An Examination of the Relative Efficiency of Fraternal Insurers

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Abstract: We examine the efficiency of fraternal insurers as compared to mutual and stock insurers in the U.S. life insurance industry. We test the hypothesis of equal efficiency across fraternal, mutual, and stock insurers. We find that mutual and stock insurer technology is dominant for producing the fraternal outputs. Additionally, stock insurers have higher profitability than fraternals. Given the characteristics of the organizational structure, fraternal policyowners may be willing to accept this lower level of efficiency because of attenuated incentives to monitor. Although fraternals are less efficient, policyowner affiliation helps to keep fraternals in business. [Key words: fraternals; organizational form; efficiency; data envelopment analysis (DEA)]

INTRODUCTION

An interesting aspect of the insurance industry is the observed variation in organizational structure. The presence of mutual and stock companies operating in the same product markets has naturally led to comparisons of the performance of insurers under alternative organizational structures.[3] Early studies (e.g., Spiller, 1972; Frech, 1980) were cross-sectional, comparing separate groups of stock and mutual companies. These studies were followed by examinations of the same firms under alternative organizational structures, including Mayers and Smith's (1986) and Erhemjamts and Phillips's (2012) examination of mutualized insurers and McNamara and Rhee's (1992) study of demutualized insurers. Some recent studies (e.g., Jeng, Lai, and McNamara, 2007; and Chen, Lai, and Wang, 2011) have

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[3]MacMinn and Ren (2011) provide an excellent review of the literature on the performance of mutual and stock insurers.

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used input/output efficiency analysis to compare the efficiency of insurers operating under alternative organizational forms. Our study extends this analysis to an interesting group of insurance companies that has largely been ignored in the literature—fraternal insurers.

We analyze the efficiency of fraternal insurers as compared to mutual and stock insurers in the U.S. life insurance industry. We utilize the DEA approach to evaluate the relative efficiency of fraternal, mutual, and stock life insurers. Our sample consists of 39 fraternal organizations over the period 2000–2007, and size-matched mutual and stock insurers. The overall results suggest that fraternals, mutuals, and stocks operate on different cost and production frontiers and that fraternals underperform their counterparts, rejecting the null hypothesis of equal efficiency across organizational forms. Given the characteristics of the organizational structure, fraternal policyowners may be willing to accept this lower level of efficiency because of attenuated incentives to monitor. Thus, the evidence leads us to conclude that the affiliation aspect of fraternals helps to keep them in business.[4]

We believe this study is important for several reasons. First, we shed some light on whether the policyowners of fraternal insurance organizations are "getting their money's worth" from these organizations. Obviously, this information is important to current and prospective policyowners, as well as to insurance regulators. In addition, our work is the first study that we are aware of to examine the efficiency of fraternal organizations. Often fraternals are combined with other mutuals or ignored when stock and mutual insurance organizations are examined.

The remainder of this study is organized as follows. Section 2 provides background on fraternal insurers, including historical development, current status of fraternals, and prior research on fraternals. Next, we develop the hypotheses in section 3. Section 4 describes our data and presents the methodology. Section 5 provides our empirical results. Conclusions are offered in Section 6.

FRATERNAL INSURERS

Historical Development

Fraternal insurers are mutual organizations that offer life and health insurance to members of certain ethnic, religious, and labor groups. The first fraternal society was formed in the United States in 1868 when a

[4]For example, the Knights of Columbus Insurance markets to the millions of Catholics in the U.S. and a number of fraternals market to specific ethnic groups (e.g., Poles, Slovaks, and Ukrainians).

railroad master mechanic organized the Ancient Order of United Workmen. Additional fraternal societies were formed as immigrants came to America in the late 1800s and early 1900s (Black and Skipper, 2000, p. 254). Distrust of existing insurers, the comfort of dealing with like-minded individuals with a similar religious or ethnic heritage, and lax regulation fueled the growth of fraternal societies. Zanjani (2003) found that the market share of fraternals reached its peak in the 1890s, when fraternals were responsible for over fifty percent of the life insurance in force. Gottlieb (2007) notes that by 1920, over one-third of adult males in the U.S. were insured by fraternal associations for sickness, accidents, or death.

The growth of fraternal societies attracted the attention of insurance regulators. A major regulatory concern was the solvency of fraternals, most of which operated on an assessment basis. To address this concern, laws were passed after the turn of the century requiring fraternals to operate on a legal reserve basis. Around the same time, competition was increasing from other insurers, including industrial life insurers. Many of the "older" fraternals which were grand-fathered with respect to the legal reserve requirement were forced to increase assessments to pay benefits as members grew older and died. Younger individuals had a disincentive to join these societies as less expensive coverage was available from alternative providers without the risk of higher assessments in future years. The market share of fraternals fell to less than ten percent by 1930 and has remained at less than five percent since 1950.

Current Status of Fraternals

According to the American Council of Life Insurers, there were 85 fraternal life insurance organizations operating in the United States in 2011, about 9.8 percent of all life insurers. While many of these societies are small, there are some well-known fraternals, including Woodmen of the World and Knights of Columbus Insurance. In 2011, fraternal organizations held assets of $123.0 billion and were responsible for $319.9 billion of life insurance coverage in force. Fraternals received $10.24 billion in premium income and paid out $8.07 billion in benefits to members and beneficiaries in 2011. These statistics are from the *Life Insurers Fact Book 2012*.

Prior Research on Fraternals

To date, the bulk of research on fraternal organizations has been historical in nature, examining fraternal associations from the late 1800s and early 1990s. Lehrman (1994), for example, examined organizational diversity in the New York life insurance market between 1881 and 1931. During the first part of this time period, fraternals coexisted with other organizational forms. The growth of fraternals attracted greater regulatory scrutiny, especially with regard to solvency. Increased regulation led to the decline of fraternal insurers. Lehrman found that size and efficiency were key determinants of the New York fraternals that survived during this period.

Emery (1996) examined health insurance fraternals in the pre-Depression era in British Columbia. Unsound actuarial principles are often cited for the demise of fraternal organizations. Emery examined some of the financially weakest lodges of the Independent Order of Odd Fellows. He concluded that early capital accumulation by these societies permitted them to weather adverse claim experience and that unsound actuarial practices were not responsible for the decline of these Canadian health insurance societies.

In an interesting study, Gottlieb (2007) considered the impact of information asymmetry and pricing policies on late-19th-century fraternals in the U.S. He found that information symmetry, rather than asymmetry, impacted fraternal societies, citing the "intrusive monitoring" employed by many early fraternal associations. Such monitoring took many forms, including medical screening of prospective members, coverage limitations based on medical conditions, and having a committee of representatives from the fraternal periodically visit members who claimed sickness and injury benefits. Such practices, combined with fraternal pricing policies, led many prospective members to delay joining fraternals, to purchase coverage at advanced ages, or to purchase life and health insurance from other organizations.

Zanjani (2003) traced the "rise and fall" of fraternal life insurers in the U.S. between 1870 and 1920. Although fraternals achieved significant growth in the late 1800s, regulatory concerns mounted about their pricing policies and long-term viability. Zanjani notes that the decline of importance of fraternals coincided with fraternals becoming subject to the same regulation that applied to legal reserve mutual and stock life insurance companies. A minimum capital requirement, a requirement that rates be based on the National Fraternal Congress mortality table, competition from industrial life companies, and early social insurance efforts all contributed to the decline of fraternals. Some fraternals that reorganized adopted the pure mutual form of organization, and retained their nonprofit status (Zanjani, 2007).

HYPOTHESES

The relative advantages and disadvantages of mutual and stock companies have been discussed in the literature. Mayers and Smith (1986), for example, note that mutual companies merge customer and ownership interests in a single group of claimholders, thus reducing the agency costs of customer/owner conflicts. This benefit, however, comes at the cost of less effective control over management. Agency issues for fraternals, and their ramifications, are especially interesting and relatively unexplored. Given the members' identification with an ethnicity or a religion, might fraternal policyowners be willing to accept lower efficiency from their insurer (i.e., "taking one for team")? Are managers of fraternals, aware of policyowners' allegiance and attenuated monitoring incentives, less likely to operate fraternals efficiently (e.g., not investing in technological innovation)?

