Intra-Industry Diversification and Firm Efficiency: A Study of the U.S. Insurance Industry

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Abstract

This study contributes to our understanding of the consequences of corporate diversification on firm efficiency by examining one case of intra-industry product diversification. Specifically, the study uses a sample of public and private firms that operate in the U.S. property-liability and life insurance markets. Using a version of Varian's Weak Axiom of Profit Maximization to measure firm efficiency, I compare relative performance of multi-product insurers to the performance of specialized insurers. A cross-sectional analysis of the effects of diversification across the property-liability and life insurance segments, as well as the extent of product diversification within each segment, on firm efficiency is performed. The findings of the study provide strong support for the agency-cost explanation of firms' decisions to diversify. I find that insurers that provide both property-liability and life insurance tend to be less efficient than specialized insurers. The degree of product diversification within each of the two insurance segments also negatively impacts insurer efficiency.

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1. Introduction

The subject of corporate diversification has been widely researched. A typical study is conducted on a sample of all U.S. public companies. However, limiting the sample to a single industry has considerable advantages. In an across-industry study, potential market limitations of the firm's ability to operate in a desired mix of businesses may hamper the ability to isolate the effect of diversification and focus on firm performance. Further, several studies suggest that the so-called 'diversification discount' associated with multi-segment firms arises not due to the fact that firms are diversified, but due to characteristics inherent in the diversified firms. For instance, firms that chose to diversify might have initially low market values due to poor investment opportunities in their existing industries (Campa and Kedia, 2002; Chevalier, 2004). Thus, studying firms operating within the same industry enables one to analyze the relationship between product diversification and performance more directly.

The insurance industry lends itself particularly well to studying issues of business focus versus diversification for several reasons. Unlike a firm choosing to diversify into another industry, an insurer can diversify across various insurance products with relative ease. An insurer has a choice of providing insurance services in the property-liability and/or life insurance segments. Further, each segment is characterized by numerous product lines that an insurer can choose to offer. In addition, unlike for example the banking industry that was constrained by the restrictions on branching and interstate banking until relatively recently, the insurance industry has been free of such constraints.[1] All these factors increase the likelihood that insurers are focused or diversified because they choose to be so. In competitive markets, firms with the strategy that generates the most efficiency should survive in the long run. In other words, if diversification or specialization has any efficiency consequences, we should expect natural selection to lead to the majority of firms in the industry being either diversified or specialized. If so then why do diversified and focused firms co-exist in the same industry?

One possible explanation is that there is no significant efficiency differential between focused and diversified insurers. The evidence on the merits of diversification in the insurance industry is mixed. While several studies have found that diversification leads to greater efficiencies (Kellner and Mathewson, 1983; Meador, Ryan, and Schellhorn, 2000), more recent research on the subject seems to suggest that diversification across insurance products does not result in economies of scope and/or better financial performance (Cummins Weiss, Xie, and Zi, 2010; Cummins and Xie, 2005; Liebenberg and Sommer, 2008).

This study extends the existing literature on the diversification-efficiency relationship in the insurance industry in two ways. First, to estimate firm efficiency I utilize a novel non-parametric approach, a version of Varian's Weak Axiom of Profit Maximization. Unlike conventional estimation methods that rely on the econometric approach, the WAPM technique does not require the specification of a functional form of the production function. To the best of my knowledge, the WAPM methodology has previously been used in the insurance context only by Garven and Grace (2002) when they examine the effect of information technology on insurer profitability. Second, I analyze how diversification across property-liability and life insurance as well as across different product lines within one of these two segments affects insurer efficiency.

I find strong evidence that specialized insurers are more efficient than their diversified counterparts, complementing the findings in Cummins et al. (2010). Moreover, not only diversification across the two insurance segments, but also across different lines of insurance within the same segment is found to hamper insurer efficiency. This finding with regards to life insurers is inconsistent with that in Meador et al. (2000). In addition, the study's results suggest that less profit-efficient insurers tend to employ a vertically-integrated distribution system. In terms of cost efficiency, diversification as well as operating in the medium-size range tend to lead to inefficiencies.

The remainder of the paper is organized as follows. Section 2 contains a review of studies that focus on issues of diversification in the insurance industry. Section 3 presents hypothesis development. Section 4 describes the study's methodology. Section 5 presents data sources and the sample selection procedure. Section 6 discusses empirical findings of this study, and section 7 concludes.

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[1] The Riegle-Neal Interstate Banking and Branching Efficiency Act that became effective as of June 1, 1997, lifted major restrictions on interstate banking.

2. Literature Review

Prior studies provide inconclusive empirical evidence on the subject of economies of scope in the insurance industry.

A number of studies have found that product diversification within the life segment of the insurance industry leads to greater efficiencies (Kellner and Mathewson, 1983; Meador et al. 2000). Berger et al. (2000) expand the sample to include both property-liability and life insurers. They examine scope economies by estimating separate functions for joint producers and specialists to allow for their potentially different technologies. They find that joint production is more efficient for some types of insurers, while specialization is more efficient for others. The first group tends to include large firms with vertically-integrated distribution systems, with an emphasis on personal lines of business; while the second group includes small firms with non-vertically-integrated distribution systems, with an emphasis on commercial lines of business.

Cummins et al. (2010) fail to find empirical support for economies of scope in a study of the effects of diversification across both property-liability and life insurance on firm technical, cost, revenue, and profit efficiency. Using data envelope analysis, a non-parametric frontier efficiency technique, to estimate firm efficiency the authors conclude that insurers are overall more efficient when they specialize in providing either property-liability or life insurance than those offering both types of insurance.

Several studies have contributed to the debate on the benefits of diversification in the insurance industry by examining the financial effects of diversification versus focus. A study of property-liability insurers by Liebenberg and Sommer (2008) provides evidence that focused insurers have a better accounting performance than their diversified peers. Furthermore, the authors report a significant market-based discount, the 'diversification discount,' associated with diversified insurers. Cummins and Xie (2005) also find that in the property-liability insurance industry focus-increasing acquisitions and divestitures earn higher positive abnormal returns than other types of acquisitions and divestitures, respectively. On the other hand, Elango, Ma, and Pope (2008) argue that the relationship between diversification and firm financial performance in the property-liability insurance market is nonlinear and that it also depends on the extent of geographical diversification. This finding of the complex relationship between product diversification and financial performance is consistent with the prior mixed evidence regarding efficiency implications of diversification by insurers.

3. Hypothesis Formulation

I test two distinct, not necessarily mutually exclusive, hypotheses regarding the effect of product diversification on insurer efficiency. Since the two hypotheses have opposing effects on profit efficiency, it is an empirical question as to what net effect diversification has on insurer performance.

Hypothesis 1

There are two main sources of scope economies specific to financial institutions. These are, what Klein and Saidenberg (2000) call, 'internal' source in joining production and marketing and 'external' source in consumption. The former arises from information (such as, client profile) and inputs that can be utilized to produce multiple products and thus leads to cost economies of scope. The latter arises from improved customer satisfaction from 'one-stop shopping' and thus leads to revenue economies.

This does not explain, however, why joint production within a single firm would be superior to market contracting. Grace and Timme (1992) suggest that the insurance industry is characterized by transaction-specific inputs, such as indivisible physical capital and human capital that can be easily shared among several outputs.

Product diversification can also result in earnings diversification, which is an especially important benefit for the insurance industry. Increasing the policyholder pool leads to more predictable losses, which, in turn, can permit switching to higher risk/higher return investments.

Therefore, according to Hypothesis 1, an insurer's efficiency is increasing in the number of insurance services it provides.

Hypothesis 2

Another plausible effect of product diversification is reduced revenues due to losing customers to more specialized insurance providers with better expertise in a particular product. This effect is also important given increasing competition from other financial institutions, such as banks and securities firms.[2]

Diversification strategy, in general, may also be a means through which managers derive private benefits, in excess of their private costs, associated with managing a more complex firm. Some of these benefits are the reduction in the risk of managers' undiversified personal portfolios, increased perquisite consumption, prestige and the sense of being indispensable to their complex firms (Amihud and Lev, 1981; Jensen, 1986; Shleifer and Vishny, 1989). It can be argued that the management will pursue a diversification strategy in order to reap private benefits even if diversification leads to a decline in firm performance and value.

Hypothesis 2 states that an insurer's efficiency is a decreasing function in the number of insurance services provided.

4. Methodology

I study whether diversified insurance firms are more efficient than specialized insurance firms along two dimensions. First, I examine whether having operations in both the property-liability and life segments, as opposed to concentrating operations in just one insurance segment, affects the insurer efficiency. In addition, I also test how the extent of diversification across several product lines *within* the same insurance segment impacts efficiency.

I next discuss variables to be used in the study's model. First, I provide the methodology for estimating the dependent variables, which measure efficiency, in section 4.1. Explanatory and control variables are described in Sections 4.2 and 4.3, respectively.

