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The Effects of Merger and Acquisition on the Price of Insurance and Firm Performance in the U.S. Property-Liability Insurance Industry

Jeung Bo Shim

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EFFECTS OF MERGERS AND ACQUISITIONS ON THE PRICE OF INSURANCE AND FIRM PERFORMANCE: EVIDENCE FROM THE U.S. PROPERTY-LIABILITY INSURANCE INDUSTRY

BY

JEUNG BO SHIM

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ACCEPTANCE

This dissertation was prepared under the direction of the Jeung Bo Shim's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor in Philosophy in Business Administration in the Robinson College of Business of Georgia State University.

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ABSTRACT

EFFECTS OF MERGERS AND ACQUISITIONS ON THE PRICE OF INSURANCE AND FIRM PERFORMANCE: EVIDENCE FROM THE U.S. PROPERTY-LIABILITY INSURANCE INDUSTRY

By

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Although the economic motivation and efficiency effects of mergers and acquisitions (M & As) in the insurance industry have been discussed, none of the prior studies have addressed the relationship between M & A activity and insurance price change. In addition, little is known about the effect of diversification on the differences in insurance price across lines. The main objective of the dissertation is to provide evidence on these issues. A secondary objective is to investigate the relationship between M & A activity and insurer's efficiency and financial performance. We also examine various firm characteristics that affect insurance price differences across lines and that influence insurer's efficiency and performance. We conduct fixed effects model regressions to test our hypotheses using unbalanced panel data over the sample period 1989-2004.

The empirical tests indicate that the price of insurance for newly formed insurers decreases following the M & As and diversified insurers charge lower prices than less diversified firms. Our result is consistent with one possible explanation that acquiring insurers reduce overall underwriting risks and more efficiently manage the frictional costs of capital through geographic and/or product line diversification by engaging in the M & As and therefore gain a competitive advantage in pricing. Our analysis also reveals

a number of other interesting results. We find that insurance price is positively related to marginal capital allocation and inversely related to firm insolvency put value, suggesting the importance of incorporating insolvency risk and marginal capital costs in pricing lines of insurance business. We also find that the price of insurance is inversely related to cost efficiency, consistent with the efficiency structure hypothesis. However, the market share variable is not significant, implying that market power that can arise from M & A activity may not be a big concern for insurance regulators. In the analysis of efficiency and financial performance, we provide evidence that acquirers' overall cost and revenue efficiency and financial performances decrease following M & As. We also find that more focused insurers outperform the diversified insurers.

CHAPTER 1
INTRODUCTION AND MOTIVATION

Since the early 1990s, the U.S. property-liability insurance industry has experienced significant changes of market structure owing to rapidly changing technologies, particularly advances in computing and communications, the increasing convergence of the financial marketplace, coupled with intense competition, and the increased catastrophic risk. The intensification of competition brought on by technological progress and increased exposure to catastrophic risk have constricted profit margins and put pressure on insurers to seek ways to reduce costs and improve efficiency. Moreover, in response to periods of dynamic structural changes, insurance firms have attempted to enhance their performance and attract new customers by increasing their geographical access and the range of products they offer through M & A activity.

The U.S. insurance industry has witnessed an increasing wave of merger and acquisition (M & A) activity in the 1990s, which draw widespread attention for commentators to investigate economic justifications and consequences of M & A activity. Among them, BarNiv and Hathorn (1997) find that mergers serve as an alternative form of market exit for insurers that are financially distressed. Chamberlain and Tennyson (1998) suggest M & A activity may be a reaction by the industry to fundamental shocks such as industry-wide depletions of capital due to large catastrophes, unanticipated inflation or even adverse asset returns. Cummins, Tennyson and Weiss (1999) suggest technological advances and increasing financial sophistication provide insurance firms with incentives to seek improvements in X-efficiency and economies of scale through M & As. They also find that M & As improve the efficiency of target insurers in the US life insurance industry.

Although the economic motivation and efficiency effects of M & As in the insurance industry have been discussed, none of the studies have addressed the impact that M & As activity will have on the changes in the price of insurance across lines of business. In addition, little is known about the effect of diversification on the differences in insurance price across lines. This is the first study that analyzes the direct relationship between insurer's M & A activity and the price of insurance in the U.S. property-liability insurance industry. Since U.S. antitrust policy is primarily concerned with the potential for collusive behavior (e.g., significantly increased market power due to M & As) within the industry, the findings of the relationship between M & As and insurance price changes are critical for anti-trust regulators in determining whether to strengthen or weaken existing anti-trust laws.