We test the hypothesis of equal efficiency across similar-sized, but differently-organized life insurers. To test the hypothesis of equal efficiency, we follow test procedures used by Cummins, Weiss, and Zi (1999) and Jeng and Lai (2005). To test whether fraternals and mutuals are equally efficient, we first test the subnull hypothesis that fraternals and mutuals are operating on the same production frontier against the alternate hypothesis that they are operating on different frontiers. If the evidence rejects this subnull hypothesis, it indicates that the frontiers of fraternals and mutuals are not identical, and we need to estimate the efficiency based on group-specific frontiers and the comparison of efficiency should be based on the group-specific frontiers. The efficiency comparison between fraternals and stocks is similar to the comparison between fraternals and mutuals. Our work represents the first to specifically examine "modern" fraternals as a distinct set of insurance organizations.

SAMPLE, DATA AND METHODOLOGY

Sample and Data

A listing of fraternal insurance organizations was obtained from the American Council of Life Insurers. Our sample of fraternals consists of fraternal organizations for which data from 2000 to 2007 are available in *Best's Insurance Reports, Life & Health Edition*. Thirty-nine fraternal insurers were identified.[5] The data for mutual and stock companies were obtained from the National Association of Insurance Commissioners (NAIC) database. To compare the efficiency of fraternals with other types of insurers, we matched each fraternal in our sample with ten stock companies and ten

[5]Appendix A lists the fraternal insurers that comprise our sample. Some fraternals are too small to be included in *Best's Insurance Reports*, or had limited data available. The sample period was limited to before the financial crisis as small firms may have been impacted differently during this period.

Table 1. Summary Statistics

Panel A: Firm Characteristics	Mutual	Fraternal	Stock
Return on assets (ROA)	0.30%	0.01%	2.43%***
ROA standard deviation	2.13%***	0.93%	3.34%***
Commissions	0.196***	0.055	0.292***
Expense ratio	0.590	0.739	0.462***
Investment income	0.677***	1.406	3.263**
Size	1,793,745***	948,674	920,002
Ordinary life output %	0.358***	0.528	0.275***
Group life output %	0.099***	0.000	0.067***
Individual annuities output %	0.141***	0.427	0.142***
Group annuities output %	0.060***	0.002	0.024***
Accident and health output %	0.341***	0.044	0.492***
Securities holdings	0.721***	0.838	0.702***
Loan portfolio	0.028***	0.013	0.017**
Number of firms	62	39	262

continued

mutual companies (nonfraternals) of similar size.[6] For each fraternal insurer, 10 control stock companies and 10 control mutual companies were identified, resulting in 390 control stock insurers and 390 control mutual insurers. Given the limited number of mutual companies (e.g., there were only 63 mutual insurers in the database in 2007), sampling with replacement was employed. Sampling with replacement was also employed for stock insurers, given the relatively small size of the fraternals. Sixty-two different mutual insurers and 262 distinct stock insurers were used as matching firms. The total number of observations is 2,463 for the sample period. Matching was based on total asset size in 2002.[7]

Table 1 shows the summary statistics for our sample and matching firms. It shows that the patterns of business mix for fraternals differ from

[6]We chose matching insurers that were closest in total admitted asset size in 2002. Panel A of Table 1 shows that the mean asset size is significantly different for the fraternals and the matching mutuals. The reason for this significant difference is the relatively small size of the fraternals and the relatively small number of mutual life insurers available to use as matching companies.

[7] The rationale for choosing 2002 as the matching year is that in that year data were available for the most fraternals (39).

Table 1. *continued*

Panel B: Outputs, Inputs, and Input Price

	Mutual	Fraternal	Stock
Output			
Y_1 = Death benefits	32,017***	12,548	20,946***
Y_2 = Annuity benefits	24,149	16,927	8,904***
Y_3 = Accident and health benefits	63,023***	409	62,085***
Y_4 = Surrender benefits	104,152***	14,119	40,573***
Input			
X_1 = Labor	39.25***	10.88	33.02***
X_2 = Business services	78.15***	24.85	40.84***
X_3 = Equity capital	176,531**	120,370	99,463
Input price			
P_1 = Price of labor	574.78	574.78	574.78
P_2 = Price of business services	547.87	547.87	547.87
P_3 = Price of equity capital	8.00***	10.23	6.14***
Number of firms	62	39	262

Note: Commissions = commissions / net premiums. Expense ratio = general expenses / net premiums. Investment income = net investment income / net premiums. Size = total admitted assets. Ordinary life output % = ordinary life output / total output. Group life output % = group life output / total output. Individual annuities output % = individual annuities output / total output. Group annuities output % = group annuities output / total output. Accident and health output % = accident and health output / total output. Securities holdings = (bonds + preferred stock + common stock) / total admitted assets. Loan portfolio= loan portfolio / total admitted assets.
All monetary variables are deflated to 1999 dollars using the CPI.
***Statistically significant difference between mutuals and fraternals in the first column and between stocks and fraternals in the last column at the 1% level; **statistically significant difference between mutuals and fraternals in the first column and between stocks and fraternals in the last column at the 5% level; *statistically significant difference between mutuals and fraternals in the first column and between stocks and fraternals in the last column at the 10% level.

those of stocks and mutuals. Fraternal insurers emphasize ordinary life insurance and individual annuities as outputs. Ordinary life insurance represented 52 percent of the fraternals' output, while individual annuities represented 42 percent of the fraternals' insurance output. Fraternals marketed no group life insurance. Although commissions were lower at fraternals, their expense ratios were higher.

Methodology

We estimate the relative efficiency of our sample firms using data envelopment analysis (DEA) to compute "best practice" frontiers based on convex combinations of firms in the industry. We use regression analysis to help explain differences in efficiency. As this methodology has been applied widely in the insurance literature, and to save space, we do not discuss the DEA methodology here. Cummins and Weiss (2000) provide a detailed review of the methodology.

Following the test procedure used in Cummins, Weiss, and Zi (1999), we first investigate whether fraternals, mutuals, and stock companies have the same technology by using the DEA approach.[8] If these differently-organized life insurers have alternative frontiers, we will perform cross-frontier analyses as used by Cummins, Weiss, and Zi (1999) and Jeng and Lai (2005) to test whether the outputs of each group could be produced more efficiently using the technology of the other group. The outputs and inputs used in this study are described below.

Outputs

Consistent with recent insurance literature, we use the value-added approach to measure life insurer outputs. The value-added approach considers asset or liability categories that have significant value-added outputs, as judged by operating cost allocation (see Berger and Humphrey, 1992). We define insurance outputs as the benefit payments for four major lines of business offered by the life insurers: death benefits, annuity benefits, accident and health benefits, and surrender benefits. We also use invested assets as an output variable to proxy for the financial intermediation function performed by insurers. All output values are expressed in thousands of dollars and deflated to the base year, 1999, using the Consumer Price Index (CPI).

Inputs

We follow Berger, Cummins, and Weiss (1997), Jeng, Lai, and McNamara (2007), and Huang, Hsiao, and Lai (2007) in measuring inputs. The inputs include labor (X_1), business services (X_2), and equity capital (X_3).[9] Labor input is defined as commissions divided by average weekly wages. We measure the price of labor (P_1) as average weekly wages for employees of insurance agencies and brokerages (North American Industry Classification System [NAICS] code 52421) and use U.S. Department of

[8]Technology refers to all contractual relationships comprising the firm and the physical technology employed (Cummins, Weiss, and Zi, 1999).

Labor data. General insurance expenses divided by the price of business services is used as a proxy for business services. The price of business services (P_2) is the average weekly earnings of production workers for the professional and business services sector from NAICS. The third input is equity capital. We use the real value of policyholder surplus (deflated to 1999 by the CPI) as a proxy for equity capital. We use the debt-equity ratio of the insurer as the price of equity (P_3).[10,11]

Panel B of Table 1 shows the summary statistics for the outputs, inputs, and input prices used in our analysis. It shows that the mutual and stock companies are significantly larger than the fraternals in terms of output and input quantities, except for stock companies' annuity benefit payments, which are smaller than those of fraternals. Obviously, we cannot tell whether mutual and stock companies are more efficient than fraternals by simply examining the magnitude of outputs and inputs of these groups of insurers.

