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by
Joseph W. Meador
Harley E. Ryan, Jr.
Carolin D. Schellhorn

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Product Focus versus Diversification: Estimates of X-Efficiency for the US Life Insurance Industry [1]

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Abstract: Using data for the life insurance industry during 1990-1995, we empirically test for a relationship between a firm's output choice and measures of X-efficiency. Our empirical evidence suggests that diversification across multiple insurance and investment product lines resulted in greater X-efficiency than a more focused production strategy. The analysis in this article is consistent with the proposition that managers of multiproduct firms are able to achieve greater cost efficiencies than their counterparts in more focused firms by sharing inputs and efficiently allocating resources across product lines in response to changing industry conditions. Our findings are important since they justify the existence of multiproduct firms in the absence of cost complementarities and identify product diversification as a source of efficiency in the life insurance industry that should be recognized by managers, policyholders, and regulators.

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[1]Joseph W. Meador, College of Business Administration, Northeastern University, Boston, MA 02115, Phone: 617-373-4713, FAX: 617-373-8798.

Harley E. Ryan, Jr., College of Business Administration, Northeastern University, Boston, MA 02115, Phone: 617-373-4707, FAX: 617-373-8798.

Carolin D. Schellhorn, Sawyer School of Management, Suffolk University, Boston, MA 02108, Phone: 617-573-8794, FAX: 617-573-8345.

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I. INTRODUCTION

Increased competition, consolidation and a changing regulatory environment in the life insurance industry have intensified interest in the analysis of insurer efficiencies. Yuengert (1993) analyzes the measurement of X-efficiency[1] and finds that estimates vary widely. Gardner and Grace (1993) suggest that X-efficiencies may be related to rent-seeking activities and external (but not internal) monitoring. Grace and Timme (1992) document the existence of scale economies, but find little evidence of economies of scope for multiproduct firms. This latter result is surprising given the well publicized trend toward diversified product offerings in the financial services industry. In the absence of cost complementarities, the authors conclude that multiproduct firms may exist to reap the benefits from diversification, or the cost savings from sharing inputs across independent product lines.

We support this conjecture by providing empirical evidence that X-efficiencies are greater for life insurance firms with a diversified product mix compared to firms that focus on a relatively narrow range of outputs. Our results are consistent with variations in X-efficiency due to differences in managers' ability to respond effectively to rapidly changing industry conditions. Compared to their counterparts in more narrowly focused firms, the managers of diversified firms appear better able to contain costs by reallocating inputs among independent product lines when adjusting to shifts in product demands.

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[1] For a definition of X-efficiency that is consistent with the original definition of Leibenstein (1966) see Berger (1993), p. 264:

> "X-efficiency is defined as the ratio of the minimum costs that could have been expended to produce a given output bundle to the actual costs expended, and varies between 0 and 100 percent. X-efficiency includes both technical inefficiency, or errors that result in general overuse of inputs, and allocative inefficiency, or errors in choosing an input mix that is consistent with relative prices."

Subjecting our data for 1990-1995 to cross-sectional analyses, we test two hypotheses regarding the effect of a firm's output choice on estimates of its X-efficiency.

1) Diversification Hypothesis: X-efficiency increases when managers make resource-allocation decisions for a broader range of distinct, but related, outputs.

Managers' abilities to reduce costs by sharing inputs and efficiently allocating resources across independent product lines result in greater efficiency. Hence, life insurance companies that offer multiple insurance and investment products may prove more X-efficient than firms that specialize.

2) Concentration Hypothesis: X-efficiency increases when managers focus on a particular area of expertise and a small number of product lines.

Managers generate cost savings by concentrating their financial and human resources in a single area of expertise. Hence, life insurance companies that focus on a limited product offering may prove more X-efficient than firms that compete in multiple product market segments.