Our analysis is guided by the theoretical propositions set forth in Froot and Stein (1998) and in the capital allocation literature (Myers and Read, 2001) which predicts the prices of illiquid and intermediated risks depend upon the firm's capital structure and also on the covariance of an individual line of insurance relative to the riskiness of firm's entire portfolio. As Froot and Stein point out in their capital budgeting model, given the capital market frictions that make raising external funds costly, financial institutions will behave in a risk-averse fashion and care about risk management. More specifically, Froot and Stein suggest that a business segment's contribution to the overall variability of the cash flows of the bank is an important factor in assessing the risk of a specific segment and in the capital budgeting decision. This implies that firm capital structure, risk management, and capital budgeting are related.

Myers and Read (2001) argue the costs of holding equity capital should be allocated to the individual lines of insurance such that the marginal contribution to firm's overall default risk is equal across all lines of insurance.[1] Using this assumption, they develop a capital allocation rule where the capital allocated to the individual lines of business "adds up" to the overall capital of the insurer where prices then reflect these marginal allocations.

In addition to the adding up property, a second important implication of the Myers and Read formulation relates to the portfolio of businesses supported by the capital of the insurer. For example, Myers and Read demonstrate theoretically that diversification by adding more lines of business with low covariability with the insurer's current loss portfolio (or high covariability of loss portfolio with asset portfolio) can decrease the overall capital requirements of the insurer. [2] This implies that firms that engage in M & A activity in an attempt to acquire a portfolio of businesses utilize the capital of the firm more efficiently and thus, the price of insurance across lines in the newly formed insurer reflect not only the lower overall capital costs but also new capital allocation by lines of business.

The capital allocation theory argues that competitive insurance price should reflect total capital requirements and their line-by-line allocations (Myers and Read, 2001). The recent empirical study by Cummins, Lin, Phillips (2006) provides evidence that insurance prices are directly related to the marginal capital allocations suggested by the Myers and Read (2001) model and also related to the covariability of losses across lines of insurance predicted by Froot and Stein (1998).

The economic literature suggests other hypotheses in observing the setting of prices. For example, the market power (MP) hypothesis states that merging firms can increase prices by acquiring varying degrees of market power, earning higher profits (e.g.,

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[1] Capital is defined as the net of total assets over liabilities. Capital is also called surplus in the insurance industry.

[2] Capital requirement is measured by capital-to-liability ratio (Myers and Read, 2001).

Berger and Hannan, 1989). The efficient-structure (ES) hypothesis posits that cost-efficiency and scale efficiency are driving forces for price and profit. Berger (1995), and Goldberg and Rai (1996) argue that prices may be relatively favorable for consumers of firms in concentrated markets or with large shares under the ES hypothesis because efficient firms with lower costs can set lower prices than other firms to attract more customers from competitors.

Such tests that exclude efficiency and market power variables in observing the determinants of insurance price differences across lines of business may be problematic if insurance price, efficiency and market power variables are jointly determined and omitted variables affect significantly the differences in insurance prices across lines. Thus, we attempt to identify a number of possible determinants of insurance price differences across lines of business by incorporating efficiency, and market power variables into the existing empirical literature of insurance price. In this dissertation, we focus on testing three specific hypotheses (capital allocation, efficient-structure, and market power hypothesis) to indicate whether these hypotheses are valid in determining insurance price differences across lines of business.

The economic premium ratio is used to proxy for the price of insurance. The economic premium ratio for a line of insurance is defined as premiums written net of dividends to policyholders and underwriting expenses scaled by the estimated present value of losses. To examine whether the marginal capital allocated across lines are reflected in the differences of line-by-line insurance price, we employ Myers-Read methodology to implement marginal capital allocation by line of business. Myers and Read (2001) use the Black-Scholes option pricing model to estimate insurer's insolvency put value and then allocate capital marginally by taking partial derivatives of firm's insolvency put value with respect to the present value of loss liabilities for each line. We incorporate cost efficiency into the regression model to examine whether ES hypothesis is valid. The market share variable is also included to control for the market power hypothesis. We also include geographical and/or product line diversification measured by Herfindahl index as explanatory variables to provide further evidence on the related hypothesis that diversified insurers charge lower prices.

Another important objective of the dissertation is to investigate the relationship between M & A activity and insurer's performance change. Although M & A activity impacts significantly the economic performance of insurance companies and their efficiency, limited evidence exists on the relationship between M & A activity and insurers' efficiency and financial performance in the U.S. property-liability insurance industry in the current changing environmental context. In particular, there have been no significant studies of direct relationship between M & A activity and differences in performance across lines of insurance. Hence, this dissertation seeks to provide further information on whether the efficiency and performance of acquiring insurers are consistently enhancing or reducing following M & As using more recent and much larger sample data. In addition, we examine the relationship between M & A activity and line by line performance change by considering underwriting performance (measured by combined ratio and expense ratio) in each line.