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[9]In traditional production theory, the production function relates amounts of labor and physical capital to the output produced. However, the literature on insurer efficiency has also recognized equity capital as an important input (e.g., McAllister and McManus, 1993; Berger, Cummins, and Weiss, 1997). Under the financial theory of insurance pricing, insurance premiums are discounted to reflect the expected cost of insurer default risk. A well-capitalized insurer can charge more than an under-capitalized insurer, all else equal, because a well-capitalized insurer has superior ability to pay claims. If economic security is one of the outputs for insurers, equity capital is an important input for producing that output. Thus, equity capital is considered an important input for insurance firms. Moreover, under the modern theory of the firm, technology is defined as including the contractual relationships that comprise the firm and physical technology choices. Contracts with suppliers of equity capital are also important. Thus, equity capital is considered an important input category for an insurance firm. Because the physical capital of insurance firms usually represents a small proportion of total capital, early studies of insurer efficiency tended to incorporate it into the business services category (e.g., Cummins et al., 1999).

[10]Following Jeng and Lai (2005), we use the debt-equity ratio of insurers as the price of equity, because the price of equity should be a function of a firm's debt-equity ratio. In financial theory, ROE = ROA + D/E (ROA – ROD), where ROE is the return on equity; ROA is the return on assets; D/E is the ratio of debt to equity; and ROD is the return on debt. We assume that the ROA of different firms in the same industry is approximately equal. If we further assume that the ROD for different firms in the same industry is approximately the same, then the ROE is dependent on the ratio of debt to equity.

[11]To avoid model estimation problems, we do not use return on equity (ROE) as the price of equity because some insurers with poor performance may have negative net income and a negative ROE will result in a negative input price.

EMPIRICAL RESULTS

We first present average efficiency results for the three distinct groups of insurers. We then conduct regression analysis to obtain further evidence regarding the equal efficiency hypothesis.

Average Efficiency Estimates

Table 2 reports tests of the null hypothesis that the pooled and separate frontiers are identical. Panels A and B report the technical efficiency (TE) and cost efficicieny (CE) tests. In each panel, the comparison between fraternals and mutuals is reported in the top section and the comparison between fraternals and stocks is reported in the lower section. In Panel A, the overall results of analysis of variance (ANOVA), Wilcoxon, Median, Van Der Waerden, and Savage nonparametric tests for TE scores reject the hypothesis that the group-specific fraternal frontier is the same as the pooled frontier. However, the TE tests do not overwhelmingly reject the hypothesis that the group-specific mutual frontier is the same as the pooled frontier, suggesting that mutuals define the pooled frontier.

The tests for fraternals and stocks also reject the hypothesis that the group-specific fraternal frontier is identical to the pooled frontier, but the tests do not reject the hypothesis that the group-specific stock frontier is identical to the pooled frontier. The results imply stocks define the pooled frontier. The CE results, shown in Panel B, are similar to the TE results. The CE results imply that fraternals and mutuals operate on different frontiers and that fraternals and stocks operate on different frontiers. Thus, we need to base our TE and CE analysis on group-specific frontiers.

Table 3 presents the efficiency scores based on group-specific frontiers. Panel A presents the comparison of fraternal and mutual insurers and Panel B reports the comparison of fraternal and stock insurers. The TE of fraternals and mutuals is shown in the columns headed $T_f(X_f, Y_f)$ and $T_m(X_m, Y_m)$, respectively. In Panel A, the average TE of fraternals is 77.9 percent, while the mutual TE averaged 61.3 percent. This result indicates that fraternals are, on average, significantly more efficient relative to the fraternal frontier, compared to the efficiency of mutuals with respect to the mutual frontier. The average CE of fraternals is also higher than the CE of the mutuals; however, the average result is insignificant. The TE and CE results cannot be interpreted to mean that the outputs of mutuals would be produced more efficiently by fraternals, because the fraternals and mutuals employ different technology and operate on different frontiers.

In Panel B, the average TE and CE shows that fraternals are significantly more efficient relative to the fraternal frontier, in comparison to the

Table 2. Tests of the Null Hypothesis That the Pooled and Separate Frontiers Are Identical

Panel A: Technical Efficiency

	ANOVA F (Prob > F)	Wilcoxon Z (Prob > Z)	Median Z (Prob > Z)	Van Der Waerden Z (Prob > Z)	Savage Z (Prob > Z
Population Comparison			**Fraternal vs. Mutual**		
39 fraternal separate efficiency vs. 101 efficiency from pooled frontier	55.4836 (0.0001)	–7.4067 (0.0001)	–7.3159 (0.0001)	–6.9663 (0.0001)	–6.5561 (0.0001)
39 fraternal separate efficiency vs. 39 fraternal efficiency from pooled frontier	193.6853 (0.0001)	–11.8009 (0.0001)	–11.5150 (0.0001)	–11.4852 (0.0001)	–10.0189 (0.0001)
62 mutual separate efficiency vs. 101 efficiency from pooled frontier	12.6053 (0.0001)	3.5028 (0.0001)	3.5124 (0.0001)	3.1425 (0.0017)	3.4516 (0.0001)
62 mutual separate efficiency vs. 62 mutual efficiency from pooled frontier	0.8757 (0.3497)	–0.9324 (0.3511)	–0.6754 (0.4995)	–0.8778 (0.3800)	–1.0054 (0.3147)
Population Comparison			**Fraternal vs. Stock**		
39 fraternal separate efficiency vs. 301 efficiency from pooled frontier	382.3647 (0.0001)	17.1012 (0.0001)	15.1939 (0.0001)	16.5349 (0.0001)	17.5969 (0.0001)
39 fraternal separate efficiency vs. 39 fraternal efficiency from pooled frontier	451.8531 (0.0001)	–15.0251 (0.0001)	–14.7242 (0.0001)	–14.3565 (0.0001)	–12.9202 (0.0001)
262 stock separate efficiency vs. 301 efficiency from pooled frontier	2.4531 (0.1174)	1.7005 (0.0890)	1.7330 (0.0831)	1.5550 (0.1199)	1.4606 (0.1441)
262 stock separate efficiency vs. 262 stock efficiency from pooled frontier	0.2172 (0.6412)	0.5463 (0.5849)	0.5833 (0.5597)	0.4930 (0.6220)	0.4327 (0.6652)

(*continued*)

Table 2. (*continued*)

Panel B: Cost Efficiency

Population Comparison	ANOVA F (Prob > F)	Wilcoxon Z (Prob > Z)	Median Z (Prob > Z)	Van Der Waerden Z (Prob > Z)	Savage Z (Prob > Z)
			Fraternal vs. Mutual		
39 fraternal separate efficiency vs.	30.5172	–5.7801	–4.9450	–5.9088	–5.2737
101 efficiency from pooled frontier	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
39 fraternal separate efficiency vs.	72.8961	–8.5819	–7.1733	–8.6541	–7.6672
39 fraternal efficiency from pooled frontier	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
62 mutual separate efficiency vs.	24.5845	5.1973	4.7448	4.9799	4.5043
101 efficiency from pooled frontier	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
62 mutual separate efficiency vs.	1.2636	–1.0407	–0.8104	–1.0626	–1.2977
62 mutual efficiency from pooled frontier	(0.2613)	(0.2980)	(0.4177)	(0.2880)	(0.1944)
Population Comparison			**Fraternal vs. Stock**		
39 fraternal separate efficiency vs.	204.8148	11.7385	9.0112	12.5777	13.9694
301 efficiency from pooled frontier	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
39 fraternal separate efficiency vs.	86.6320	–9.5667	–8.4947	–9.5115	–8.3516
39 fraternal efficiency from pooled frontier	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
262 stock separate efficiency vs.	2.4854	1.5533	1.0525	1.3927	1.5603
301 efficiency from pooled frontier	(0.1150)	(0.1203)	(0.2926)	(0.1637)	(0.1187)
262 stock separate efficiency vs.	1.7909	1.2382	0.6600	1.2382	1.3737
262 stock efficiency from pooled frontier	(0.1809)	(0.2157)	(0.5093)	(0.2156)	(0.1695)

Note: The information presented in this table is for the matched year.

efficiency of stocks relative to the stock frontier. In addition, the dispersion of the stock TE in each year is higher than the dispersion of the fraternal TE.[12] The lower stock TE scores and higher dispersions of stock TE are consistent with stock companies operating in more complicated lines of insurance, consistent with the prediction of the managerial discretion hypothesis (Cummins, Weiss, and Zi, 1999).[13] The TE might be lower in more complex lines because it is easier to make mistakes in designing technology when insurance underwriting and pricing become more complicated (Cummins, Weiss, and Zi, 1999). The results cannot be interpreted to mean that the outputs of stocks would be produced more efficiently by fraternals because these insurers face different frontiers.