The life insurance industry is particularly suitable for testing these alternative hypotheses because the output choices faced by managers are essentially distinct (various life and/or health and accident insurance products versus various annuity products). Furthermore, reporting requirements make these choices observable and allow us to measure both X-efficiency and product focus. Using Berger's (1993) distribution free method to estimate X-efficiency and a firm specific Herfindahl index calculated across each insurance firm's product line premiums to measure product focus, we perform two independent tests of our hypotheses. First, we conduct an univariate comparison of means and medians for focused vs. diversified firms over 1990-1995.

Second, we estimate a multivariate fixed effects model over the same time period to control for other firm specific and environmental factors that have been identified in previous studies of insurer efficiency. Analyzing a sample of 358 life insurance firms, we find that multiproduct insurance companies are more X-efficient than firms that focus.

The scope of our analysis is also related to research in corporate finance that analyzes the influence of business focus on the value and performance of publicly traded industrial firms. These studies generally conclude that greater focus leads to increased shareholder wealth. For example, Hite, Owers and Rogers (1987) find that asset sales by firms increase their value, while John and Ofek (1995) present evidence that asset sales lead to improved operating performance. Results reported by Wernerfelt and Montgomery (1988) suggest that Tobin's q, the market value of a firm's assets divided by their replacement value, is negatively related to the number of industries in which a firm operates.[2] There are two fundamental differences, however, between these studies and our paper. First, our analysis of life insurance companies addresses the *intra-industry* characteristics of diversified versus focused financial service providers, while these industrial studies primarily analyze the effects of *inter-industry* diversification for manufacturing firms. Second, we estimate cost-efficiency, not market performance. Our results shed new light on sources of X-efficiency from intra-industry diversification for life insurance companies and, thus, are important for managers, policyholders, and regulators who must weigh the benefits and costs of the continuing trend toward increased diversification of financial service providers.

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[2] Further support for the notion that greater corporate focus is consistent with shareholder wealth maximization in publicly traded industrial firms is provided by Berger and Ofek (1995) and Comment and Jarrell (1995).

The remainder of our paper is organized as follows. Section II explains our data and estimation methodology. In Section III, we present X-efficiency estimates and regression results. Section IV summarizes and concludes the study.

II. DATA AND ESTIMATION METHODOLOGY

A. Data

We gathered most of the cross-sectional data required for this study from the NAIC data tapes. State wage rate information was obtained from the Bureau of Labor Statistics, and information on firm distribution systems was collected from the *Best's Insurance Reports.* The data were collected for individual firms, since aggregating firms into fleets could distort our measure of product focus and the corresponding X-efficiency estimates. Hence, our results cannot be directly compared to those of studies using fleets. To be included in our sample, an insurance firm's data had to be available for six consecutive years (1990-1995) on the NAIC tapes. A total of 358 life insurance companies met this requirement.[3]

B. Variable Definitions

Outputs and Input Prices

Following Gardner and Grace (1993) and Grace and Timme (1992), we specify six outputs for the life insurance firm: 1) ordinary life insurance premiums (Y_1), 2) ordinary annuity

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[3] This sample size is smaller than a similar six year sample from 1985-1990 of 561 firms analyzed by Gardner and Grace (1993). The smaller size of our sample is most likely indicative of increased concentration in the life insurance industry from the mid 1980's to the mid 1990's.

considerations (Y_2), 3) group life insurance premiums (Y_3), 4) group annuity considerations (Y_4), 5) group accident and health premiums (Y_5), and 6) the dollar amount of securities investments (Y_6). Summary statistics for outputs and total assets are reported in Table 1. A perusal of this table reveals high average concentrations in the production of ordinary life insurance (approximately 37%) and accident and health insurance (approximately 36%). A comparison of total asset averages for the firms in our sample with the total asset averages reported for 1987 by Grace and Timme (1992) and for 1989 by Yuengert (1993) shows that the average size of our sample firms is greater than the average size of sample firms in their studies that cover earlier time periods. The relatively greater average size of our sample firms is consistent with increased industry concentration and may be a result of the higher merger-and-acquisitions activity in the life insurance industry in recent years.