Prior studies investigate the performance effects of diversification based on two alternative hypotheses- the strategic focus hypothesis and the conglomeration hypothesis. Pro-focus arguments state that firms can maximize value by focusing on core businesses and core competencies where the firm has a comparative advantage. It is also argued that conglomeration may aggravate agency problems by allowing cross-subsidization to poor subsidiaries (Jensen, 1986; Berger and Ofek, 1995; Shin and Stulz, 1998; Scharfstein, 1998). In contrast, pro-conglomeration hypothesis asserts that operating multiple lines of business can add value from taking advantage of cost scope economies that can arise from the shared use of resources such as information technology, customer database, and marketing distribution systems (e.g., Teece, 1980), or from revenue scope economies in offering “one-stop shopping” to customers who are willing to pay more (e.g., Gallo, Apilado, and Kolari, 1996). Conglomeration may also improve financial efficiency by creating internal capital markets which is less affected by capital market frictions (Gertner, et al., 1994; Stein, 1997).

Despite substantial empirical research on the validity of the strategic focus and conglomeration hypotheses, there is little consensus on which hypothesis dominates in the insurance industry. Cummins and Nini (2002) find a positive relation between returns on equity and product line Herfindahl index in the property-liability insurance industry, consistent with the strategic focus hypothesis. Meador, Ryan, and Schellhorn (2000) conducted efficiency analysis to investigate the effects of product diversification for U.S. life insurers. Their results suggest that diversified life insurers are more X-efficient than their more focused counterparts. Cummins, Tennyson and Weiss (1999) suggest technological advances and increasing financial sophistication provide insurance firms with incentives to seek improvements in X-efficiency and economies of scale through M & As. They find that M & As improve the efficiency of target insurers in the US life insurance industry. Berger, et al.(2000) provide evidence that conglomeration hypothesis holds more for large personal lines insurers, while strategic focus hypothesis may apply more to small insurers that emphasize commercial lines. Their results suggest that the strategic focus hypothesis dominates for some types of insurers and the conglomeration hypothesis dominates for other types. Cummins, et al.(2003) examine whether it is advantageous for insurers to offer both property-liability and life-health insurance or to focus on one or a few specialized area by estimating efficiency scores using data envelopment analysis. Their results provide evidence that strategic focus is a better strategy than conglomeration, consistent with the findings of most of the recent literature on diversification.

The recent study by Cummins and Xie (2005b) investigates scale economies in the US property-liability insurance industry. They find that most small insurers operate with increasing returns to scale, thus gaining scale economies, while most large firms operate with decreasing returns to scale, indicating scale diseconomies. Their results imply that large insurers with decreasing returns to scale are already too large to be scale efficient. Cummins and Xie (2005a) provide evidence that larger insurers are more likely to be acquirers. They also argue that scale economies were not a predominant motive for M & As since non-decreasing returns to scale is unrelated to being an acquirer. Accordingly, we hypothesize that the efficiency of acquiring insurers is likely to decrease following M & A perhaps due to scale diseconomies and increased frictional costs associated with managerial conflict and agency costs.

It has been argued that there is no single dominating hypothesis or theory that justifies M & A activity (e.g., Trautwein, 1990). In any given case, more than one motive may underlie the decision to merge. For example, the agency theory states that M & A activity is driven by the manager's incentive to grow firm beyond its optimal size and the motive for M & A transaction may not be stockholder wealth maximization, but managerial self-interests that pursue manager's private benefits (Jensen, 1986). The managerial hubris hypothesis suggests that M & As may not create value or even destroy value because they may be the result of poor decisions by overconfident managers (Roll, 1986). Bidding firm managers motivated by managerial hubris are likely to overestimate their own ability to manage an acquisition and overvalue the target, leading to overbidding. As a result, the hubris hypothesis predicts a negative gain for bidders. Other things being equal, the level of a firm's earnings depends on the efficiency and skill of its management. Thus, we hypothesize that the financial performance of acquiring insurers is also likely to decrease following an M & A if the agency theory and the managerial hubris hypothesis are predominant motives for M & As.