To examine whether mutuals and stocks could produce outputs of fraternals more efficiently, we follow Cummins, Weiss, and Zi (1999) and Jeng and Lai (2005) and conduct cross-frontier efficiency estimation. If mutuals could produce fraternal output vectors more efficiently, we can reject the hypothesis of equal efficiency of mutuals and fraternals. Likewise, if stocks could produce fraternal outputs more efficiently, we can reject the hypothesis that each group is operating with equal efficiency. Cross-frontier measures the TE and CE of each group relative to the frontier of the other group. For instance, the fraternal relative-to-mutual-frontier efficiency measures fraternal efficiency relative to the frontier consisting of all mutuals. A cross-frontier efficiency score with a value greater than 1 implies that it is infeasible to replicate one group's output vector by using another group's technology.

Table 4 presents the cross-frontier efficiency results. Panel A reports the efficiency comparison between fraternals and mutuals, and Panel B reports the efficiency comparison between fraternals and stocks. The TE of fraternals relative to the mutual frontier, i.e., cross-frontier efficiency, is shown in column (2), headed $T_m(X_f, Y_f)$. The TE of mutuals relative to the fraternal frontier is shown in the column (4), headed $T_f(X_m, Y_m)$. Most of the averages of $T_m(X_f, Y_f)$ are less than 1 (6 of 8 years), implying that fraternals operate inside the mutual frontier. In other words, it may be feasible to replicate fraternal input-output combinations using the mutual technology. The averages of $T_f(X_m, Y_m)$ are greater than 1 for all years, implying that it is infeasible to replicate the mutuals' input-output combination using fraternal technology.

In addition, the mutual efficiencies relative to the mutual frontier ($T_m(X_m, Y_m)$) are significantly lower than the mutual efficiencies relative to

[12]Numbers in parentheses are standard deviations.

[13]The managerial discretion hypothesis predicts that the stock ownership form will be dominant in insurance lines that require more managerial discretion (Mayers and Smith, 1988).

Table 3. Separate Frontier Efficiency Results

Panel A: Fraternal and Mutual Comparison

Year	$T_f(X_f,Y_f)$	$T_m(X_m,Y_m)$	$C_f(X_f,Y_f)$	$C_m(X_m,Y_m)$
Mean	0.7786***	0.6132	0.4590	0.4571
	(0.2299)	(0.3149)	(0.3208)	(0.3067)
2000	0.7986***	0.5187	0.6065**	0.4196
	(0.2294)	(0.3336)	(0.3046)	(0.3063)
2001	0.8355***	0.5781	0.6251*	0.4893
	(0.2001)	(0.3300)	(0.2932)	(0.3125)
2002	0.7520***	0.5654	0.3713	0.4268
	(0.2407)	(0.3339)	(0.2910)	(0.3017)
2003	0.7315*	0.6049	0.3611	0.3927
	(0.2487)	(0.3066)	(0.3082)	(0.2983)
2004	0.7639*	0.6470	0.4062	0.4880
	(0.2266)	(0.3118)	(0.2980)	(0.3179)
2005	0.7703*	0.6546	0.4079	0.4540
	(0.2326)	(0.2976)	(0.3574)	(0.2975)
2006	0.8026**	0.6702	0.4421	0.4547
	(0.2177)	(0.2852)	(0.3299)	(0.3014)
2007	0.8161	0.7031	0.5924	0.5512
	(0.2420)	(0.2799)	(0.2823)	(0.3118)

(*continued*)

the fraternal frontier ($T_f(X_m,Y_m)$) in all years, indicating that mutual technology is dominant in producing the mutual output vectors.[14]

The fraternal CE scores relative to the mutual frontier ($C_m(X_f,Y_f)$) are presented in column (6) and the mutual CE scores relative to the fraternal frontier ($C_f(X_m,Y_m)$) are presented in the column (8). The results show that the averages of $C_m(X_f,Y_f)$ are less than 1 in all sample years, indicating that fraternals operate inside the mutual cost frontier. The averages of $C_f(X_m,Y_m)$ exceed 1 in all sample years, suggesting that it is infeasible to replicate the mutual input-output vectors by using fraternal technology.

[14]Intuitively, if fraternals have higher efficiency with regard to the fraternal frontier than they do with regard to the mutual frontier (i.e., $T_m(X_f,Y_f) < T_f(X_f,Y_f)$), it means that fraternals have to improve more to achieve full efficiency with regard to the mutual frontier. Thus, the mutual technology dominates the fraternal technology for producing fraternal output vectors.

Table 3. (*Continued*)

Panel B: Fraternal and Stock Comparison				
Year	$T_f(X_f,Y_f)$	$T_s(X_s,Y_s)$	$C_f(X_f,Y_f)$	$C_s(X_s,Y_s)$
Mean	0.7786***	0.3838	0.4590***	0.2371
	(0.2299)	(0.3083)	(0.3208)	(0.2263)
2000	0.7986***	0.4296	0.6065***	0.2599
	(0.2294)	(0.3131)	(0.3046)	(0.2278)
2001	0.8355***	0.4085	0.6251***	0.2605
	(0.2001)	(0.2995)	(0.2932)	(0.2225)
2002	0.7520***	0.3743	0.3713***	0.2342
	(0.2407)	(0.3014)	(0.2910)	(0.2279)
2003	0.7315***	0.4090	0.3611**	0.2546
	(0.2487)	(0.3129)	(0.3082)	(0.2370)
2004	0.7639***	0.4015	0.4062***	0.2647
	(0.2266)	(0.3150)	(0.2980)	(0.2463)
2005	0.7703***	0.3477	0.4079***	0.1977
	(0.2326)	(0.3121)	(0.3574)	(0.2068)
2006	0.8026***	0.3503	0.4421***	0.1900
	(0.2177)	(0.3133)	(0.3299)	(0.1992)
2007	0.8161***	0.3267	0.5924***	0.2183
	(0.2420)	(0.2869)	(0.2823)	(0.2240)

Note: Numbers in parentheses are standard deviations. X_f,Y_f = input and output for fraternal insurers; X_m,Y_m = input and output for mutual insurers; X_s,Y_s = input and output for stock insurers. The subscript on T or C denotes the frontier on which insurers are based. Subscript f = fraternal frontier; m = mutual frontier; s = stock frontier. Asterisks between pairs of columns show the results of tests for differences between the efficiency scores in the corresponding cells of the two columns. Reported significance levels are based on analysis of variance (ANOVA).

***Statistically significant difference at the 1% level; **statistically significant difference at the 5% level; *statistically significant difference at the 10% level.

The averages of $C_m(X_f,Y_f)$ are lower than $C_f(X_f,Y_f)$ in 5 of 8 years, indicating on average that the mutual cost frontier dominates the fraternal cost frontier for producing fraternal input-output vectors. The efficiency score for mutuals relative to the mutual frontier ($C_m(X_m,Y_m)$) is significantly lower than the efficiency score for mutuals relative to the fraternal frontier ($C_f(X_m,Y_m)$), providing evidence that the mutual cost frontier dominates the fraternal cost frontier for producing mutual output vectors. Combining these results, we reject the null hypothesis that fraternal insurers and mutual insurers are equally efficient.