Our specification of three inputs (labor, physical capital and miscellaneous items), and the assumptions we make to compute the required input prices, are consistent with recent studies in this literature. The price of labor (w_1) equals the product of the average statewide salary of insurance workers and the portion of insurance business written in the state. We divide physical capital expenses by the value of physical capital assets to obtain the price of physical capital (w_2). Miscellaneous costs include all production factors other than labor and physical capital, such as legal and accounting services, travel and advertising. Since prices for these items are difficult to determine from the available data, we assume that they do not vary across firms.[4]

[4] This assumption is consistent with the extant literature (e.g., Grace and Timme (1992)). The validity of this assumption may be suspect, however, if diversification results in greater administrative costs. The reader should interpret these results within the limitations of the available data.

Costs

We define total costs (C) as operating costs, i.e. the sum of labor, capital and miscellaneous expenses. Labor expenses consist of commissions on premiums and annuity considerations (direct business only) and all salaries, wages and benefits. Capital expenses comprise rent for buildings and equipment, and depreciation on furniture and equipment. Since we assume miscellaneous items prices to remain constant across firms, we exclude them from the total cost equation specified below.

Focus Proxy

We use a firm specific product Herfindahl index (FOCUS) calculated across the output premiums described above to measure the extent to which a firm chooses to focus versus diversify its output across insurance and investment product lines. The Herfindahl index is estimated across the firms' premiums derived from insurance and annuity products and is defined as:

$$\text{FOCUS} = \frac{Y_{OL}^2 + Y_{OA}^2 + Y_{GL}^2 + Y_{GA}^2 + Y_{AH}^2}{[Y_{OL} + Y_{OA} + Y_{GL} + Y_{GA} + Y_{AH}]^2}$$

where

Y_{OL} = Net premiums collected for ordinary life insurance.

Y_{OA} = Considerations for ordinary annuities.

Y_{GL} = Net premiums collected for group life insurance

Y_{GA} = Considerations for group annuities.

Y_{AH} = Collected premiums for accident and health insurance.

A firm that exclusively focuses on the production of any one of the outputs defined above, has a Herfindahl index of one, while a firm that offers a broader range of product lines would have a lower Herfindahl index.

Table 2 reports summary statistics for the focus proxy used in our analysis. On average, firms have a focus proxy of 0.6837 for the entire time period. The focus metric ranges from a low of 0.2462 to a maximum of 1. Thus, we have a wide range of product strategy choices in our sample. This dispersion makes our sample suitable for an analysis of the relationship between X-efficiency and product choice.

C. Control Variable Definitions

Previous studies have identified numerous firm specific and environmental factors that influence X-efficiency. We control for these factors in our fixed effects model by including the same vector of variables as Gardner and Grace (1993) in our multivariate test of the relationship between firm X-efficiency and product focus. These control variables and their proxies are discussed below.

New York Regulation

Boose (1990) argues that the higher regulatory standards imposed by New York on all life insurance companies writing insurance in the state (regardless of state of domicile) should increase the efficiency of these firms relative to the efficiency of "non-New York" firms. We include a 0/1 dummy variable (NY) to control for the New York regulatory influence. The dummy equals 1 if a firm wrote any business in New York and zero otherwise.

Organizational Form

A priori, mutual life insurers would be expected to be less efficient than stock companies due to the lack of effective monitoring of managers by the firm's shareholders. Yet, the empirical evidence in the literature is mixed (Fields (1988), Grace and Timme (1992) and Gardner and Grace (1993)). We include a 0/1 dummy variable (MUTUAL) to control for the influence of organizational structure on efficiency.

Distribution System

Similar agency-theoretic arguments predict that companies using general agency or branch office distribution systems should be more efficient than firms using non-agency building systems such as brokerages. But, again, prior empirical evidence is ambiguous (Grace and Timme (1992) and Gardner and Grace (1993)). To control for a firm's choice of distribution system, we include a dummy variable (AGENCY) that is 1 if a firm uses an agency building system and 0 if not.