To examine the relationship between M & A activity and efficiency change, we estimate the cost, revenue, pure technical, scale and allocative efficiency of firms using data envelopment analysis (DEA). DEA is a mathematical programming (non-parametric) approach that compares each firm to a "best-practice" cost and production frontiers formed by convex combination of the most efficient firms in the sample (Cooper, Seiford, and Tone, 2006).[3] The frontier efficiency method summarizes the overall performance of a firm into one score by taking account of the multi-dimensional production process of the firm. A firm is considered fully efficient if it operates on the frontiers, while any departure from the frontiers is measured as inefficiency. An advantage of DEA is that it is expected to yield more accurate results if the objective is to study the performance of specific units of observation, because the optimization is conducted separately for each decision making unit (DMU) (Cummins and Weiss, 1998). We also estimate the return on equity and on assets on the basis of balance sheet ratios as a measurement of firm performance.[4]

The primary data source for the study is from annual regulatory statements filed with the National Association of Insurance Commissioners (NAIC). The samples of M & A are identified through list of Best's Insurance Reports-Property/Casualty. We also utilize the NAIC by-line quarterly data (1991-2004) to estimate underwriting returns

[3] While the econometric frontier efficiency methodology requires the specification of functional form such as the translog to estimate the frontier and requires the distributional assumptions about error term, DEA method avoids this type of the specification error since it is not necessary to specify a functional form or distributional assumptions (Cummins and Weiss, 1998)

[4] A number of previous studies on M & As have been characterized by the use of stock price performance using event study methodology. We do not possess information on share price for the available data, since the majority of firms are not listed on the stock exchange.

which are used to obtain estimates of industry-wide volatilities and correlation matrix between the asset and liability portfolios. Data for the input prices used to estimate efficiency are obtained from the U.S. Bureau of Labor Statistics. The quarterly time series of returns of asset classes are obtained from the standard rate of return series. Our analysis is based on merging or acquiring groups and unaffiliated insurers over the sample period 1989-2004 in the U.S. property-liability insurance industry because corporate strategies such as M & A decisions and investment strategies are likely performed at the group level (Berger, et al. 2000; Cummins and Xie, 2005).

By way of preview, the results of empirical tests provide support for the hypothesis that the price of insurance for newly formed insurers decreases following the M & As and diversified insurers charge lower prices then less diversified firms. We find that the price of insurance is inversely related to cost efficiency, consistent with the efficiency structure hypothesis. However, the negative and/or insignificant signs for the market share variable indicate that market power hypothesis is not valid with our sample data. We also find that the price of insurance across lines are inversely related to the firm insolvency risk and are positively related to the marginal capital allocation. These findings have some implications that show the importance of incorporating insolvency risk and marginal capital costs in pricing lines of insurance business.

The analysis on insurer's performance generally supports for the hypotheses that acquirers' overall cost and revenue efficiency and financial performances decrease following M & As. This implies that the benefits of risk diversification through M & As tend to be offset by the additional costs associated with management governance and integration, allocation of resources, and administrative and regulatory issues. These results are consistent with the findings of recent empirical studies for the relationship between diversification and firm performance (e.g., Liebenberg and Sommer, 2005).

The dissertation is organized as follows: Chapter 2 reviews prior literature on the determinants of the insurance price. Chapter 3 provides an overview of various theories that explains M & As. Chapter 4 specifies hypotheses about the relationship between M & A activity and the price of insurance and insurers' efficiency and financial performance. Chapter 5 discusses the rationale of capital allocation, and capital allocation methodology. Chapter 6 reviews DEA efficiency methodology. Chapter 7 describes the data and sample selection criteria. Summary statistics are also described in chapter 7. Chapter 8 explains the regression methodology for examining the relationship between M & A activity and price of insurance and presents the results of that analysis. Chapter 9 discusses efficiency regression methodology and analyzes those results. Chapter 10 discusses the regression methodology to investigate the relationship between M & As and insurers' financial performance. Chapter 11 concludes the dissertation by summarizing the results and by discussing future extensions.

CHAPTER 2
LITERATURE REVIEW
−DETERMINANTS OF INSURANCE PRICES

How should insurance companies determine premium rates for insurance policies? Traditional actuarial approaches to pricing property-liability insurance contracts reflect a supply (insurer)-side perspective, relying on retrospective data to estimate the timing and level of future cash flows. Insurance prices are determined by a complex set of supply and demand relationships. Although more modern actuarial models (e.g., Borch, 1974; Buhlmann, 1984) recognize the role of supply and demand in determining insurance price by modeling a market where buyers and sellers of insurance contracts are risk-averse utility maximizers, they have valued insurance apart from any financial market considerations.