Table 4. Cross-Frontier Efficiency Results

Panel A: Fraternal and Mutual Comparison

Year	(1) $T_f(X_f, Y_f)$	(2) $T_m(X_f, Y_f)$	(3) $T_m(X_m, Y_m)$	(4) $T_f(X_m, Y_m)$	(5) $C_f(X_f, Y_f)$	(6) $C_m(X_f, Y_f)$	(7) $C_m(X_m, Y_m)$	(8) $C_f(X_m, Y_m)$
Mean	0.7786	0.7780	0.6132***	2.2808	0.4590	0.4009	0.4571***	1.4874
	(0.2299)	(0.8194)	(0.3149)	(1.5386)	(0.3208)	(0.5870)	(0.3067)	(1.3062)
2000	0.7986	0.6457	0.5187***	2.1041	0.6065***	0.3315	0.4196***	1.6096
	(0.2294)	(0.6147)	(0.3336)	(1.5052)	(0.3046)	(0.2548)	(0.3063)	(1.2408)
2001	0.8355***	0.5243	0.5781***	2.3958	0.6251***	0.2763	0.4893***	1.8383
	(0.2001)	(0.3933)	(0.3300)	(1.5748)	(0.2932)	(0.1884)	(0.3125)	(1.3581)
2002	0.7520*	0.5686	0.5654***	2.1600	0.3713	0.2786	0.4268***	1.2810
	(0.2407)	(0.5477)	(0.3339)	(1.6081)	(0.2910)	(0.3622)	(0.3017)	(1.2980)
2003	0.7315	0.6933	0.6049***	2.2818	0.3611	0.3478	0.3927***	1.3510
	(0.2487)	(0.8011)	(0.3066)	(1.5884)	(0.3082)	(0.5680)	(0.2983)	(1.3206)
2004	0.7639	0.9050	0.6470***	2.3619	0.4062	0.5106	0.4880***	1.4239
	(0.2266)	(0.9201)	(0.3118)	(1.5770)	(0.2980)	(0.7242)	(0.3179)	(1.4438)
2005	0.7703	0.8498	0.6546***	2.2336	0.4079	0.4093	0.4540***	1.3183
	(0.2326)	(0.8707)	(0.2976)	(1.4741)	(0.3574)	(0.5587)	(0.2975)	(1.1559)
2006	0.8026	1.0148	0.6702***	2.3016	0.4421	0.3322	0.4547***	1.4659
	(0.2177)	(1.0365)	(0.2852)	(1.5094)	(0.3299)	(0.5141)	(0.3014)	(1.2702)
2007	0.8161	1.1012	0.7031***	2.4564	0.5924	0.8188	0.5512***	1.6131
	(0.2420)	(1.0911)	(0.2799)	(1.5173)	(0.2823)	(1.0666)	(0.3118)	(1.3267)

Panel B: Fraternal and Stock Comparison

Year	(1) $T_f(X_f, Y_f)$	(2) $T_s(X_f, Y_f)$	(3) $T_s(X_s, Y_s)$	(4) $T_f(X_s, Y_s)$	(5) $C_f(X_f, Y_f)$	(6) $C_s(X_f, Y_f)$	(7) $C_s(X_s, Y_s)$	(8) $C_f(X_s, Y_s)$
Mean	0.7786***	0.3588	0.3838***	1.7223	0.4590***	0.2957	0.2371***	0.8837
	(0.2299)	(0.4348)	(0.3083)	(1.5020)	(0.3208)	(0.3794)	(0.2263)	(0.9319)
2000	0.7986***	0.3872	0.4296***	1.9422	0.6065***	0.3248	0.2599***	0.9952
	(0.2294)	(0.2667)	(0.3131)	(1.5118)	(0.3046)	(0.2491)	(0.2278)	(0.9160)
2001	0.8355***	0.3980	0.4085***	1.8173	0.6251***	0.2789	0.2605***	1.0414
	(0.2001)	(0.3132)	(0.2995)	(1.4561)	(0.2932)	(0.2171)	(0.2225)	(0.9647)
2002	0.7520***	0.3358	0.3743***	1.7191	0.3713**	0.2230	0.2342***	0.8468
	(0.2407)	(0.3501)	(0.3014)	(1.5022)	(0.2910)	(0.2594)	(0.2279)	(0.9464)
2003	0.7315***	0.3386	0.4090***	1.8321	0.3611	0.2933	0.2546***	0.8098
	(0.2487)	(0.4516)	(0.3129)	(1.5097)	(0.3082)	(0.4217)	(0.2370)	(0.8146)
2004	0.7639***	0.3563	0.4015***	1.7535	0.4062	0.3303	0.2647***	0.9442
	(0.2266)	(0.4593)	(0.3150)	(1.4910)	(0.2980)	(0.4401)	(0.2463)	(0.9826)
2005	0.7703***	0.3212	0.3477***	1.5771	0.4079	0.2924	0.1977***	0.7681
	(0.2326)	(0.4280)	(0.3121)	(1.5444)	(0.3574)	(0.4231)	(0.2068)	(0.9339)
2006	0.8026***	0.3646	0.3503***	1.5561	0.4421	0.2702	0.1900***	0.7789
	(0.2177)	(0.6334)	(0.3133)	(1.5406)	(0.3299)	(0.4308)	(0.1992)	(0.9024)
2007	0.8161***	0.4038	0.3267***	1.4744	0.5924	0.3986	0.2183***	0.8464
	(0.2420)	(0.5208)	(0.2869)	(1.4189)	(0.2823)	(0.5209)	(0.2240)	(0.9637)

Note: Numbers in parentheses are standard deviations. X_f, Y_f = input and output for fraternal insurers; X_m, Y_m = input and output for mutual insurers; X_s, Y_s = input and output for stock insurers. The subscript on T or C denotes the frontier on which insurers are based. Subscript f = fraternal frontier; m = mutual frontier; s = stock frontier. Asterisks between pairs of columns show the results of tests for differences between the efficiency scores in the corresponding cells of the two columns. Reported significance levels are based on analysis of variance (ANOVA).
***Statistically significant difference at the 1% level; **statistically significant difference at the 5% level; *statistically significant difference at the 10% level.

We next compare the efficiency scores between fraternals and stocks. In Panel B of Table 4, the TE results based on the cross-frontier for fraternals and stocks are shown in column (2) and column (4), headed $T_s(X_f,Y_f)$ and $T_f(X_s,Y_s)$, respectively. The averages of $T_s(X_f,Y_f)$ are all significantly less than 1, implying that fraternals operate inside the stock frontier. The averages of $T_f(X_s,Y_s)$ are greater than 1 in all years, implying that it is not feasible to replicate the stock input-output combination using fraternal technology.

The efficiency of fraternals relative to stock frontiers ($T_s(X_f,Y_f)$) is significantly lower than the efficiency of fraternals relative to fraternal frontiers ($T_f(X_f,Y_f)$) in all years, implying that the stock frontier dominates the fraternal frontier in producing fraternal output vectors. The stock relative-to-stock frontier ($T_s(X_s,Y_s)$) is significantly lower than the stock relative-to-fraternal frontier ($T_f(X_s,Y_s)$), suggesting that the stock frontier dominates the fraternal frontier in producing stock output vectors.

The fraternal CE relative to the stock frontier and the stock CE relative to the fraternal frontier are presented in the columns headed $C_s(X_f,Y_f)$ and $C_f(X_s,Y_s)$, respectively. Fraternal CE relative to the stock frontier $C_s(X_f,Y_f)$ is lower than the fraternal CE relative to the fraternal frontier $C_f(X_f,Y_f)$ in all years, implying that the stock cost frontier is superior in producing fraternal output vectors. The stock CE relative to the stock frontier $C_s(X_s,Y_s)$ is smaller than the stock CE relative to the fraternal frontier $C_f(X_s,Y_s)$ in all years, indicating that the stock cost frontier dominates the fraternal cost frontier in producing the stock input-output combination.

In sum, the separate efficiency and cross-efficiency analysis discussed above indicate that the mutuals and stocks dominate fraternals in terms of TE and CE. Thus, we reject the null hypothesis of equal efficiency across fraternal, mutual, and stock insurers.

