary liquidation and 0 otherwise. The dependent variable in the Acquiring regression equals 1 for acquiring firms and 0 otherwise. The life and non-life specialist dummies equal 1 for the respective specializations and 0 otherwise.

Table 7: Malmquist Productivity Indices: Summary Table

		Stock			Mutual			All Stocks and Mutuals		
		TE Change	T Change	TFP Change	TE Change	T Change	TFP Change	TE Change	T Change	TFP Change
Complete Panel of Firms Present in All Years										
	N									
1989-1990	201	0.916	1.042	0.955	0.961	0.938	0.901	0.923	1.024	0.945
1990-1991	201	1.242	0.819	1.018	0.956	0.964	0.922	1.190	0.841	1.001
1991-1992	201	1.038	0.982	1.018	1.065	1.030	1.097	1.042	0.989	1.031
1992-1993	201	1.054	0.963	1.015	1.067	0.922	0.984	1.056	0.956	1.010
1993-1994	201	1.063	1.033	1.099	1.054	0.920	0.970	1.062	1.013	1.076
1994-1995	201	0.942	1.095	1.031	0.873	1.149	1.003	0.930	1.103	1.026
1995-1996	201	1.145	0.861	0.986	1.133	0.827	0.937	1.143	0.856	0.978
1996-1997	201	1.047	0.962	1.007	1.053	0.933	0.983	1.048	0.957	1.003
1997-1998	201	0.995	1.001	0.996	1.047	0.935	0.979	1.004	0.990	0.993
Geometric Mean		1.045	0.970	1.013	1.021	0.954	0.974	1.041	0.967	1.007
Arithmetic Mean		1.049	0.973	1.014	1.023	0.958	0.975	1.044	0.970	1.007
Complete Panel: 1989 vs 1998*		1.399	0.792	1.107	1.267	0.644	0.816	1.375	0.764	1.051
All Firms Present in Each Adjacent Two-Year Period										
1989-1990	390	0.947	1.021	0.967	1.001	0.934	0.935	0.955	1.007	0.962
1990-1991	402	1.252	0.852	1.066	1.061	0.912	0.968	1.224	0.860	1.052
1991-1992	392	1.059	0.990	1.048	1.010	1.028	1.038	1.052	0.995	1.047
1992-1993	383	1.019	1.007	1.027	0.952	1.024	0.975	1.010	1.010	1.020
1993-1994	363	0.989	1.099	1.087	1.014	0.958	0.972	0.993	1.079	1.072
1994-1995	337	1.069	0.964	1.031	0.966	1.071	1.035	1.055	0.978	1.031
1995-1996	328	1.088	0.914	0.994	1.039	0.877	0.911	1.081	0.909	0.983
1996-1997	320	1.008	1.039	1.047	1.016	1.003	1.019	1.009	1.034	1.043
1997-1998	286	0.994	1.038	1.031	1.020	0.982	1.002	0.998	1.030	1.027
Geometric Mean		1.044	0.989	1.033	1.008	0.975	0.983	1.039	0.987	1.026
Arithmetic Mean		1.047	0.992	1.033	1.009	0.977	0.984	1.042	0.989	1.026
Implied Annual Rates of Productivity Growth										
Complete Panel of Firms Present in All Years										
Geometric Mean		4.5%	-3.0%	1.3%	2.1%	-4.6%	-2.6%	4.1%	-3.3%	0.7%
Arithmeric Mean		4.9%	-2.7%	1.4%	2.3%	-4.2%	-2.5%	4.4%	-3.0%	0.7%
Complete Panel: 1989-98**		3.8%	-2.6%	1.1%	2.7%	-4.8%	-2.2%	3.6%	-2.9%	0.6%
All Firms Present in Each Adjacent Two-Year Period										
Geometric Mean		4.4%	-1.1%	3.3%	0.8%	-2.5%	-1.7%	3.9%	-1.3%	2.6%
Arithmeric Mean		4.7%	-0.8%	3.3%	0.9%	-2.3%	-1.6%	4.2%	-1.1%	2.6%

Key: TE = technical efficiency, T = technical, TFP = total factor productivity. *Malmquist analysis for 1989 vs. 1998. **Implied annual growth rate.

Note: In calculating the averages, firms were omitted if their total factor productivity index exceeded the 99th percentile or was less than the 1st percentile of TFP indices for the entire sample period, based on the complete panel sample. This approach had a very slight effect on the reported averages and does not change the conclusions to be drawn from the table.