4.1 Estimating Efficiency

There are several methods of estimating efficiency commonly used in the insurance and banking literature. These methods are broadly categorized into two groups: the econometric approach and the mathematical programming approach. Both approaches involve estimation of firm efficiency by measuring its deviation from a constructed

[2] In 1999, the Financial Services Modernization Act (a.k.a. the Gramm-Leach-Bliley Act) allowed banks, insurance companies and securities firms to affiliate with each other and offer each other's products.

production frontier, i.e., boundaries of production possibilities. The econometric approach is based on estimating a functional form of the production function and decomposing disturbances from the model into estimates of inefficiency and noise. While mathematical programming approach (also referred to as data envelopment analysis (DEA)) is not able to distinguish between inefficiency and noise, it is based on the nonparametric estimation of the frontier and thus is not vulnerable to its misspecification. DEA efficiency (e.g., cost and revenue efficiency) is generally calculated from the ratio of frontier costs to the firm's actual costs (or the ratio of actual revenues to frontier revenues), where the frontier is established by solving a linear programming problem for each firm in the set.[3]

To estimate efficiency in this study, I adopt a version of Varian's Weak Axiom of Profit Maximization (WAPM) test formalized by Hermalin and Wallace (1994). The WAPM test is similar to other more standard methods of estimating insurer efficiency in that it compares an individual firm's performance to the best observed practice in the sample. However, unlike the econometric approach, the WAPM technique does not require the specification of a functional form. The only study that I am aware of that has applied the WAPM method to a sample of insurance firms is Garven and Grace (2002), which examines the effect of information technology on insurer profitability.

According to Hermalin and Wallace's efficiency test, firm i is relatively inefficient if another firm j is able to generate greater revenues using an input mix that, at firm i's factor prices, would cost less than the input mix firm i chose. Formally, firm i is inefficient relative to firm j if $R_i < R_j$ and $w_i \bullet z_i \geq w_i \bullet z_j$, or if $R_i \leq R_j$ and $w_i \bullet z_i > w_i \bullet z_j$, where R_i denotes the firm i's total revenues, z_i its vector of inputs, and w_i the vector of corresponding factor prices. Since firm i could reduce its costs by at least mimicking the input mix of firm j, firm i's observed method of operations is considered relatively inefficient.

Following Hermalin and Wallace (1994), for each year I estimate a measure of relative efficiency—the proportion of comparisons firm i fails using the WAPM test. That is,

[3] For more details on different methodologies of estimating firm efficiency in the financial services sector, refer to Fried, Lovell and Schmidt (1993), Cummins and Weiss (2000), and Banker, Cummins, and Klumpes (2010).

$$FailureRate_i = \frac{\#(D(n))}{\#(\{j \mid R_j \geq R_i\})} \quad ,$$

where # (D(i)) denotes the number of firms that dominate firm i using the WAPM test and # ($\{j \mid R_j \geq R_i\}$) is the number of firms with revenues greater than that of firm i. The ratio equals zero if the firm is fully efficient in the sense that no other firm dominates it, i.e., $\#D(i) = 0$. In order to facilitate the interpretation of the regression results, I transform this measure by subtracting it from one. The new measure, efficiency, equals one (zero) when a firm is fully efficient (inefficient).

In addition, for each insurer, I estimate the degree of efficiency in a given year, which Hermalin and Wallace (1994) interpret as "an upper bound on how inefficient the inefficient firms" are:

$$Degree\ of\ \ Efficiency\ \ _i = \min_{k \in \mathrm{D}(i) \cup \{i\}} \frac{w_i \bullet z_j}{w_i \bullet z_i} \quad ,$$

where z_i denotes the firm i's vector of inputs and w_i the vector of corresponding factor prices. The above measure of efficiency represents the fraction of costs that firm i would incur if it operated in the most efficient way feasible, that is, using the most cost-minimizing input mix from the set of input mixes of all firms that dominate firm i.[4] In this respect, this measure of efficiency is analogous to DEA cost efficiency. Degree of inefficiency equals one if the firm is fully efficient. One minus this measure shows how much cost reduction a firm could realize by improving its efficiency.

The two measures of efficiency—efficiency and degree of inefficiency—are different in the sense that the first is based on relative ranking and the second is based on relative costs. By design, both measures lie between 0 and 1. Since I perform the analysis on the industry level as well as the segment level, I estimate (i) insurer efficiency relative to all other firms in the entire insurance industry and (ii) insurer efficiency in the

[4] Hermalin and Wallace (1994) note that this measure of the degree of inefficiency is less robust than the ratio of proportion of comparisons failed. This measure could potentially overestimate the amount of inefficiency by putting too much weight on outliers that are characterized by exceptionally high efficiency. The authors report that an alternative measure, the average of $w_i \bullet z_j / w_i \bullet z_i$, did not improve over the existing measure because it was likely to underestimate inefficiency by putting too much weight on inefficient firms, themselves.

property-liability or life insurance segment relative to other firms that operate in the same segment.[5] I next define the inputs and outputs that I use in estimating insurer efficiency.

Inputs and Input Prices

In line with the literature, insurance inputs are classified into five groups: administrative labor, agent labor, physical capital, business services, and equity capital (Cummins, Tennyson, and Weiss, 1999; Cummins and Weiss, 2000).[6]

Administrative labor and agent labor are conventionally estimated separately due to their different prices and proportions of utilization. The price of administrative labor is proxied using state average weekly wages for Standard Industrial Classification (SIC) code 6331, *Fire, Marine & Casualty Insurance*, for property-liability insurers and 6311, *Life Insurance*, for life insurers from the U.S. Department of Labor.[7] The wage rate for administrative labor is used for the state in which the insurer's home office is located, as indicated by the state of its domicile.[8]

The price of agent labor is proxied for by using state average weekly wages for SIC code 6411, *Insurance Agents, Brokers & Service*, from the U.S. Department of Labor. The agent labor contains mostly expenses associated with services performed outside the insurer's home office, such as agents' commissions and brokerage. Therefore, the wage rate for agent labor is weighted based on the proportions of premiums written by an insurer in each state.[9]

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[5] In estimating the efficiency measures at the industry-level, for insurers with operations in only one insurance segment I take prices for the missing segment's inputs to be those that would be faced by an insurer if it operated in that segment.

[6] For a detailed discussion of insurance inputs and input prices, see Zi (1994).

[7] For each SIC code, an average weekly wage per employee in a particular state is computed by dividing the average annual wage per employee in that state by 52, where the average annual wage per employee is obtained by dividing the state's total annual wages by the state's annual average employment.

[8] In aggregating the data to the group level, I calculate the wage rate for administrative labor for a group as a weighted average of each company's wage rates, with weights based on the proportion of administrative personnel employed by each company. The number of administrative employees in a company is estimated by dividing the company's total administrative-labor expenses by the wage rate for the company's state of domicile.

[9] The wage rate for each insurer is calculated using premiums written in 50 states as well as the District of Columbia. In addition, after 1997 premiums written in two U.S. territories—Puerto Rico and the Virgin Islands—are also included in the calculation since the wage-rate data for these territories are available starting that year.

Physical capital input includes rent, rental of equipment, depreciation, and other real estate expenses. To obtain the price of physical capital, I compute the ratio of physical capital expenses to physical capital assets.

Business services input is comprised of all other miscellaneous services pertaining to business operation. Such services include marketing, accounting, legal services, printing and travel. The price of business services is measured using the weighted state average weekly wage rate for SIC code 7389, *Business Services*, with weights equal to the proportions of premiums written by an insurer in each state.[10]

Equity capital is considered to be an important input because an insurer's capitalization should have an effect on its output prices. The cost of equity capital is approximated following the Cummins, Tennyson, and Weiss (1999) three-tier approach, which is based on financial ratings by the A.M. Best Company. Accordingly, insurers in the top tier (the four ratings in the A range, i.e., A++, A+, A and A-) are assigned a cost of capital between 11 and 13 percent, insurers in the middle tier (the four ratings in the B range, i.e., B++, B+, B and B-) are assigned 14-16 percent, and insurers in the lowest tier (all other ratings) are assigned 17-19 percent. I also account for differential costs of equity capital for property-liability and life insurers. Based on the evidence provided in Cummins and Phillips (2004), I set the cost of capital for property-liability insurers equal to 85 percent of the cost of capital for life insurers.

The input quantities are calculated by dividing the relevant expense by a corresponding input price.

Measuring Revenue

Revenues (i.e., price times quantity of output) could theoretically be estimated from transaction flow data, such as those related to the number of policies issued and claims

[10] Industry coding of the BLS covered employment and wage data for the 1988-2000 period is based on the U.S. Standard Industrial Classification (SIC) system. Starting year 2001, the data are coded using the 2002 North American Industry Classification System (NAICS). In order to establish continuity in the wage data over the entire sample period, I match the SIC codes used during the 1988-2000 period to the best-fitting NAICS codes. The following NAICS codes are used in estimating corresponding wages for year 2001: NAICS 52411, *Direct Life, Health, and Medical Insurance Carriers*, (equivalent to SIC 6311); NAICS 52412, *Direct Insurance (Except Life, Health, and Medical) Carriers*, (equivalent to SIC 6331); NAICS 52421, *Insurance Agencies and Brokerages*, (equivalent to SIC 6411); and NAICS 5614, *Business Support Services*, (equivalent to SIC 7389).

incurred. However, such data are not publicly available for all segments of insurance. In estimating insurers' revenues in this study, I adopt the value-added approach used in measuring insurance output.[11] The net revenue before taxes is used as a proxy for the revenues, i.e., price times quantity of output. Specifically, the net revenue represents total premiums (and annuity considerations—for life insurers) plus investment and other income minus output.