Cross-Frontier Efficiency: Further Analysis

To further examine dominance of production frontiers, we follow prior studies (e.g., Cummins, Weiss, and Zi, 1999, 2003; Jeng and Lai, 2005) and estimate dominance statistics to evaluate the distance between frontiers. Dominance statistics, or so-called F-scores, measure the distance between frontiers for each firm in the sample. The F-score of the production frontier for fraternals relative to the mutual frontier is defined as follows:

$$F_p(X_f,Y_f) = 1 - \frac{T_f(X_f,Y_f)}{T_m(X_f,Y_f)} \tag{1}$$

A positive value of $F_m(X_f,Y_f)$ implies that the fraternal insurer technology is dominant for producing the input–output vector, whereas a negative value of $F_m(X_f,Y_f)$ means the mutual technology is dominant for producing

Table 5. Dominance Statistics by Size Quartile

Panel A: Fraternal and Mutual Comparison

		Production frontiers		Cost frontiers	
		Fraternal	Mutual	Fraternal	Mutual
Quartile 1	Mean	–1.5136***	–0.7041***	–3.3157***	–0.6876***
Quartile 2	Mean	–0.8382***	–0.7094***	–0.9389***	–0.6707***
Quartile 3	Mean	–0.1919*	–0.6959***	–0.2635**	–0.6075***
Quartile 4	Mean	–0.9716***	–0.6167***	–1.0619***	–0.4269***

Panel B: Fraternal and Stock Comparison

		Production frontiers		Cost frontiers	
		Fraternal	Mutual	Fraternal	Mutual
Quartile 1	Mean	–17.7298***	–0.7713***	–5.6371***	–0.7320***
Quartile 2	Mean	–1.8296***	–0.7533***	–1.1222***	–0.6782***
Quartile 3	Mean	–1.7743***	–0.7612***	–0.5671***	–0.6849***
Quartile 4	Mean	–4.5212***	–0.7411***	–2.0274***	–0.6225***

Quartile 1 is the smallest size quartile.
Note: Reported significance levels are based on the results of t-tests of the null hypothesis that averages equal zero. ***Statistically significant difference at the 1% level; **statistically significant difference at the 5% level; *statistically significant difference at the 10% level.

the input–output vector. The intuition is as follows: if fraternals have higher efficiency relative to the fraternal frontier than they do relative to the mutual frontier (i.e., $T_f(X_f,Y_f) > T_m(X_f,Y_f)$), it means that fraternals have to improve more to achieve full efficiency relative to the mutual frontier. The F-score for fraternals relative to stocks is defined in similar fashion. A positive value of $F_s(X_f,Y_f)$ implies that the fraternal insurer technology is dominant for producing the input–output vector, whereas a negative value of $F_s(X_f,Y_f)$ means the stock technology is dominant for producing the input–output vector.

Table 5 shows the results of dominance statistics (F-scores) by asset size quartiles. Panel A compares the fraternals and mutuals and Panel B compares the fraternals and stocks. The production F-scores of fraternals and mutuals are shown in the first two columns in Panel A. The results show that the averages of production F-scores of fraternals and mutuals are negative and significantly different from zero in all size quartiles, confirming that mutuals dominate fraternals for the output–input vectors. The cost results are negative for both organizational forms, paralleling the production F-score results and implying that mutuals dominate fraternals in the CE sense.

In Panel B, the F-scores of fraternals and stocks are shown in the first two columns. The production and cost F-scores are significantly negative in all size quartiles for both fraternals and stocks, implying that stocks dominate fraternals. Overall, the F-score analysis suggests that the mutual and stock insurer technology is dominant for producing the fraternal input–output vector, providing further evidence that fraternal insurers may operate at lower efficiency.

Regression Analysis of Efficiency Performance

To seek further evidence regarding the equal efficiency and managerial discretion hypotheses, we follow Cummins, Weiss, and Zi (1999, 2003) and Jeng and Lai (2005) and regress F-scores on a set of independent variables representing types of organizational form, size, and business mix. We use three models for the TE and CE regression analysis. Model 1 includes dummies representing size quartile, organizational form (*Fraternal* = 1 for fraternals, 0 for mutuals), an interaction term between size dummies and the organizational form dummy, and business mix (ordinary life output%, group life output%, individual annuities output%, and group annuities output%).[15] The omitted category of business mix variables is accident and health output%.

Model 2 adds interaction terms between the organizational form dummy and the business mix variables. Model 3 additionally includes the interaction terms between business mix and size. The comparative advantage of fraternals can be seen by examining the interaction terms between the organizational form dummy and business mix variables in Models 2 and 3. The positive coefficient on the *Fraternal* and business mix interaction variables implies that fraternals tend to have a comparative advantage in issuing these types of insurance outputs relative to accident and health insurance output. It also implies that issuing more of these lines by fraternals would shift the fraternal frontier to the left of their counterpart's frontier.

The regression results of fraternals and mutuals are presented in Table 6. Panel A reports technical dominance results and Panel B reports cost dominance results. In Models 2 and 3 of Panel A, the coefficients of ordinary life output%*Fraternal* interactions are statistically positive, indicating that

[15]Ordinary life output % = the proportion of total benefits in the ordinary life insurance; group life output % = the proportion of total benefits in group life insurance; individual annuities output % = the proportion of total benefits in individual annuities; group annuities output % = the proportion of total benefits in group annuities.

Table 6. Regression Analysis of Dominance Statistics—Mutual Control Insurers, Dependent Variable: Dominance Statistics

Panel A: Technical Dominance Results

	Model 1		Model 2		Model 3	
	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio
Constant	–1.37	–8.11***	–1.23	–7.94***	–1.18	–7.13***
Size2	–0.08	–0.46	–0.04	–0.24	–0.10	–0.58
Size3	–0.21	–1.23	–0.04	–0.23	–0.12	–0.62
Size4	–0.29	–1.60	–0.05	–0.28	–0.17	–0.76
Fraternal	–0.99	–5.18***	–4.15	–9.86***	–4.19	–9.86***
Size2*Fraternal	0.84	2.81***	–0.03	–0.12	–0.08	–0.27
Size3*Fraternal	0.79	2.73***	–0.42	–1.37	–0.49	–1.53
Size4*Fraternal	0.39	1.41	–0.67	–2.32**	–0.78	–2.54**
Ordinary life output %	0.27	1.72*	0.19	1.22	–0.19	–0.48
Group life output %	0.32	1.04	0.05	0.18	0.24	0.20
Individual annuities output %	1.57	6.84***	0.40	1.58	–0.15	–0.18
Group annuities output %	0.45	1.09	0.21	0.56	–0.05	–0.01
Ordinary life output %*Fraternal			3.25	7.21***	3.37	7.26***
Group life output %*Fraternal			203.12	0.60	233.99	0.69
Individual annuities output %*Fraternal			5.74	10.22***	5.94	10.06***
Group annuities output %* Fraternal			7.30	2.72***	7.37	2.20**
Ordinary life output %* Ln(Output)					0.04	1.08
Group life output %* Ln(Output)					–0.02	–0.16
Individual annuities output %* Ln(Output)					0.05	0.68
Group annuities output* Ln(Output)					0.02	0.08
Adjusted R^2	0.19		0.34		0.33	

(*continued*)

fraternals tend to have a comparative advantage in producing ordinary life output relative to accident and health policies in terms of technical dominance. The coefficients of ordinary life output%**Fraternal* interaction terms are significantly lower than those of individual annuities output%**Fraternal* interaction terms in Models 2 and 3, implying that the comparative advantage of fraternals is higher in producing individual annuities relative

Table 6. (*continued*)

Panel B: Cost Dominance Results

	Model 1		Model 2		Model 3	
	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio
Constant	–1.36	–5.59***	–0.72	–6.39***	–0.68	–5.71***
Size2	–0.07	–0.30	0.00	–0.02	–0.07	–0.58
Size3	–0.30	–1.20	–0.04	–0.36	–0.14	–1.01
Size4	–0.26	–1.01	0.04	0.29	–0.02	–0.14
Fraternal	–3.20	–11.60***	–0.72	–6.39***	–14.79	–48.04***
Size2*Fraternal	2.16	5.01***	0.46	2.17**	0.36	1.68*
Size3*Fraternal	2.46	5.89***	0.50	2.19**	0.45	1.95*
Size4*Fraternal	1.89	4.68***	0.18	0.86	0.14	0.61
Ordinary life output %	1.23	5.47***	0.14	1.19	–0.38	–1.34
Group life output %	0.81	1.84*	0.03	0.14	–0.20	–0.22
Individual annuities output %	2.91	8.84***	1.06	5.62***	2.26	3.72***
Group annuities output %	1.41	2.34**	0.72	2.56**	0.33	0.12
Ordinary life output %*Fraternal			12.91	39.14***	13.05	38.76***
Group life output %*Fraternal			–32.25	–0.13	–10.93	–0.04
Individual annuities output %*Fraternal			15.25	37.06***	15.20	35.44***
Group annuities output %* Fraternal			17.72	9.03***	17.96	7.38***
Ordinary life output %* Ln(Output)					0.06	1.98**
Group life output %* Ln(Output)					0.02	0.23
Individual annuities output %* Ln(Output)					–0.11	–2.07**
Group annuities output* Ln(Output)					0.03	0.15
Adjusted R^2	0.34		0.86		0.86	