Rent-Seeking Activities

Gardner and Grace (1993) hypothesize that firms trying to build barriers to entry in an effort to seek economic rents will, ceteris paribus, spend more on bureau and agency fees, litigation, and advertising. To control for the possibility of rent seeking by life insurance companies, we include bureau and agency fees as a percentage of net premiums (BUREAU), legal expenses unrelated to claims as a percentage of net premiums (LEGLFEE), and advertising expenditures as a percentage of net premiums (ADVERT).

Non-Admitted Assets

Non-admitted assets represent relatively less productive assets. These assets may lack liquidity, be excessively risky, or have value that is very specific to the firm. For regulatory purposes, non-admitted assets are assigned little value in assessing solvency requirements. We use non-classified aggregate write-ins as a percentage of total assets (AGWRITES) to control for non-productive assets.

Capital Structure, Market Share and Firm Size

As inefficient firms face increased competition, they will experience a depletion of their capital surpluses. This problem is especially severe for mutual companies that cannot issue stock. We use the ratio of equity to total assets (CAP) to control for differences in firms' capital structures. Firms that serve a large percentage of the market tend to have market power. Percentage market share based on total premiums (MSHR) is included to control for this possibility. Finally, since previous studies have identified economies of scale (Grace and Timme (1992)) and size related heteroscedasticity in insurance cost residuals (Fields (1988)), we include total assets (TOTAL ASSETS) as a proxy for firm size.

D. Methodology

We use Berger's (1993) distribution free approach to estimate X-efficiency in order to avoid having to impose an arbitrary distribution on cost residuals. We specify the translog cost function for the six outputs and three inputs described above. Firm and time subscripts s and t are suppressed in Equation 1) for expositional ease:

$$\ln C = \alpha + \sum_{j=1}^{6} b_j \, g(Y_j) + \frac{1}{2} \sum_{j=1}^{6} \sum_{k=1}^{6} b_{jk} \, g(Y_j) \, g(Y_k) + \sum_{n=1}^{3} g_n \ln \omega_n$$

$$+ \frac{1}{2} \sum_{n=1}^{3} \sum_{p=1}^{3} \gamma_{np} \ln \omega_n \ln \omega_p + \sum_{j=1}^{6} \sum_{n=1}^{3} \rho_{jn} g(Y_j) \ln \omega_n + \ln \varepsilon \qquad 1)$$

The Y_j represent dollar amounts of the outputs, and the ω_n denote input prices. We follow Yuengert (1993) in setting

$$g(Y) = \ln (Y) \qquad Y > 0,$$

$$g(Y) = 0 \qquad Y = 0.$$

By Shephard's Lemma, the share equations for labor and capital are defined as the n^{th} input's share of total costs, $S_n = \frac{d\ln C}{d\ln w_n}$. To avoid singularity, as the sum of the shares equals unity, we drop the labor share from this system of equations.

The error term, $\ln \varepsilon_{st}$, consists of two components; the persistent error ($\ln u_{st}$) and the random disturbance ($\ln x_{st}$) which averages over time to equal zero. To compute an average efficiency ratio for each firm during 1990-1995, we estimate the cost function along with the corresponding share equations and cross-equation restrictions (required for symmetry and homogeneity) for each of the years 1990-1995. Given estimates of six cost functions, we determine the residual $\ln \varepsilon_{st}$ for each firm s in year t. We then average across a firm's residuals to determine the firm's mean residual, which we take to be our estimate of the firm's persistent error for the sample period, $\ln \bar{u}_{st}$. We identify a benchmark efficiency measure by selecting the firm with the lowest persistent error, $\ln \bar{u}_{st}^{\min}$. Our efficiency measure thus corresponds to the formula developed in Berger (1993):

$$XEFF_{st} = \exp(\ln \bar{u}_{st}^{\min} - \ln \bar{u}_{st}). \qquad 2)$$

The most efficient firm obtains an average X-efficiency estimate of one, while X-efficiency is bounded from below at zero.[5]