4.2 Explanatory Variables

Diversification dummy is set equal to one if an insurer operates in both property-liability and life insurance segments and equal to zero if it operates in only one of these segments.

The extent of product diversification within the property-liability and life insurance segments is proxied by the Herfindahl index, which is based on the proportions of premiums written within each product line in the given segment. In parallel with Berger and Ofek's (1995) revenue-based Herfindahl index, a premium-based Herfindahl index is calculated as the sum of the squares of premiums written in each product line within a segment as a proportion of the firm's total premiums written in all product lines within the corresponding segment. Thus, for firm *i*'s insurance segment in year *t*,

$$HERFINDAHL_{it} = \sum_{j=1}^{Nit}\left(P_{jit}\Big/\sum_{j=1}^{Nit}P_{jit}\right)^2$$

where P_{jit} is total net premiums written in product line j by insurer i in year t and N_{it} is the number of product lines with non-zero premiums written by insurer i in year t. I distinguish five lines of insurance in the property-liability segment: personal, commercial property, commercial liability, financial guaranty, and accident and health insurance. The components of each of these lines of insurance are listed in Appendix 1. In the life insurance segment, I define the following six product lines: ordinary life, ordinary individual annuities, group life, group annuities, accident and health, and other (includes industrial life, credit life and ordinary supplementary contracts).

[11] See Cummins and Weiss (2000) for a discussion of the value-added approach to measuring insurance output.

4.3 Control Variables

Control variables include firm size, organizational form and distribution system.

Firm Size

Several studies on scale economies in the insurance industry have provided evidence that insurer size significantly impacts efficiency. Cummins and Zi (1998) document that in the life insurance industry small insurers operate at increasing returns to scale, while large insurers operate at deceasing returns to scale. The inverse U-shape relationship implies that only firms in the medium-size range are optimizing their production costs by operating at constant returns to scale. However, Ryan and Schellhorn (2000) find that medium-size life insurers are relatively less efficient than smaller and larger life insurers. To account for a potential nonlinear relationship between size and efficiency, in addition to the size variable I also include the square of size as a control variable. I use two proxies for size: the natural logarithm of total assets and the natural logarithm of net premiums written.

Organizational Form

Organizational form (ownership structure) has been suggested to be a potentially significant factor in insurer performance. According to Mayers and Smith (1988), comparative advantages of different organizational forms lead insurers to be more prevalent in those lines of insurance, where their organizational form is most efficient. Specifically, it is argued that mutual insurers (mutuals) are less efficient in reducing agency costs between managers and owners as compared to stock insurers (stocks). Empirical evidence provided in Mayers and Smith (1988) supports the managerial discretion hypothesis. Cummins, Weiss, and Zi (1999) provide further support for the hypothesis by demonstrating that stock insurers and mutual insurers in the property-liability segment have different technologies. In a more recent study of credit default swap (CDS) users in the U.S. insurance industry, Fung, Wen, and Zhang (2012) find that stock insurers tend to participate more actively in the CDS market than mutuals do. This finding supports the managerial discretion hypothesis considering that CDS trading is a complex and risky activity.[12]

In addition, mutual insurance companies are predicted to have higher costs and thus be less efficient than stock insurance companies due to mutual managers exhibiting 'expense preference' behavior (Mester, 1989, 1991). The premise is that because owners in mutuals have weak mechanisms for controlling and disciplining managers, mutual managers will engage in more excessive perquisite consumption than stock managers. However, empirical evidence regarding the expense preference hypothesis is somewhat mixed. While several studies find no evidence of 'expense preference' behavior in mutual insurance companies (Cummins and Zi, 1998; Gardner and Grace, 1993), other studies do provide evidence that mutuals are less efficient than stocks (Cummins, Weiss, and Zi, 1999; Liebenberg and Sommer, 2008). Organizational form is a dummy variable that is set equal to one if the insurer is policyholder controlled (i.e., mutual or reciprocal), and zero if it is a stock company or Lloyd.

Distribution System

Distribution system has also been found to affect insurers' costs. Insurers conduct marketing through either a vertically-integrated system (such as exclusive agents, direct and mass marketing) or a non-vertically-integrated system (such as independent agents and brokers). Although independent agents are generally reported to be less cost efficient, their higher costs seem to be compensated by higher revenues (Berger, Cummins, and Weiss, 1997). The distribution system variable is set equal to one if an insurer uses a vertically-integrated distribution system and equal to zero if an insurer uses a non-vertically-integrated system. Note that at the group level this variable is a weighted average of individual distribution-system variables of all the companies within the same group, with weights equal to the proportions of premiums written by the group's

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[12] This could also suggest that mutuals are more likely not only to specialize in certain lines of business that require little managerial discretion in setting rates, but also to concentrate in fewer lines of business and geographical areas than stocks. The analysis of correlations between the organizational form variable and other predictor variables presented in Table 7 indicates that multicollinearity is not a problem. In particular, the correlation coefficient between the organizational form variable and the diversification dummy variable is statistically significant, but small (0.109).

companies. As a result, the distribution system variable at the group level can take any value in the interval [0, 1].

5. Data

5.1 Data Sources

The main source of data for this study is the regulatory annual statements, which insurance companies are required to file with the National Association of Insurance Commissioners (NAIC). Additional sources of data are A.M. Best Insurance Reports and the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor. The wage data are obtained from the annual *Employment and Wages* bulletin from the BLS Covered Employment and Wages program.

5.2 Sample Selection

My initial sample included a complete panel of individual insurers whose annual statements are reported on the NAIC data tapes over the 1988-2001 period. I eliminated companies with incomplete demographic information, inadequate group affiliation, unusual data items (such as non-positive assets) and those in financial distress.

The analysis is performed at the group level, which is likely to be the decision-making unit for such strategic decisions as diversification and refocusing. In order to compile a sample of groups of affiliated insurers, I aggregated the data for affiliated insurers under common ownership.[13] Thus, a unit of observation in this study is a group of affiliated insurers or an individual unaffiliated insurer (hereafter both referred to as an insurer, firm or company).

Lastly, I eliminated very small insurers with net premiums written under $1 million in 1988 dollars (accounting in the aggregate for less than 0.1 percent of industry premiums) and risk retention groups. The resulting sample consists of 13,890 firm-years that represent 2,174 individual insurers with operations in the property-liability and/or life insurance segments during the 1988-2001 period. Individually, the property-liability

[13] Some variables (such as, price of administrative labor, cost of equity, and distribution system variable) were not available at the group level. Therefore, these variables were converted to their corresponding weighted averages, with weights equal to the proportions of premiums written by the group's individual companies.

insurer subsample contains 8,817 firm-years (1,365 insurers) and the life insurer subsample contains 6,216 firm-years (1,026 insurers). The two subsamples overlap because some firms choose to have operations in both insurance segments. The insurers in the sample account for approximately 76 percent of property-liability-segment assets and 82 percent of life-segment assets over the sample period.

6. Estimation results

6.1 Sample Description

First, I present summary and diversification statistics for insurance firms in the sample. The distribution of insurers by year is presented in Panel A of Table 1. Two observations are evident here. First, the annual number of insurers steadily decreased from 1,151 in year 1988 to 775 in year 2001. Second, the fraction of single-segment firms in the insurance industry is on average 82.0 percent, with the fraction of diversified firms continuing to decline from 19.7 to 15.9 percent over the sample period. It is evident that the insurance industry is dominated by firms that choose to operate in a single segment: the property-liability or life insurance segment, but not both. Similar results are observed in Panels B and C, which report corresponding statistics separately for the property-liability and life insurance segments. The size of both segments in terms of the number of firms contracted, most notably with the life segment shrinking to almost half of its size by 2001 of what it used to be in 1988. The majority of firms in both insurance segments do not have operations in the other segment: On average, 79.7 and 70.2 percent of firms in the property-liability and life segments, respectively, are focused. However, the gap in diversification between the two segments was gradually widening. Unlike a steady decline in the fraction of diversified firms in the property-liability segment (from 24.4 to 16.5 percent), there was a shift in the life insurance segment to diversification over the same period (from 27.7 to 29.3 percent).

As seen in Table 2, the annual average number of segments (out of two) per each insurer is 1.18 (which corresponds to 82 percent of single-segment insurers reported earlier in Table 1). Table 2 also provides diversification statistics in terms of product lines by year for each insurance segment. The general trend observed in both segments is towards concentration on fewer lines of insurance. Further, the average number of product lines that a property-liability insurer offers is 2.96, while that for a life insurer is 3.88. It should be noted, however, that according to the classification of product lines in the two segments, the property-liability segment simply has fewer possible lines of insurance (five) than the life segment (six). Therefore, a more informative statistic of the degree of firm diversification within each segment is the firm-level Herfindahl index. It again indicates that property-liability insurers are, on average, more concentrated in their product offerings than life insurers.