Note: Size2 = 1 if insurer is in size quartile 2 (quartile 1 = smallest size quartile), 0 otherwise; Size3 = 1 if insurer is in size quartile 3, 0 otherwise; Size4 = 1 if insurer is in size quartile 4, 0 otherwise; Fraternal = 1 if insurer is a fraternal insurer, 0 otherwise. Size = total admitted assets. Ordinary life output % = ordinary life output / total output. Group life output % = group life output / total output. Individual annuities output % = individual annuities output / total output. Group annuities output % = group annuities output / total output. The omitted category is accident and health benefit %. Total output is the sum of ordinary life output, individual annuities output, group life output, group annuities output, and accident and health output. Ln(Output) = Total Output (1999 $, Thousands). Year dummies are included in the models but are not shown here.
***Statistically significant difference at the 1% level; **statistically significant difference at the 5% level; *statistically significant difference at the 10% level.

to ordinary life output. The coefficients on individual annuities output%**Fraternal* and on group annuities output%**Fraternal* interaction terms are significantly positive in both Models 2 and 3, suggesting that fraternals tend to have a comparative advantage in producing individual and group annuities output relative to accident and health output. Cost dominance regressions yield similar results and suggest that fraternals tend to have a cost comparative advantage in producing ordinary life output, individual annuities output, and group annuities output, relative to accident and health insurance output.

Table 7 presents the regression results for fraternal and stock companies. In Panels A and B, the coefficients of individual annuities output %**Fraternal* and group annuities output %**Fraternal* interaction terms in Models 2 and 3 are significantly positive, indicating that fraternals tend to have a comparative advantage in producing annuities output relative to accident and health insurance output. It also implies that issuing more of these lines by fraternals would tend to shift the fraternal frontier to the left of their counterpart's frontier.

In sum, the regression evidence, in conjunction with our univariate results, show dominance of mutuals and stocks over fraternals. We reject the null hypothesis of equal efficiency across fraternals, mutuals, and stocks and conclude that fraternals are less efficient than mutuals and stocks. The dominance of stocks and mutuals over fraternals raises a concern about the coexistence of low-efficiency fraternals and their higher-efficiency counterparts. One possible explanation of the coexistence is that fraternals may serve a different market segment. For instance, fraternals may write more standardized products or the insureds of fraternals are relatively homogeneous. Our regression results show that fraternals have a comparative advantage in producing individual insurance. Our overall results imply that, given the members' identification with an ethnicity or a religion, current fraternal members are willing to accept lower efficiency from their insurer (i.e., "taking one for team").

Regression Analysis of Financial Performance

The frontier efficiency results indicate that fraternal insurers are less efficient than stock and mutual insurers. In this section, we further explore whether fraternals are less profitable than their counterparts by analyzing a number of multiple regression models. We first examine insurers' profitability (return on assets, ROA) and use ROA as the dependent variable in the regression analysis.[16] To provide more evidence about the variation in

[16]We also calculate the return on equity (ROE) as an alternative measure of profitability. The results using ROE yield the same qualitative conclusions as the ROA results.

Table 7. Regression Analysis of Dominance Statistics—Stock Control Insurers, Dependent Variable: Dominance Statistics

Panel A: Technical Dominance Results	Model 1		Model 2		Model 3	
	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio
Constant	–0.30	–0.83	–0.38	–1.13	–0.24	–0.69
Size2	–0.07	–0.20	0.00	0.01	–0.15	–0.42
Size3	0.03	0.09	0.00	0.01	–0.25	–0.68
Size4	–0.13	–0.33	0.03	0.07	–0.36	–0.81
Fraternal	–16.39	–23.93***	–7.44	–4.12***	–7.48	–4.15***
Size2*Fraternal	14.95	13.87***	9.10	7.81***	8.34	6.97***
Size3*Fraternal	14.39	14.27***	5.30	4.26***	4.61	3.64***
Size4*Fraternal	11.80	11.98***	5.16	4.65***	4.40	3.80***
Ordinary life output %	–1.01	–2.86***	0.04	0.12	–2.90	–2.60***
Group life output %	0.02	0.03	0.06	0.09	0.19	0.07
Individual annuities output %	1.57	3.43***	0.26	0.58	2.13	1.31
Group annuities output %	–0.01	–0.01	0.03	0.03	–0.43	–0.10
Ordinary life output %*Fraternal			–12.88	–6.74***	–12.02	–6.22***
Group life output %*Fraternal			–1046	–0.70	–878	–0.59
Individual annuities output %*Fraternal			6.57	2.90***	7.21	3.16***
Group annuities output %* Fraternal			42.23	3.57***	42.22	3.55***
Ordinary life output %* Ln(Output)					0.34	2.74***
Group life output %* Ln(Output)					–0.02	–0.06
Individual annuities output %* Ln(Output)					–0.18	–1.13
Group annuities output* Ln(Output)					0.06	0.13
Adjusted R^2	0.36		0.44		0.44	

(*continued*)

profitability for the insurers, we also investigate insurer commissions, expenses, and investment income.

With regard to the independent variables, we include dummy variables for the mutuals (*Mutual* = 1 for mutuals, 0 otherwise) and stocks (*Stock* = 1 for stocks, 0 otherwise), with fraternals the omitted category. For other control variables, we follow Lai and Limpaphayom (2003) and use the

Table 7. (*continued*)

Panel B: Cost Dominance Results

	Model 1		Model 2		Model 3	
	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio
Constant	–0.84	–5.91***	–0.67	–8.33***	–0.66	–8.04***
Size2	–0.07	–0.49	0.03	0.31	0.00	0.02
Size3	–0.12	–0.83	0.00	–0.02	–0.02	–0.23
Size4	–0.21	–1.40	0.01	0.08	0.02	0.17
Fraternal	–5.29	–19.56***	–26.94	–62.47***	–26.94	–62.59***
Size2*Fraternal	4.65	10.93***	1.20	4.32***	1.08	3.79***
Size3*Fraternal	4.82	12.10***	1.10	3.71***	0.99	3.27***
Size4*Fraternal	3.62	9.31***	0.44	1.68*	0.33	1.20
Ordinary life output %	0.59	4.18***	0.05	0.66	–0.40	–1.49
Group life output %	0.32	1.09	0.00	0.03	0.00	0.01
Individual annuities output %	1.31	7.26***	0.65	6.09***	1.47	3.79***
Group annuities output %	1.16	2.77***	0.86	3.62***	2.21	2.07**
Ordinary life output %*Fraternal			23.70	52.00***	23.83	51.68***
Group life output %*Fraternal			28.65	0.08	47.25	0.13
Individual annuities output %*Fraternal			27.32	50.45***	27.39	50.35***
Group annuities output %* Fraternal			32.22	11.41***	31.81	11.21***
Ordinary life output %* Ln(Output)					0.05	1.72*
Group life output %* Ln(Output)					0.00	0.01
Individual annuities output %* Ln(Output)					–0.08	–2.16**
Group annuities output* Ln(Output)					–0.16	–1.28
Adjusted R^2	0.26		0.76		0.76	

Note: Size2 = 1 if insurer is in size quartile 2 (quartile 1 = smallest size quartile), 0 otherwise; Size3 = 1 if insurer is in size quartile 3, 0 otherwise; Size4 = 1 if insurer is in size quartile 4, 0 otherwise; Fraternal = 1 if insurer is a fraternal insurer, 0 otherwise. Size = total admitted assets. Ordinary life output % = ordinary life output / total output. Group life output % = group life output / total output. Individual annuities output % = individual annuities output / total output. Group annuities output % = group annuities output / total output. The omitted category is accident and health benefit %. Total output is the sum of ordinary life output, individual annuities output, group life output, group annuities output and accident and health output. Ln(Output) = Total Output (1999 $, Thousands). Year dummies are included in the models but are not shown here.
***Statistically significant difference at the 1% level; **statistically significant difference at the 5% level; *statistically significant difference at the 10% level.

following firm-specific control variables: size, business mix, securities holdings, and loan portfolio. Gibson (1995), Houston and James (1996), and Knopf and Teall (1996) contend that the size of financial firms and business risk share an inverse relation. Larger firms tend to take less risk and are less profitable.