II. ESTIMATION AND RESULTS

A. Estimation

We jointly estimate Equation 1), the input share equations and imposed restrictions using full information maximum likelihood (FIML). To obtain unbiased hypothesis tests, we scaled the dependent variable of the cost function by its mean (Spitzer (1985)). We calculate input price elasticities as follows:

$$\sigma_{n,n} = (\gamma_{n,n}/S_n) + S_n - 1 \qquad 3)$$

and

$$\sigma_{n,p} = (\gamma_{n,p}/S_n S_p) + 1 \qquad 4)$$

The translog cost function is well-behaved with negative own-price elasticities and positive cross-price elasticities for the inputs capital and labor.[6]

We estimate the X-efficiency for each firm in two different ways. One efficiency measure equals the average of the residuals over the entire six-year sample period. This estimate is used

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5 Note that this is a relative efficiency measure since there is no guarantee that the minimum residual firm is operating on the efficient frontier.

6 Values of R-Square range from a minimum of 0.86 for the 1992 estimation to 0.90 for 1995.

for univariate comparisons and tests. Second, we create a panel data set by averaging residuals over five years, excluding the current year. These efficiency estimates serve as the dependent variable in a fixed effects model. As recommended by Berger (1993), we used 5% truncations on both tails of the distribution of the average residuals.

Table 3 contains summary statistics on the estimates of X-efficiency. For the overall time period, we estimate an average X-efficiency of 41.6%. This estimate is very close to the 42% distribution free estimate of X-efficiency reported by Gardner and Grace (1993). X-efficiency ranges from a low of 13.7% to a maximum of 100%. The distribution is slightly skewed with median estimates running approximately 35%.

B. Univariate Tests of X-efficiency and Product Focus

Univariate comparisons of X-efficiency by quartiles of the product focus proxy (FOCUS) using mean t-tests and non-parametric Wilcoxon tests are presented in Table 4. Means are presented on the left side of the table and medians on the right. In general, diversified firms (Q1 + Q2) are more X-efficient (44.7% vs. 38.6%, T=2.67) than focused firms (Q3 + Q4). This difference is also significant when we compare the first quartile with the third and fourth quartiles, respectively (T=2.62 and T=2.64). Although not all quartile pairs are statistically different, the average X-efficiency estimates decrease monotonically as one moves from each lower quartile to a higher quartile of FOCUS. The results for medians are even stronger. All differences between median X-efficiencies across quartiles have statistically significant Wilcoxon statistics except for

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[7] Non-truncated estimates of X-efficiency averaged 7.4%. For a 1% truncation the average was 13.1%, and the average estimate for a 10% truncation was 54.9%. The distribution free approach is sensitive to the presence of outliers. Therefore, some truncation of the average residuals is required. For the purposes of this paper and consistent with previous researchers, we use the 5% truncation.

the difference between the medians of the two most focused groups (Q3 vs. Q4). In each case, the more diversified quartile has the higher median X-efficiency estimate, replicating the montonic relationship documented for the means.

These results provide strong evidence that diversified life insurance firms have achieved greater X-efficiency than focused firms which justifies the existence of multipoduct insurers in the absence of cost complementarities. It is possible, however, that certain firm characteristics correlated with product diversification (e.g., firm size) influence X-efficiency. To control for this possibility, we estimate a fixed effects model on pooled cross-section and time series data using the control variables previously described. This analysis is presented in the next subsection.

C. Fixed Effects Model Using Pooled Cross-section and Time Series Panel Data

We estimate a fixed effects model using generalized least squares with adjustments for heteroscedasticity and autocorrelation (see Kmenta (1986)). Dummy intercept variables (D91-D95) allow for a different intercept in each year. The results are presented in Table 5. Model 1 replicates the analysis of Gardner and Grace (1993) on an updated data set. Model 2 adds the focus proxy to the specification.