The distribution of firms by each product line is presented in Table 3. Panel A provides the breakdown of insurers into five property-liability product lines. (For the classification of these lines of insurance, refer to Appendix 1.) The majority of property-liability insurers offer commercial liability (84.5 percent), personal insurance (80.2 percent) and commercial property (76.2 percent). With the exception of commercial-liability insurance, all property-liability product lines experienced a considerable decline in the fraction of insurers that offer that particular line of business over the 1988-2001 period. This provides additional evidence that individual property-liability insurers have become more concentrated in fewer product lines. Panel B presents the breakdown of insurers into six life product lines. About every nine out of ten life insurers provide ordinary life insurance. The majority of life insurers also offer accident and health (86.9 percent), group life (69.0 percent) and ordinary individual annuities (67.5 percent). The least populated product line in the life insurance segment is group annuities (31.1 percent).

Next, I report in Table 4 descriptive statistics for the variables used in the model. The sample mean and median of efficiency variable (i.e., one minus failure rate) are 0.83 and 0.90, respectively, where the maximum value of 1.0 indicates a fully efficient firm and the minimum value of 0.0 indicates a fully inefficient firm according to the WAPM test. The mean degree of inefficiency across all insurers is 0.32, where a firm with the most cost-minimizing input mix in the sample has a value of 1.0. This implies that an average insurer could reduce its current costs by as much as 68 percent if it operated in the most efficient way feasible.

Descriptive statistics for various diversification measures are presented next. A mean of 0.18 for the diversification dummy variable indicates that the majority of insurers in the sample are single-segment firms, that is, they have operations in either the property-liability or life insurance segment, but not in both. However, as suggested by segment-specific diversification measures, insurers choose to diversify across product lines within each insurance segment.

While the mean of the organizational form variable, which is a dummy variable, is 0.53, the majority of insurers in the sample are policyholder-controlled, as indicated by the variable's median of 1.0. Furthermore, most insurers use a vertically-integrated distribution system as opposed to selling insurance through independent agents and brokers. Finally, firms on average have $2.4 billion in assets and $427 million in premiums written (not reported).

6.2 Univariate Analysis

Table 5 present summary statistics for regression variables, as well as input/output measures used to estimate the efficiency variables, separately for the property-liability and life insurance segments.[14] The table also contains results of t-tests for the difference in means of these variables between the two segments. Although there are more property-liability insurers than life insurers, the latter are individually significantly larger both in terms of assets and premiums. Life insurers are also significantly more diversified across the two insurance segments as well as product lines within each segment. Furthermore, they are on average more efficient within their segment than property-liability insurers, and this difference in efficiency is highly significant at the 1 percent level. Examining the differences in input prices and quantities between the two insurance segments, it is observed that property-liability insurers incur significantly higher costs for administrative, agent labor and business services. The only cost that is significantly lower for property-liability insurers is the cost of equity, which by design was set equal to 85 percent of that for life insurers to reflect the differential in the cost of equity capital between property-liability and life insurers reported in Cummins and Phillips (2005). On the other hand, property-liability insurers utilize significantly lower levels of agent labor, physical capital

[14] In calculating summary statistics for variables in this and further tables, each variable is first averaged by firm. This addresses the issue of incomplete time series for some firms by giving the same weight to all panel units, and thus producing unbiased estimates.

and business services. Finally, life insurers generate net revenues (42 millions) that are twice as higher than property-liability insurers generate (21 millions).

In Panel A of Table 6, I present summary statistics for regression variables for single-segment insurers and diversified insurers. All variables have statistically significantly different means between the two groups. As expected, diversified firms are larger than single-segment firms. However, firms with operations in only one insurance segment are significantly more efficient and have a slightly lower degree of inefficiency in terms of their costs. These results are consistent with the hypothesis that an insurer's efficiency is hampered by it having operations in the two insurance segments concurrently. Interestingly, diversified insurers are more likely to have a vertically-integrated system than specialized insurers. As suggested by Berger et al. (2000), one reason for this can be that integrated insurers may "'reuse' their relatively large investments in marketing and sales systems to sell both life and P-L insurance, creating cost scope economies."

Similar findings are observed when one examines mean differences in variables separately for property-liability insurers (Panel C) and life insurers (Panel B). In both insurance segments, focused firm are significantly smaller in size, more likely to be mutuals and more efficient than diversified firms. However, the difference in efficiency between focused and diversified insurers is more profound in the property-liability segment. Interestingly, while focused firms in the life insurance segment enjoy lower input prices (except for the cost of equity), their focused counterparts in the property-liability segment face higher prices for all the inputs (except the price of physical capital, for which the difference in means is statistically insignificant) than diversified firms. Consistent with their larger size, diversified insurers in both segments employ a higher quantity of each input and generate higher net revenues.

Correlations between the variables used in the subsequent regression analysis are shown in Table 7. Consistent with the hypothesis of a negative effect of diversification on insurers' performance, efficiency and diversification exhibit a strong negative correlation of -0.23, which is statistically significant at the 1 percent level. Interestingly, there are positive, albeit small, statistically-significant correlation coefficients between the organizational form variable and both the diversification and size variables. Contrarily to the managerial discretion hypothesis, this suggests that mutual insurers tend to engage in more complex business operations by being more diversified and larger compared to stock insurers. Two alternative proxies of insurer size, log (premiums) and log (total assets), show an almost perfect positive correlation (0.94) with each other. All other predictor variables have low to moderate pairwise correlations, indicating that multicollinearity is not a problem in the multivariate models.[15] Results of the regression analysis are presented next.

6.3 Multivariate Analysis

In this section, I test the effect of diversification across two segments and the extent of product diversification within each segment on insurer efficiency, while controlling for other firm characteristics that have been linked to insurer efficiency in the literature. The general test specification is as follows:

$$\begin{aligned} Efficiency_{it} = \alpha_0 + \alpha_1\, Diversification_{it} + \alpha_2\, Size_{it} + \alpha_3\, Organizational\ Form_{it} + \\ \alpha_4\, Distribution\ System_{it} + \varepsilon_{it}, \end{aligned}$$

where

$Efficiency_{it}$	= Measure of efficiency of insurer *i* in year *t*, as defined in Section 4.1.
$Diversification_{it}$	= Measure of diversification of insurer *i* in year *t*, as defined in Section 4.2.
$Size_{it}$	= The natural logarithm of total assets of insurer *i* year *t*.
$Organizational\ Form_{it}$	= 1 if insurer *i* is mutual in year *t*, and 0 if insurer *i* is a stock company in year *t*.
$Distribution\ System_{it}$	= 1 if insurer *i* uses a vertically-integrated distribution system in year *t*, and 0 if insurer *i* uses a non-vertically-integrated system in year *t*.

Regression Results: Full Sample

First, I examine the effect of firm diversification across the two insurance segments—the property-liability and life segments—on its efficiency. The dependent variable is insurer

[15] To assess multicollinearity, I also examine the variance inflation factor (VIF) for each independent variable used in the model. The VIF is obtained by regressing an explanatory variable against all other explanatory variables and calculating the inverse of (1-R-square). None of the variables' VIF values exceeds 10 (the highest value is only 1.25), confirming that multicollinearity is not a concern in the multivariate regressions.

efficiency, which is constructed to be between 0 and 1. Given the censored nature of the dependent variable, I use a Tobit model to estimate the relationship between efficiency and diversification. In addition, the regressions include firm and year dummies in order to account for any omitted firm-specific and time-specific factors.[16,17] As a robustness check of the Tobit estimates, I present alternative estimates from two other models: pooled OLS and between-estimator regressions. The between estimator is an OLS estimator obtained using time-series averages for each firm, and thus it accounts for any potential correlation across longitudinal observations for the same firm. In the discussion that follows, I mainly focus on the estimation results obtained from the Tobit regression.

The estimated coefficients from the Tobit, OLS and between-estimator regressions are presented in Table 8. The coefficient estimates on the diversification variable are negative and statistically significant in all regressions, except for those estimated using OLS. This result is consistent with the prediction that offering both property-liability and life insurance negatively affects insurers' profit efficiency. Size, measured by the natural logarithm of total assets, also has a significantly negative impact on efficiency.[18] Furthermore, when I add the square of the size variable to the model, I do not find evidence of any considerable nonlinear relationship between size and efficiency: The coefficient on the square term in the Tobit regression is zero and statistically insignificant. All coefficients on the organizational form variable are not statistically different from zero in all regression specifications. Hence, similar to Gardner and Grace (1993), and Cummins and Zi (1998), I am not able to provide evidence in support or against the 'expense preference' hypothesis that predicts that mutual insurance companies should have higher costs and thus be less efficient than stock insurance companies. The coefficient on the distribution system variable in the Tobit model is positive and statistically significant at the 1 percent level.