Business mix may have an impact on insurer profitability due to underwriting gains. Business mix variables include the percentage of ordinary life output, the percentage of group life output, the percentage of individual annuity output, the percentage of group annuity output, and the percentage of accident and health output. The omitted category is percentage accident and health output. Securities holdings and contract loans could also relate to insurer profitability due to potential investment gains from securities holdings and contract loans. Security holding is defined as the sum of bonds, preferred stock, and common stock holdings divided by total admitted assets. The loan variable is contract loans (cash value borrowed by policyowners) divided by total admitted assets. The descriptive statistics for financial variables for all insurers are shown in Panel A of Table 1. The results show that stocks significantly dominate fraternals in terms of profitability.

Table 8 presents the results of ordinary least squares (OLS) regression.[17] *Stock* has a positive coefficient in the profitability model and is statistically significant at the 1% level, suggesting that stock insurers have higher profitability than fraternals. We also use risk-adjusted ROA (RAROA) as a robustness check.[18] The coefficient of *RAROA* is supportive of the *ROA* results and is statistically significant at the 1% level, suggesting that stocks have significantly higher *RAROA* than fraternals. Thus, the results reject our null hypothesis of equal efficiency between stock and fraternals in terms of profitability. The findings of financial performance provide further evidence that fraternals underperform their counterparts and imply that fraternal policyholders may be accepting a lower level of efficiency from their insurer. With regard to the relation between organizational form and commissions, *Stock* has a significant positive coefficient. This result suggests that stocks pay higher commissions than fraternals. Thus, although stocks exhibit higher commission expense than fraternals, stocks still outperform fraternals.

[17]We test for multicollinearity using a variance inflation factor (VIF). The results of VIF suggest that the multicollinearity problem does not tend to be an empirical issue in the sample.

[18]Risk-adjusted ROA is calculated by dividing ROA of year *t* by the standard deviation of ROA during prior periods. For instance, the 2007 risk-adjusted ROA is calculated by dividing the 2007 ROA by the standard deviation of ROA over 2005, 2006, and 2007.

Table 8. Regression Results for Financial Variables

	ROA		RAROA		Commissions		Expense ratio		Investment income	
	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio	Coeff.	T-ratio
Constant	0.0021	0.22	0.0570	6.66***	0.1488	1.40	0.0619	0.17	–4.1296	–1.15
Mutual	–0.0029	–0.39	0.0115	1.81*	0.1436	1.41	0.2512	0.95	0.2938	0.11
Stock	0.0174	2.73***	0.0178	3.20***	0.1898	2.16**	0.1034	0.45	2.6790	1.20
Size	–0.0002	–0.29	–0.0021	–3.82***	–0.0163	–1.70*	–0.0916	–3.65***	–0.1854	–0.68
Ordinary life output %	–0.0266	–5.06***	–0.0098	–2.17**	–0.0335	–0.47	0.6497	3.54***		
Individual annuities output %	–0.0267	–4.05***	–0.0161	–2.89***	–0.2257	–2.43**	1.1177	4.66***		
Group life output %	–0.0245	–2.33**	–0.0139	–1.57	–0.3724	–2.55**	–0.0728	–0.19		
Group annuities output %	–0.0204	–1.40	–0.0267	–2.14**	–0.2445	–0.90	0.4376	0.62		
Securities holdings	0.0127	1.65*	–0.0318	–4.76***			–0.0898	–0.32	5.3575	1.83*
Loan portfolio	0.0123	0.29	–0.1133	–3.10***					–12.7407	–0.78
Adjusted R^2	0.0451		0.0827		0.0096		0.0189		0.0001	

Note: ROA is return on assets. RAROA is risk-adjusted return on assets. Commissions = commissions / net premiums. Expense ratio = general expenses / net premiums. Investment income = net investment income / net premiums. Size = total admitted assets in millions of 1999 dollars. Ordinary life output % = ordinary life output / total output. Individual annuities output % = individual annuities output / total output. Group life output % = group life output / total output. Group annuities output % = group annuities output / total output. The omitted category for output is accident and health benefit %. Securities holdings = (bond + preferred stock + common stock) / total admitted assets. Loan portfolio = loan portfolio / total admitted assets. Mutual = 1 if the insurer is a mutual insurer, 0 otherwise. Stock = 1 if the insurer is a stock insurer, 0 otherwise. The omitted category for organizational form is fraternal insurer. Year dummies are included in the models but are not shown here.

***Statistically significant difference at the 1% level; **statistically significant difference at the 5% level; *statistically significant difference at the 10% level.

Among other control variables, the coefficients of percentage of ordinary life, percentage of individual annuities, and percentage of group annuities are significantly negative in the ROA equation. These results indicate that insurers with a relatively larger business in these lines tend to have poorer financial performance. The coefficient of securities holdings is positive and statistically significant in the ROA models, suggesting that there is a positive relationship between securities holdings and ROA.

CONCLUSIONS

This paper examines the efficiency of fraternal insurers as compared to stock and mutual insurers in the U.S. life insurance industry. We use the nonparametric frontier method to estimate the relative cost efficiency (CE) and technical efficiency (TE) for fraternals, mutuals, and stocks over the period 2000–2007. This study is the first to examine the relative efficiency of fraternal organizations using DEA analysis.

We first test the null hypothesis that fraternals, mutuals, and stocks face the same technology and operate on the same production and cost frontiers. The results suggest that fraternal and mutual insurers use different technology and operate on different frontiers. To seek further evidence about the null hypothesis of equal efficiency, we compare the cross-frontier efficiency of these three types of insurers to examine whether the outputs of fraternals could be produced more efficiently by their counterparts. The cost and technical cross-frontier efficiency show that the mutual technology dominates fraternal technology in producing fraternal and mutual insurer output vectors. The analysis of dominance statistics and regression analysis provide the same results.

Our comparison of fraternals and stocks shows that fraternal and stock insurers employ distinct technologies and operate on different production and cost frontiers. The cost and technical cross-frontier efficiency show that the stock frontier dominates the fraternal frontier for producing fraternal output vectors as well as stock output vectors. The analysis of dominance statistics and regression analysis provide the same findings. We also observe that stocks have higher profitability than fraternals, after controlling for other variables. This result reinforces our findings that stocks dominate fraternals. Overall, the empirical evidence consistently rejects the null hypothesis of equal efficiency among these three organizational forms and suggests that fraternals are less efficient and less profitable than their counterparts.

The findings indicate that fraternal policyowners are willing to accept lower efficiency from their insurer (i.e., "taking one for team"), perhaps because of their affiliation with the fraternal insurer. The results suggest that the stakeholders of fraternals and insurance regulators should pay more attention to fraternal society operations and the long-term viability of fraternals.

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APPENDIX A

Fraternal Insurers

ACA Assur	Polish Roman Catholic Union of America
Association of the Sons of Poland	Polish Union of US of North America
Catholic Knights	Polish Womens Alliance of America
Catholic Life Ins	Royal Neighbors of America
Catholic Order of Foresters	Serb Natl Federation
Croatian Catholic Union USA	Slovak Gymnastic Union Sokol USA
Degree of Honor Protective Assn	Slovene Natl Benefit Society
Equitable Reserve Assn	SPJST
Firemans Mut Aid & Benefit Assn	Travelers Protective Assn of America
First Cath Slovak Ladies Assn USA	Ukrainian Fraternal Assn
First Cath Slovak Union Of The USA	Ukrainian Natl Assn Inc
Gleaner Life Ins Society	United Lutheran Society
Greek Catholic Union of the USA	United Transportation Union Ins Assn
Independent Order of Vikings	Western Fraternal Life Assn
Knights of Columbus	William Penn Assn
Ladies PA Slovak Catholic Union	Womans Life Ins Society
Modern Woodmen of America	Woodmen World Assur Life Assn
Mutual Beneficial Assn Inc	Woodmen World Life Ins Soc
National Mut Benefit	Workmens Benefit Fund of the USA
Polish Natl Alliance of Brooklyn	

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