Product Focus and X-efficiency

For the purpose of this paper, the most important result is that the coefficient on FOCUS in Model 2 is negative and significant (T=2.33). This finding confirms that the results of the

univariate tests are robust to the inclusion of other known influences on X-efficiency. Furthermore, the impact of FOCUS is significant economically, as well as statistically. Table 2 shows that the minimum FOCUS in our sample is 0.2468 (1991) and the maximum is 1 (all years) for a difference of 0.7532. The estimated coefficient on FOCUS from the fixed effects model (Table 5) is -0.0343.[8] Thus, the efficiency loss for the most focused firms when compared to the most diversified firm in our sample is estimated to be 0.0258 or 2.58%. Given that the average estimate for X-efficiency is approximately 42%, this loss in cost efficiency is economically significant.

Firm Specific and Environmental Influences

We confirm the basic results reported by previous researchers in both model specifications. Specifically, we estimate a positive coefficient on TOTAL ASSETS (T=2.24 and T=2.14 in each model respectively) and a positive (but insignificant) relationship with ADVERT. Like Gardner and Grace (1993), we do not document significant coefficients on BUREAU or MSHR. Although we estimate a positive coefficient on MUTUAL, it is not significant at standard significance levels. Hence, our analysis (like some previous studies) suggests a minor influence (if any) on efficiency for organizational structure.

We document a significant (Model 2 only) and negative relationship between X-efficiency and NY as opposed to the positive sign reported by Gardner and Grace (1993). The increased concentration of the industry between the two time periods provides a possible explanation for this difference in findings. As inefficient firms not subject to New York regulation have been absorbed by more efficient firms, the relative efficiency of the remaining “non New York” firms

[8] Note that the dependent variable, X-efficiency , was expressed as a fraction.

has likely increased. There is some evidence in support of this "survivorship bias" in our data. In 1990, only 39.4% of all firms reporting to the NAIC wrote business in New York, while from 1990-1995 60.4% of the firms that met the six-consecutive-year requirement were subject to New York regulation. Furthermore, risk-based capital requirements instituted nationwide in 1992 may have had a greater effect on "non-New York" insurers than on the more heavily regulated "New York" companies. In any event our findings suggest that additional analysis of the influence of New York regulation on X-efficiency is warranted.

We also find positive and significant signs on AGENCY, CAP and LEGLFEE and a significant negative sign on AGWRITES . The positive sign on AGENCY is consistent with the principal-agent prediction that agency building distribution systems are the more efficient distribution networks. The positive sign on CAP likely reflects the erosion of capital surpluses of inefficient insurers facing increased competition. The sign on AGWRITES is negative as expected for non-producing assets. Finally, the positive relationship between LEGLFEE and X-efficiency may result from higher legal expenses incurred by diversified firms involved in takeovers of less efficient firms.[9]

IV. SUMMARY AND CONCLUSION

Using data for the life insurance industry during 1990-1995, we empirically test for a relationship between a firm's output choice and measures of X-efficiency. We introduce a firm specific Herfindahl index (FOCUS) across premiums from different market segments as a proxy

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[9] This explanation is consistent with the previously presented evidence that suggested consolidation in the life insurance industry (increased average firm size and a smaller number of firms as compared to earlier time periods).

for product focus in the life insurance industry. Our empirical evidence suggests that product diversification across both insurance and investment product lines resulted in greater X-efficiency than a more focused product choice. These results are robust to the inclusion of previously examined firm specific and environmental control variables. We thus update evidence from earlier time periods on the influence of these firm specific and environmental factors while introducing a firm's product choice as an important explanatory variable.

The analysis in this article is consistent with the proposition that managers of multiproduct firms are able to achieve greater cost efficiencies than their counterparts in more focused firms by sharing inputs and efficiently allocating resources across product lines in response to changing industry conditions. Our findings are important since they justify the existence of multiproduct firms in the absence of cost complementarities and identify product diversification as a source of efficiency in the life insurance industry that should be recognized by managers, policyholders, and regulators.