Next, I analyze the effect of diversification on insurer efficiency by regressing degree of inefficiency on the same set of explanatory variables. Since the degree of

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[16] The Hausman test suggests the use of the fixed effects model over an alternative random effects model, as the null hypothesis of no correlations between the random effects and the regressors is rejected.

[17] Omitting the firm dummies results in economically larger and statistically more significant coefficient estimates of almost all variables.

[18] I obtain qualitatively and statistically similar results (not reported here) using the natural logarithm of net premiums written as a measure of insurer size.

inefficiency variable is constructed to measure the fraction of costs that a firm would incur if it operated in the most efficient way feasible, the results of this regression specification are more readily compared to findings in the insurance literature on cost efficiency. The estimation results for the Tobit, OLS and between-estimator regression models are presented in Table 9. Parallel to the findings in the regressions with the efficiency variable as a dependent variable, diversification is also found to be significantly negatively related to degree of inefficiency, i.e., cost efficiency. However, unlike in the former regression specification, I document a statistically significant U-shaped relationship between an insurer's size and its cost efficiency. The coefficient on the size variable is negative and statistically significant, while that on the size-squared variable is positive and statistically significant. This implies that medium-size insurers are less cost efficient than their smaller and larger counterparts. However, the size-efficiency nonlinearity found here is dominated by the linear component. Finally, the coefficients on neither the organizational form variable nor the distribution system variable are statistically significant in the Tobit model.

Regression Results: Property-Liability Insurers versus Life Insurers

I repeat the analysis separately for property-liability insurers and life insurers, where a measure of their efficiency is regressed on firm characteristics. This allows me to compare how product diversification impacts efficiency of property-liability insurers versus life insurers. To measure the degree of insurer diversification within the segment, I use the firm-level Herfindahl index, where the Herfindahl index is calculated as the sum of the squares of premiums written in each product line within a segment as a proportion of the insurer's total premiums written in all product lines within this segment. To facilitate the interpretation of the results, I define the Herfindahl variable as one minus the Herfindahl index. The estimation results from Tobit regressions for the property-liability and life subsamples are reported in Table 10.

With respect to product diversification, the results of the regression analysis are similar for the two subsamples. In both insurance segments, product diversification has a significantly negative effect on efficiency as well as on degree of inefficiency. I document, however, that this effect is almost twice as strong economically for property-liability insurers, as indicated by the relative size of the coefficients on the Herfindahl variable between the two subsamples.

The firm size appears to have a different impact on efficiency in each insurance segment. In the property-liability segment, size and efficiency have an inverse U-shape relationship, whereas life insurers have a negative linear relationship between firm size and efficiency. When degree of inefficiency is used as the dependent variable, the coefficients on the size variables are consistent in the two insurance segments. However, only life insurers experience an effect of size on cost efficiency that is statistically significant. Consistent with the finding in Ryan and Schellhorn (2000), smaller and larger life insurers are found to be more cost efficient than insurers of medium size.

In both insurance segments, I again find no significant impact of the insurer organizational form on either efficiency or degree of inefficiency. On the other hand, the type of the distribution system has opposite effects in the two segments. Vertically-integrated insurers in the property-liability segment are more efficient, whereas those in the life segment tend to be less efficient relative to insurers in the same insurance segment that use non-vertically-integrated distribution systems, such as independent agents and brokers. These findings concerning the effects of the type of the distribution system on property-liability and life insurers' efficiency are consistent with the findings reported in Berger et al. (1997) and Cummins et al. (2010).

7. Conclusion

In this study, I focus on the U.S. insurance industry to examine the relationship between diversification and firm efficiency. In particular, I study the impact of diversification across property-liability and life insurance, as well as the extent of product diversification within each of these two insurance segments, on firm efficiency. To estimate insurer efficiency, I employ a version of Varian's Weak Axiom of Profit Maximization test. Apart from its computational simplicity, the major advantage of this non-parametric approach is that it enables one to estimate firm efficiency without relying on a functional-form assumption for the production function.

The cross-sectional analysis of 2,174 individual insurers with operations in the property-liability and/or life insurance segments during the 1988-2001 period shows that insurer efficiency is decreasing in the number of insurance services offered. I find that insurers that provide both property-liability and life insurance tend to be less efficient than specialized insurers. The degree of product diversification within each of the two insurance segments also negatively impacts insurer efficiency. These results are in line with the prior findings in the insurance literature of positive effects of focus-increasing activities on firm efficiency (Cummins et al., 2010) and on accounting and market-based firm performance (Cummins and Xie, 2005; Liebenberg and Sommer, 2008).

The study's findings, taken together with the observed tendency of diversified insurers to be substantially larger than focused insurers, support the agency-cost explanation of firms' decisions to diversify. It appears that insurers that choose to pursue conglomeration do so at the detriment of their operational efficiency, possibly pursuing a suboptimal strategy that primarily benefits the management.

Future research that examines firms operating in more than one financial industry would shed more light on the merits of focus versus diversification in the financial services sector. With the introduction of the Financial Services Modernization Act in 1999, banks, insurance companies, and securities firms have been able to offer each other's financial products. Since then we have seen examples of firms moving towards combining the insurance business with other financial services (e.g., in 2002 J.P. Morgan Chase began underwriting its own insurance products) and firms divesting their insurance units (in the same year, Citigroup spun off its Travelers' property-liability insurance business). It would be interesting to know whether the conclusions of this study hold for the rest of the financial services sector.

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APPENDIX 1
Classification of Lines of Insurance in the Property-Liability Segment

PERSONAL
- Farmowners multiple peril
- Homeowners multiple peril
- Private passenger auto liability
- Auto physical damage*

COMMERCIAL PROPERTY
- Fire
- Allied lines
- Ocean marine
- Inland marine
- Earthquake
- Glass
- Burglary and theft
- Broiler and machinery
- Aggregate write-ins for other lines of business

COMMERCIAL LIABILITY
- Commercial multiple peril
- Medical malpractice
- Workers compensation
- Products liability
- Other liability
- Commercial auto liability
- Aircraft (all perils)
- International
- Reinsurance

FINANCIAL GUARANTY
- Mortgage guaranty
- Financial guaranty
- Fidelity
- Surety
- Credit

ACCIDENT/HEALTH
- Group accident and health
- Credit accident and health (group and individual)
- Other accident and health

* Auto physical damage contains both commercial and personal business. However, no breakdown of premiums written into commercial and personal business is available. Since the majority of the auto physical damage insurance is personal, we categorize it as a

APPENDIX 2
Variable Definitions

Variable	Definition
Dependent Variables	
Efficiency	One minus the proportion of comparisons a firm fails using the WAPM test. The ratio equals one (zero) if the firm is fully efficient (inefficient).
Degree of Inefficiency	Degree of inefficiency is the fraction of costs that a firm would incur if it operated in the most efficient way feasible. The measure equals one if the firm is fully efficient.
Explanatory Variables	
Diversification Dummy	Diversification dummy variable that is set equal to one if the insurer offers both property-liability and life insurance and equal to zero if it offers only one type of insurance.
Herfindahl	One minus the Herfindahl Index. Premium-based Herfindahl Index is calculated as the sum of the squares of premiums written in each product line within a segment as a proportion of a firm's total premiums written in all product lines within the correspondi
Control Variables	
Log (Total Assets)	The natural logarithm of total assets.
Log (Premiums)	The natural logarithm of net premiums written.
Organizational Form	Organizational-form dummy is set equal to one if the insurer is policyholder controlled (i.e., mutual or reciprocal), and zero if it is a stock company or Lloyd.
Distribution System	The distribution system variable is a weighted average of individual distribution-system variables of all the companies within the same group, with weights equal to the proportions of premiums written by the group’s companies. An individual company's dist

APPENDIX 2
Variable Definitions (continued)

Variable	Definition
Input and Output Measures	
Net revenue	Total premiums (and annuity considerations, in the case of life insurers) plus investment and other income minus output.
Price of administrative labor	State average weekly wages for SIC code 6331, *Fire, Marine & Casualty Insurance*, for property-liability insurers and for SIC code 6311, *Life Insurance*, for life insurers. The wage rate for administrative labor is used for the state in which the insurer's
Price of agent labor	The weighted state average weekly wages for SIC code 6411, *Insurance Agents, Brokers & Service,* with weights equal to the proportions of premiums written by an insurer in each state.
Price of physical capital	The ratio of physical capital expenses to physical capital assets.
Price of business services	The weighted state average weekly wage rate for SIC code 7389, *Business Services*, with weights equal to the proportions of premiums written by an insurer in each state.
Cost of equity	Based on financial ratings by the A.M. Best Company, cost of capital is set equal to between 11 and 13 percent for insurers in the top tier (the four ratings in the A range, i.e., A++, A+, A and A-), equal to between 14 and 16 for insurers in the middle
Quantity of administrative labor	Total administrative labor expenses divided by the price of administrative labor.
Quantity of agent labor	Total agent labor expenses divided by the price of agent labor.
Quantity of physical capital	Total physical capital expenses (i.e., rent, rental of equipment, depreciation, and other real estate expenses) divided by the price of physical capital.
Quantity of business services	Total business expenses (such as, marketing, accounting, legal and other miscellaneous services) divided by the price of business services.
Quantity of equity	Total capital divided by the cost of equity.

TABLE 1

Sample Distribution of Insurers by Year

PANEL A: Full Sample

The panel presents the distribution of sample firms by year. The full sample consists of 13,890 firm-years that represent 2,174 insurers with operations in the property-liability and/or life insurance segments during the 1988-2001 period. An insurer is categorized as diversified if it offers both property-liability and life insurance.

Year	Total Number of Firms	Number of Single-Segment Firms		Number of Diversified Firms	
		Frequency	%	Frequency	%
1988	1,151	924	80.3	227	19.7
1989	1,120	911	81.3	209	18.7
1990	1,091	884	81.0	207	19.0
1991	1,099	889	80.9	210	19.1
1992	1,068	873	81.7	195	18.3
1993	1,047	858	81.9	189	18.1
1994	1,024	845	82.5	179	17.5
1995	1,016	842	82.9	174	17.1
1996	978	807	82.5	171	17.5
1997	971	801	82.5	170	17.5
1998	910	753	82.7	157	17.3
1999	851	698	82.0	153	18.0
2000	789	650	82.4	139	17.6
2001	775	652	84.1	123	15.9
1988-2001	13,890	11,387	82.0	2,503	18.0

TABLE 1 (continued)
Sample Distribution of Insurance Companies by Year

PANEL B: Property-Liability Sample

The panel presents the distribution of property-liability insurers by year. The sample consists of 8,817 firm-years that represent 1,365 property-liability insurers during the 1988-2001 period. An insurer is categorized as diversified if it offers both property-liability and life insurance.

Year	Total Number of Firms	Number of Single-Segment Firms		Number of Diversified Firms	
		Frequency	%	Frequency	%
1988	657	497	75.6	160	24.4
1989	642	499	77.7	143	22.3
1990	653	517	79.2	136	20.8
1991	675	525	77.8	150	22.2
1992	665	521	78.3	144	21.7
1993	661	523	79.1	138	20.9
1994	651	523	80.3	128	19.7
1995	659	530	80.4	129	19.6
1996	644	519	80.6	125	19.4
1997	646	520	80.5	126	19.5
1998	620	505	81.5	115	18.5
1999	573	464	81.0	109	19.0
2000	530	430	81.1	100	18.9
2001	541	452	83.5	89	16.5
1988-2001	8,817	7,025	79.7	1,792	20.3

PANEL C: Life Sample

The panel presents the distribution of life insurers by year. The sample consists of 6,216 firm-years that represent 1,026 life insurers during the 1988-2001 period. An insurer is categorized as diversified if it offers both property-liability and life insurance.

Year	Total Number of Firms	Number of Single-Segment Firms		Number of Diversified Firms	
		Frequency	%	Frequency	%
1988	591	427	72.3	164	27.7
1989	567	412	72.7	155	27.3
1990	532	367	69.0	165	31.0
1991	530	364	68.7	166	31.3
1992	509	352	69.2	157	30.8
1993	479	335	69.9	144	30.1
1994	455	322	70.8	133	29.2
1995	442	312	70.6	130	29.4
1996	410	288	70.2	122	29.8
1997	404	281	69.6	123	30.4
1998	358	248	69.3	110	30.7
1999	336	234	69.6	102	30.4
2000	320	220	68.8	100	31.3
2001	283	200	70.7	83	29.3
1988-2001	6,216	4,362	70.2	1,854	29.8

TABLE 2
Segment and Product-Line Diversification by Year

The table presents diversification statistics for the full sample as well as the property-liability and life insurance subsamples for the 1988-2001 period. Firm-level Herfindahl Index is calculated as the sum of the squares of premiums written in each product line within the property-liability or life insurance segment as a proportion of the firm's total premiums written in all product lines within that segment. The full sample consists of 13,890 firm-years that represent 2,174 insurers. The property-liability sample consists of 8,817 firm-years that represent 1,365 property-liability insurers. The life sample consists of 6,216 firm-years that represent 1,026 life insurers.

Year	Full Sample (*N* =13,890)		Property-Liability Sample (*N* =8,817)				Life Sample (*N* =6,216)			
	Number of Segments		Number of Product Lines		Herfindahl Index		Number of Product Lines		Herfindahl Index	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
1988	1.20	0.40	3.08	1.22	0.68	0.23	4.02	1.40	0.61	0.22
1989	1.19	0.39	3.05	1.22	0.68	0.23	3.99	1.37	0.62	0.22
1990	1.19	0.39	3.01	1.23	0.69	0.23	3.96	1.38	0.62	0.22
1991	1.19	0.39	2.98	1.22	0.70	0.23	3.88	1.41	0.64	0.23
1992	1.18	0.39	2.97	1.26	0.70	0.23	3.82	1.41	0.64	0.23
1993	1.18	0.38	2.97	1.26	0.71	0.23	3.87	1.40	0.63	0.22
1994	1.17	0.38	2.92	1.26	0.71	0.23	3.87	1.37	0.64	0.22
1995	1.17	0.38	2.95	1.25	0.72	0.23	3.81	1.41	0.65	0.22
1996	1.17	0.38	2.86	1.27	0.73	0.23	3.82	1.40	0.65	0.22
1997	1.18	0.38	2.88	1.26	0.72	0.23	3.84	1.38	0.64	0.22
1998	1.17	0.38	2.93	1.27	0.72	0.23	3.81	1.43	0.65	0.22
1999	1.18	0.38	2.93	1.26	0.72	0.23	3.79	1.41	0.64	0.23
2000	1.18	0.38	3.00	1.24	0.71	0.23	3.81	1.41	0.64	0.23
2001	1.16	0.37	2.90	1.26	0.71	0.23	3.84	1.41	0.63	0.23
Annual Mean	1.18	0.38	2.96	1.25	0.71	0.23	3.88	1.40	0.63	0.22

TABLE 3
Product-Line Distribution

The table reports the number of firms that offer each line of insurance during the 1988-2001 period in the property-liability insurance segment and the life insurance segment in panel A and B, respectively. The property-liability sample consists of 8,817 firm-years that represent 1,365 property-liability insurers. The life sample consists of 6,216 firm-years that represent 1,026 life insurers. For the classification of the lines of insurance in the property-liability insurance segment, refer to Appendix 1.

PANEL A: Property-Liability Sample (*N* =8,817)

Year	Product Line										Number of Firms
	Commercial Property		Personal Insurance		Commercial Liability		Financial Guaranty		Accident and Health		
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
1988	530	80.7	562	85.5	550	83.7	236	35.9	144	21.9	657
1989	513	79.9	545	84.9	535	83.3	232	36.1	133	20.7	642
1990	518	79.3	546	83.6	541	82.8	237	36.3	124	19.0	653
1991	533	79.0	556	82.4	553	81.9	244	36.1	123	18.2	675
1992	518	77.9	535	80.5	541	81.4	247	37.1	132	19.8	665
1993	511	77.3	536	81.1	546	82.6	241	36.5	129	19.5	661
1994	483	74.2	519	79.7	541	83.1	237	36.4	119	18.3	651
1995	494	75.0	518	78.6	574	87.1	237	36.0	119	18.1	659
1996	463	71.9	492	76.4	548	85.1	226	35.1	113	17.5	644
1997	468	72.4	493	76.3	555	85.9	234	36.2	112	17.3	646
1998	457	73.7	483	77.9	532	85.8	229	36.9	114	18.4	620
1999	425	74.2	447	78.0	498	86.9	199	34.7	108	18.8	573
2000	407	76.8	424	80.0	464	87.5	194	36.6	103	19.4	530
2001	401	74.1	418	77.3	475	87.8	179	33.1	97	17.9	541
Annual Mean	480	76.2	505	80.2	532	84.5	227	36.0	119	18.9	630

TABLE 3 (continued)
Product-Line Distribution

PANEL B: Life Sample (N =6,216)

Year	Product Line: Ordinary Life Insurance		Ordinary Individual Annuities		Group Life		Group Annuities		Accident and Health		Other*		Number of Firms
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
1988	548	92.7	403	68.2	412	69.7	190	32.1	525	88.8	296	50.1	591
1989	529	93.3	388	68.4	393	69.3	175	30.9	505	89.1	274	48.3	567
1990	493	92.7	369	69.4	363	68.2	168	31.6	467	87.8	245	46.1	532
1991	488	92.1	353	66.6	349	65.8	156	29.4	456	86.0	252	47.5	530
1992	469	92.1	346	68.0	339	66.6	150	29.5	432	84.9	209	41.1	509
1993	441	92.1	326	68.1	329	68.7	147	30.7	413	86.2	199	41.5	479
1994	415	91.2	309	67.9	319	70.1	143	31.4	397	87.3	178	39.1	455
1995	396	89.6	295	66.7	303	68.6	137	31.0	381	86.2	174	39.4	442
1996	366	89.3	271	66.1	287	70.0	131	32.0	355	86.6	158	38.5	410
1997	360	89.1	273	67.6	288	71.3	125	30.9	350	86.6	157	38.9	404
1998	316	88.3	235	65.6	252	70.4	115	32.1	311	86.9	136	38.0	358
1999	296	88.1	217	64.6	241	71.7	105	31.3	291	86.6	124	36.9	336
2000	285	89.1	217	67.8	218	68.1	96	30.0	276	86.3	126	39.4	320
2001	256	90.5	194	68.6	194	68.6	95	33.6	241	85.2	107	37.8	283
Annual Mean	404	91.0	300	67.5	306	69.0	138	31.1	386	86.9	188	42.4	444

*Other life insurance includes industrial life, credit life, and ordinary supplementary contracts.