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TABLE 1

Insurance Product Line Output, Percentages of Total Output and Total Asset Averages for 358 Firms
1990-1995
(Amounts are in millions of dollars)

Year	*Investments*	*Ordinary Life*	*Ordinary Annuity*	*Group Life*	*Group Annuity*	*Accident & Health*	*Total Assets*
1990	1,705	106	42	24	21	105	2,325
		(35.6%)	(14.1%)	(8.1%)	(7.0%)	(35.2%)	
1991	1,858	125	40	25	20	115	2,563
		(38.5%)	(12.3%)	(7.7%)	(6.1%)	(35.4%)	
1992	1,990	123	42	30	19	122	2,753
		(36.6%)	(12.5%)	(8.9%)	(5.7%)	(36.3%)	
1993	2,139	134	41	32	17	127	3,010
		(38.2%)	(11.7%)	(9.1%)	(4.8%)	(36.2%)	
1994	2,267	138	43	35	15	131	3,167
		(38.1%)	(11.9%)	(9.7%)	(4.1%)	(36.2%)	
1995	2,459	146	46	36	17	132	3,485
		(38.7%)	(12.2%)	(9.6%)	(4.5%)	(35.0%)	
1990-95	2,070	126	42	30	18	122	2,884
		(37.3%)	(12.4%)	(8.9%)	(5.3%)	(36.1%)	

TABLE 2

Summary Statistics for the Focus Proxy for 358 Firms
1990-1995

Year	*Mean*	*Median*	*Minimum*	*Maximum*	*Coeff. of Variation*
1990[a]	0.6978	0.6989	0.2493	1.0000	31.88
1991[a]	0.6987	0.7076	0.2468	1.0000	32.17
1992[a]	0.7016	0.6933	0.2565	1.0000	31.64
1993[a]	0.7005	0.7051	0.2490	1.0000	31.96
1994[a]	0.7035	0.6976	0.2515	1.0000	31.49
1995[a]	0.7050	0.6941	0.2696	1.0000	31.30
1990-95[b]	0.6837	0.6633	0.2462	1.0000	31.99

Definitions:

[a] Herfindahl index based on premiums from this year. This index is used to create a panel data set in order to estimate a six-year fixed effects model.

[b] Herfindahl index based on six years of summed premium data.

$$\text{FOCUS} = \frac{Y_{OL}^2 + Y_{OA}^2 + Y_{GL}^2 + Y_{GA}^2 + Y_{AH}^2}{[Y_{OL} + Y_{OA} + Y_{GL} + Y_{GA} + Y_{AH}]^2}$$

Y_{OL} = Net premiums collected for ordinary life insurance

Y_{OA} = Considerations for ordinary annuities

Y_{GL} = Net premiums collected for group life insurance

Y_{GA} = Considerations for group annuities

Y_{AH} = Collected premiums for accident and health

TABLE 3

Distribution-Free Estimates of X-Efficiency (5% Truncation) for 358 Firms
1990-1995

Year	*Mean*	*Median*	*Minimum*	*Maximum*	*Coeff. of Variation*
1990[a]	42.4%	36.8%	15.8%	100%	51.64
1991[a]	41.4%	35.0%	14.8%	100%	52.43
1992[a]	41.7%	35.8%	15.5%	100%	51.30
1993[a]	41.4%	35.1%	16.3%	100%	51.29
1994[a]	41.2%	35.4%	14.8%	100%	52.11
1995[a]	40.5%	34.6%	13.7%	100%	53.44
1990-95[b]	41.6%	35.6%	14.9%	100%	51.89

Definitions:

[a] The X-efficiency estimate (XEFF) is based on five years of data, excluding the current year. This measure is used to create a panel data set in order to estimate a six-year fixed effects model.

[b] The X-efficiency estimate (XEFF) is based on six years of data. This measure is used for average and median comparisons over the sample period.