TABLE 4
Descriptive Statistics

The table reports descriptive statistics for variables used in estimating regressions. The sample consists of 13,890 firm-years that represent 2,174 insurers with operations in the property-liability and/or life insurance segments during the 1988-2001 period. The variables are defined in Appendix 2.

Variable	N	Mean	Median	Standard Deviation	Minimum	Maximum
Efficiency Variables						
Efficiency	13,890	0.83	0.90	0.20	0.00	1.00
Degree of Inefficiency	13,890	0.32	0.25	0.26	0.00	1.00
Diversification Variables						
Diversification Dummy	13,890	0.18	0.00	0.38	0.00	1.00
Herfindahl Index - P-L	8,817	0.71	0.69	0.23	0.25	1.00
Herfindahl Index - Life	6,216	0.63	0.58	0.22	0.21	1.00
Number of Product Lines - P-L	8,817	2.96	3.00	1.25	1.00	5.00
Number of Product Lines - Life	6,216	3.88	4.00	1.40	1.00	6.00
Control Variables						
Organizational Form	13,890	0.53	1.00	0.50	0.00	1.00
Distribution System	13,890	0.20	0.00	0.34	0.00	1.00
Log (Premiums)	13,890	17.39	17.14	2.08	13.82	24.54
Log (Total Assets)	13,890	18.44	18.06	2.35	12.93	26.37

TABLE 5
Univariate Analysis: Property-Liability Insurers versus Life Insurers

The table presents summary statistics for regression variables and input/output variables for property-liability insurers and life insurers and t-tests for the difference in means of the variables between the two groups. The variables are first averaged within each firm over the 1988-2001 period. The property-liability sample and the life sample contain 1,365 insurers and 1,026 insurers, respectively. The variables are defined in Appendix 2. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Property-Liability Insurers (*N* =1,365)		Life Insurers (*N* =1,026)		Test Statistic: $\mu_{P\text{-}L} = \mu_{Life}$
	Mean	Standard Deviation	Mean	Standard Deviation	
REGRESSION VARIABLES					
Efficiency Variables					
Efficiency	0.82	0.16	0.84	0.15	3.07 ***
Degree of Inefficiency	0.37	0.22	0.39	0.25	1.61
Diversification Variables					
Diversification Dummy	0.18	0.36	0.25	0.42	4.46 ***
Herfindahl Index	0.74	0.22	0.66	0.21	-9.08 ***
Number of Product Lines	2.75	1.24	3.68	1.34	17.34 ***
Control Variables					
Organizational Form	0.36	0.47	0.12	0.32	-14.25 ***
Distribution System	0.25	0.37	0.23	0.29	-1.27
Log (Premiums)	16.95	1.87	17.14	2.05	2.36 **
Log (Total Assets)	17.79	2.03	18.40	2.37	6.68 ***
INPUT/OUTPUT PRICES AND QUANTITIES					
Price of administrative labor ($)	769.68	159.07	650.33	153.94	-18.41 ***
Price of agent labor ($)	668.53	136.60	605.93	113.00	-12.25 ***
Price of physical capital	6.31	41.69	9.00	91.42	0.88
Price of business services ($)	419.90	92.29	383.94	74.84	-10.52 ***
Cost of equity (%)	11.11	0.88	13.31	1.21	49.43 ***
Quantity of administrative labor	48,193	218,282	26,606	96,268	-3.26 ***
Quantity of agent labor	41,992	215,171	59,292	165,007	2.23 **
Quantity of physical capital (in millions)	11	81	38	296	2.78 ***
Quantity of business services	23,865	113,002	33,774	116,768	2.09 **
Quantity of equity (in millions)	2,129	12,055	1,392	5,361	-2.01 **
Net Revenue (in millions)	21	101	42	243	2.63 ***

TABLE 6

Univariate Analysis: Single-Segment Insurers versus Diversified Insurers

PANEL A: Full Sample

The panel reports full-sample summary statistics for single-segment insurers and diversified insurers and t-tests for the difference in means of the variables between the two groups. The variables are first averaged within each firm over the 1988-2001 period. The single-segment sample and the diversified sample contain 1,971 and 357 insurers, respectively. The variables are defined in Appendix 2. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Single-Segment Insurers (*N* =1,971)		Diversified Insurers (*N* =357)		Test Statistic: $\mu_{focused}=\mu_{diversified}$
	Mean	Standard Deviation	Mean	Standard Deviation	
Efficiency Variables					
Efficiency	0.84	0.15	0.74	0.19	9.67 ***
Degree of Inefficiency	0.33	0.22	0.30	0.20	2.50 **
Control Variables					
Organizational Form	0.51	0.45	0.67	0.44	-6.10 ***
Distribution System	0.23	0.33	0.27	0.35	-2.16 **
Log (Premiums)	16.81	1.78	18.77	2.13	-16.40 ***
Log (Total Assets)	17.79	2.06	19.92	2.33	-16.14 ***

TABLE 6 (continued)
Univariate Analysis: Single-Segment Insurers versus Diversified Insurers

PANEL B: Property-Liability Sample

The panel presents summary statistics for single-segment insurers and diversified insurers in the property-liability insurance segment. We report statistics for regression variables and input/output variables for single-segment insurers and diversified insurers and t-tests for the difference in means of the variables between the two groups. The variables are first averaged within each firm over the 1988-2001 period. The single-segment sample and the diversified sample contain 1,174 and 281 property-liability insurers, respectively. The variables are defined in Appendix 2. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Single-Segment Insurers (N=1,174)		Diversified Insurers (N=281)		Test Statistic: $\mu_{focused}=\mu_{diversified}$
	Mean	Standard Deviation	Mean	Standard Deviation	
REGRESSION VARIABLES					
Efficiency Variables					
Efficiency	0.84	0.15	0.73	0.20	8.94 ***
Degree of Inefficiency	0.38	0.23	0.34	0.24	2.39 **
Diversification Variables					
Herfindahl Index	0.75	0.22	0.66	0.22	6.01 ***
Number of Product Lines	2.62	1.18	3.58	1.28	-12.07 ***
Control Variables					
Organizational Form	0.37	0.48	0.27	0.43	3.62 ***
Distribution System	0.23	0.36	0.33	0.41	-3.92 ***
Log (Premiums)	16.69	1.64	18.57	2.23	-13.27 ***
Log (Total Assets)	17.53	1.83	19.47	2.27	-13.34 ***
INPUT/OUTPUT PRICES AND QUANTITIES					
Price of administrative labor ($)	776.27	163.78	744.66	145.72	3.19 ***
Price of agent labor ($)	674.93	141.85	642.17	113.37	4.13 ***
Price of physical capital	5.47	33.56	8.43	61.41	-0.78
Price of business services ($)	423.57	95.43	404.60	76.92	3.53 ***
Cost of equity (%)	11.15	0.89	10.89	0.84	4.39 ***
Quantity of administrative labor	21,882	84,838	183,207	452,353	-5.95 ***
Quantity of agent labor	18,446	67,454	162,068	452,208	-5.31 ***
Quantity of physical capital (in millions)	5	22	44	174	-3.80 ***
Quantity of business services	11,134	34,897	87,653	236,216	-5.42 ***
Quantity of equity (in millions)	899	3,247	8,113	25,574	-4.72 ***
Net revenue (in millions)	10	53	74	212	-5.02 ***

TABLE 6 (continued)
Univariate Analysis: Single-Segment Insurers versus Diversified Insurers

PANEL C: Life Sample

The panel presents summary statistics for single-segment insurers and diversified insurers in the life insurance segment. We report statistics for regression variables and input/output variables for single-segment insurers and diversified insurers and t-tests for the difference in means of the variables between the two groups. The variables are first averaged within each firm over the 1988-2001 period. The single-segment sample and the diversified sample contain 801 and 287 life insurers, respectively. The variables are defined in Appendix 2. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	**Single-Segment Insurers (N=801)**		**Diversified Insurers (N=287)**		**Test Statistic: $\mu_{focused}=\mu_{diversified}$**
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	
REGRESSION VARIABLES					
Efficiency Variables					
Efficiency	0.86	0.15	0.81	0.17	4.36 ***
Degree of Inefficiency	0.40	0.26	0.38	0.24	1.03
Diversification Variables					
Herfindahl Index	0.69	0.21	0.56	0.20	8.54 ***
Number of Product Lines	3.52	1.33	4.24	1.26	-7.96 ***
Control Variables					
Organizational Form	0.15	0.34	0.05	0.22	5.34 ***
Distribution System	0.24	0.28	0.21	0.32	1.43
Log (Premiums)	16.99	1.95	17.94	2.34	-6.12 ***
Log (Total Assets)	18.17	2.31	19.44	2.50	-7.81 ***
INPUT/OUTPUT PRICES AND QUANTITIES					
Price of administrative labor ($)	645.92	156.80	681.57	168.08	-3.24 ***
Price of agent labor ($)	601.48	117.44	630.77	107.20	-3.71 ***
Price of physical capital	7.82	98.80	11.51	53.82	-0.78
Price of business services ($)	381.72	76.72	397.85	73.67	-3.09 ***
Cost of equity (%)	13.38	1.20	13.05	1.25	3.89 ***
Quantity of administrative labor	19,836	59,058	57,823	165,698	-3.80 ***
Quantity of agent labor	44,425	130,412	125,561	257,181	-5.11 ***
Quantity of physical capital (in millions)	28	157	81	512	-1.75 *
Quantity of business services	24,997	73,508	73,720	200,468	-4.02 ***
Quantity of equity (in millions)	1,005	4,057	3,221	9,018	-4.02 ***
Net revenue (in millions)	35	226	86	311	-2.56 **

TABLE 7
Correlation Matrix

The table presents Pearson correlation coefficients for variables used in the regression analysis. The correlation coefficients are estimated for the full sample of 13,890 firm-years over the 1988-2001 period. The variables are defined in Appendix 2. P-values are in parentheses. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Efficiency	Degree of Inefficiency	Diversification Dummy	Organizational Form	Distribution System	Log (Premiums)	Log (Total Assets)
Efficiency	1.00						
Degree of Inefficiency	0.615 *** (0.00)	1.00					
Diversification Dummy	-0.228 *** (0.00)	-0.025 *** (0.00)	1.00				
Organizational Form	-0.004 (0.66)	0.030 *** (0.00)	0.109 *** (0.00)	1.00			
Distribution System	0.013 (0.13)	0.075 *** (0.00)	0.106 *** (0.00)	-0.085 *** (0.00)	1.00		
Log (Premiums)	-0.414 *** (0.00)	-0.032 *** (0.00)	0.429 *** (0.00)	0.091 *** (0.00)	0.012 (0.15)	1.00	
Log (Total Assets)	-0.361 *** (0.00)	0.020 ** (0.02)	0.405 *** (0.00)	0.077 *** (0.00)	0.017 ** (0.04)	0.939 *** (0.00)	1.00

TABLE 8
The Effect of Diversification on Insurer Efficiency: Full Sample

The table reports the results of regressions of insurers' diversification on their efficiency for the sample of 13,890 firm-years that represent 2,174 insurers with operations in the property-liability and/or life insurance segments during the 1988-2001 period. The dependent variable is *Efficiency*, where 1(0) indicates a fully efficient (inefficient) firm. *Size* is proxied by the natural logarithm of total assets. These and other variables are defined in Appendix 2. The table displays estimated coefficients from the pooled OLS regression, between estimator, and double-censored Tobit regression. The standard errors in the pooled OLS and between-estimator regressions are obtained from White's estimates of the variance-covariance matrix. T-statistics are shown in parentheses. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Pooled OLS		Between Estimator		Tobit	
Intercept	1.390 ***	1.412 ***	1.376 ***	2.603 ***	1.491 ***	1.513 ***
	(9.07)	(5.22)	(44.96)	(12.58)	(22.30)	(7.43)
Diversification Dummy	-0.016	-0.016	-0.048 ***	-0.056 ***	-0.017 **	-0.016 **
	(-1.47)	(-1.47)	(-4.10)	(-4.76)	(-2.00)	(-1.99)
Size	-0.039 ***	-0.041	-0.030 ***	-0.164 ***	-0.039 ***	-0.041 **
	(-8.6)	(-1.43)	(-16.82)	(-7.04)	(-13.45)	(-2.01)
Size × *Size*		0.000		0.004 ***		0.000
		(0.08)		(5.53)		(0.10)
Organizational Form	0.004	0.004	0.007	0.011	0.004	0.004
(1 = mutual)	(0.82)	(0.82)	(1.00)	(1.60)	(0.87)	(0.87)
Distribution System	-0.028 **	-0.028 **	0.028 ***	0.024 ***	-0.028 ***	-0.028 ***
(1= vertically integrated)	(-2.07)	(-2.07)	(3.15)	(2.74)	(-2.59)	(-2.59)
Firm Dummies	Yes	Yes	No	No	Yes	Yes
Year Dummies	Yes	Yes	No	No	Yes	Yes
Adjusted R-squared	0.4702	0.4702	0.2179	0.2361		
Log Likelihood					8225.71	8225.71
Number of observations	13,890	13,890	2,174	2,174	13,890	13,890

TABLE 9
The Effect of Diversification on Degree of Inefficiency: Full Sample

The table reports the results of regressions of insurers' diversification on their degree of inefficiency for the sample of 13,890 firm-years that represent 2,174 insurers with operations in the property-liability and/or life insurance segments during the 1988-2001 period. The dependent variable is *Degree of Inefficiency*, where 1(0) indicates a fully efficient (inefficient) firm. *Size* is proxied by the natural logarithm of total assets. These and other variables are defined in Appendix 2. The table displays estimated coefficients from the pooled OLS regression, between estimator, and double-censored Tobit regression. The standard errors in the pooled OLS and between-estimator regressions are obtained from White's estimates of the variance-covariance matrix. T-statistics are shown in parentheses. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Pooled OLS		Between Estimator		Tobit	
Intercept	0.400 **	2.532 ***	0.415 ***	5.316 ***	0.333 ***	2.524 ***
	(2.29)	(7.38)	(8.40)	(18.43)	(3.88)	(9.68)
Diversification Dummy	-0.022 *	-0.020 *	-0.027 *	-0.059 ***	-0.022 **	-0.020 *
	(-1.83)	(-1.67)	(-1.83)	(-4.09)	(-2.11)	(-1.91)
Size	-0.003	-0.234 ***	-0.006 **	-0.539 ***	-0.003	-0.234 ***
	(-0.53)	(-6.54)	(-2.11)	(-17.20)	(-0.81)	(-8.93)
Size × *Size*		0.006 ***		0.014 ***		0.006 ***
		(6.34)		(16.90)		(8.90)
Organizational Form	0.007	0.006	0.005	0.021 **	0.007	0.006
(1 = mutual)	(1.00)	(0.92)	(0.51)	(2.18)	(1.08)	(0.99)
Distribution System	0.020	0.016	0.079 ***	0.064 ***	0.020	0.016
(1= vertically integrated)	(1.16)	(0.92)	(5.50)	(4.76)	(1.42)	(1.12)
Firm Dummies	Yes	Yes	No	No	Yes	Yes
Year Dummies	Yes	Yes	No	No	Yes	Yes
Adjusted R-squared	0.4738	0.4767	0.0193	0.1745		
Log Likelihood					4758.01	4797.50
Number of observations	13,890	13,890	2,174	2,174	13,890	13,890

TABLE 10
The Effect of Product Diversification on Efficiency and Degree of Inefficiency: Property-Liability Insurers versus Life Insurers

The table reports estimated coefficients from the double-censored Tobit regressions of product diversification on efficiency and the degree of inefficiency for property-liability and life insurers during the 1988-2001 period. The property-liability sample consists of 8,817 firm-years that represent 1,365 insurers. The life sample consists of 6,216 firm-years that represent 1,026 insurers. The dependent variables are *Efficiency* and *Degree of Inefficiency*, where in both cases 1(0) indicates a fully efficient (inefficient) firm. *Size* is proxied by the natural logarithm of total assets. These and other variables are defined in Appendix 2. T-statistics are shown in parentheses. The symbols *, ** and *** indicate statistical significance at less than the 10-percent, 5-percent, and 1-percent levels, respectively.

Variable	Property-Liability Insurers		Life Insurers	
	Efficiency	**Degree of Inefficiency**	**Efficiency**	**Degree of Inefficiency**
Intercept	-0.511 (-1.36)	0.783 (1.60)	1.742 *** (7.69)	2.799 *** (7.77)
Herfindahl	-0.060 *** (-2.89)	-0.109 *** (-3.99)	-0.030 * (-1.78)	-0.075 *** (-2.81)
Size	0.188 *** (4.79)	-0.014 (-0.28)	-0.060 *** (-2.60)	-0.247 *** (-6.76)
Size × *Size*	-0.007 *** (-6.35)	0.000 (0.33)	0.001 (1.34)	0.006 *** (6.76)
Organizational Form (1 = mutual)	-0.018 (-1.00)	-0.022 (-0.92)	0.009 (0.58)	-0.002 (0.00)
Distribution System (1= vertically integrated)	0.018 (1.13)	0.062 *** (3.04)	-0.048 *** (-3.17)	-0.025 (-1.04)
Firm Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Log Likelihood	4323.27	1966.55	4538.61	1652.54
Number of observations	8,817	8,817	6,216	6,216