TABLE 4

Comparison of X-Efficiency by Level of Product Focus for 358 Firms
1990-1995

	Means			*Medians*		
	Diversified	*Non-Diversified*	*T-Statistic*	*Diversified*	*Non-Diversified*	*Wilcoxon*
(Q1[a] +Q2[b]) versus (Q3[c] +Q4[d])	44.7% (N=179)	38.6% (N=179)	2.67***	39.9% (N=179)	31.2% (N=179)	4.16***
Q1 versus Q4	47.1% (N=90)	38.2% (N=89)	2.64***	45.7% (N=90)	30.0% (N=89)	3.88***
Q2 versus Q3	42.2% (N=89)	39.0% (N=90)	1.06	35.5% (N=89)	32.8% (N=90)	1.73*
Q2 versus Q4	42.2% (N=89)	38.2% (N=89)	1.21	35.5% (N=89)	30.0% (N=89)	2.70***
Q3 versus Q4	39.0% (N=90)	38.2% (N=89)	0.23	32.8% (N=90)	30.0% (N=89)	1.10
Q1 versus Q3	47.1% (N=90)	39.0% (N=90)	2.62***	45.7% (N=90)	32.8% (N=90)	3.41***
Q1 versus Q2	47.1% (N=90)	42.2% (N=89)	1.61	45.7% (N=90)	35.5% (N=89)	2.21**

1) Definitions:

[a] The set of firms in the first (bottom) quartile of FOCUS.

[b] The set of firms in the second quartile of FOCUS.

[c] The set of firms in the third quartile of FOCUS.

[d] The set of firms in the fourth (top) quartile of FOCUS.

2) Notes:

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

TABLE 5

Fixed Effects Models of US Life Insurer Efficiency (X-efficiency, 5% Truncation)
1990-1995

Explanatory variable	*Model 1 coefficient (t statistic)*	*Model 2 coefficient (t statistic)*
Intercept	0.3579***	0.3852***
	(34.44)	(24.60)
D91	-0.0127	-0.0128
	(-1.23)	(-1.24)
D92	-0.0065	-0.0064
	(-0.64)	(-0.62)
D93	-0.0099	-0.0099
	(-0.96)	(-0.96)
D94	-0.0017	-0.0115
	(-1.14)	(-1.12)
D95	-0.0204**	-0.0200*
	(-1.97)	(-1.94)
MUTUAL	0.0074	0.0078
	(0.96)	(1.02)
NY	-0.0101	-0.0130*
	(-1.47)	(-1.87)
AGENCY	0.0476***	0.0447***
	(6.69)	(6.19)
AGWRITES	-0.0211***	-0.0213***
	(-5.04)	(-5.08)
LEGLFEE	0.0007**	0.0007**
	(2.30)	(2.40)
BUREAU	-0.0075	-0.0088
	(-0.71)	(-0.84)
ADVERT	0.0002	0.0003
	(0.52)	(0.64)
TOTAL ASSETS	1.56E-12**	1.49E-12**
	(2.24)	(2.14)
CAP	0.1597***	0.1635***
	(9.08)	(9.27)
MSHR	-0.0001	-0.0010
	(-0.01)	(-0.07)
FOCUS		-0.0343
		(-2.33)**
R^2	0.0910	0.0933
Adjusted R^2	0.0846	0.0865

Notes: Fixed effect models are estimated on a vector of explanatory variables, with and without the inclusion of a firm product focus proxy (FOCUS). D91-D95 are 0/1 dummy variables allowing for differing intercepts by year, MUTUAL is 1 if the insurance company is a mutual firm and 0 if not, NY is 1 if the firm conducted business in New York and 0 if not, AGENCY is 1 if the firm uses a captive agent sales force and 0 if not, AGWRITES is non-classified aggregate write-in non-admitted assets as a percentage of total assets, LEGLFEE is legal expenses unrelated to claims, as a percentage of net premiums, BUREAU is bureau and association expense as a percentage of net premiums, ADVERT is advertising expense as a percentage of net premiums, TOTAL ASSETS are total admitted assets, CAP is equity divided by total admitted assets, MSHR is percentage market share, and FOCUS is a

firm specific herfindahl index calculated across the insurance company's sources of premiums. The models are estimated using generalized least squares corrected for heteroscedasticity and autocorrleation.

***Significant at the 1% level
**Significant at the 5% level
*Significant at the 10% level