The insurance pricing models have developed continually in conformity with changes in tax laws, price regulation, and financial theories. Financial economists use financial theory to address the deficiencies of actuarial pricing models, incorporating the time value of money, investment income and surplus commitments. Financial theory views insurance policies as financial instruments that are traded in markets where prices also take into account the forces of supply and demand (Cummins, 1990b). The financial pricing approaches reflect equilibrium relationships between return and risk and competitive market constraints.

The earliest financial insurance models are based on the capital asset pricing model (CAPM) (Cooper, 1974; Biger and Kahane, 1978; Fairley, 1979). The CAPM indicates that the invested assets earn the risk free rate of interest plus a risk premium; this implies that investors are rewarded for bearing systematic (beta) risk but not for taking unsystematic risk, i.e., risk that is uncorrelated with the market return. Because the

CAPM assumes that investors hold efficient asset portfolios, the market does not reward investors for risk that can be diversified away by holding a properly structured asset portfolio. The CAPM is used to derive the equilibrium rate of underwriting return called the insurance CAPM (Biger and Kahane ,1978; Fairley, 1979; Hill, 1979). Later, the arbitrage pricing model has been applied to insurance pricing (Kraus and Ross, 1982). Myers and Cohn (1987) develop the discounted cash flow model. A significant drawback of these models mentioned above is the lack of recognition of firm default risk. This issue is addressed through option pricing models. Several authors, including Smith (1977), Brennan and Schwartz (1979), Doherty and Garven (1986), Cummins (1988), Cummins and Danzon (1997), and Phillips, Cummins, and Allen (1998), have applied option pricing technology to insurance pricing. Both Cummins (1988) and Doherty and Garven (1986) use a more general form of the options relationship where both assets and the exercise price are random. Doherty and Garven (1986) use discrete-time risk-neutral valuation methods while Cummins (1988) employs the continuous time method underlying the Black-Scholes option pricing formula. Cummins and Danzon (1997) and Phillips, Cummins, and Allen (1998) extend the insurance option model to the multiple-line business. Descriptions and analyses of financial pricing models are presented in Cummins and Phillips (2001).

This section first describes the insurance pricing characteristics and insurance risks that should be taken into account in pricing models. We then outline financial pricing models such as insurance CAPM, discounted cash flow model (DCF), option pricing model. We also discuss the issue of pricing of the intermediated risks under imperfect capital market.

2.1 INSURANCE PRICING CHARATERISTICS AND INSURANCE RISKS

Financial theory views insurance companies as liability-driven financial intermediaries with equity capital and debt. As corporations issue bonds to raise debt capital, insurers issue debt capital (premiums) in the form of insurance policies. Insurance contracts are roughly analogous to the non-financial corporate bonds. This view suggests that financial theory often used to value traditional corporate debt can be applied to insurance pricing (e.g., Doherty and Garven, 1986; Cummins, 1988).

However, there are some unique characteristics of insurance debt that differ from conventional corporate bonds. For example, when most corporate bonds are issued, the maturity date and coupon payments are known in advance. In contrast, both the payment time and amount on a given contract for property-liability insurance are uncertain and stochastic due to contingent events such as the occurrence of fire and hurricane (Cummins, 1990b). Furthermore, although insurance pricing models often assume that premium is collected at the inception of the policy, it is possible in practice to spread premium payments over the policy period. For example, large commercial insurance lines may pay monthly premiums or may spread premium payments over the first three quarters of the policy year (Feldblum, 1992). In long-tail lines of business like product liability or workers' compensation, losses are not paid until long after the accident has occurred due to several factors such as loss adjustment procedures and litigated claims.[5] Thus, insurance pricing that should incorporate both premium collection and loss payment patterns confronts some different problems that are not present in conventional financial instruments.

The owners of the insurance company provide equity capital to support their insurance writings. When an insurer writes a policy, part of premium is used to pay

[5] Industry-wide loss payment patterns are available from Schedule P of the Annual Statement, but industry-wide premium payment patterns are not available.

acquisition, underwriting and administrative expenses. The remaining premiums along with equity capital committed to the firm by shareholders are invested in financial securities such as stocks and bonds to support the unearned premium reserve and the loss reserve. During the time lag between premium payment and loss settlement dates, insurers earn investment income. The shareholders' investment is subject to a layer of taxes. The insurance company has to recover these tax costs when pricing. Investment income is one stimulus for insurance pricing models that account for time value of money. Because insurance cash flows exchanged at different times have different time value of money and investment income is considered in the price-setting process, the risks of economic inflation and fluctuating interest rates should be taken into account in pricing insurance contracts (Cummins and Phillips, 2001).

Timing differences between premium payments and loss settlements and the resulting investment income were not considered in the earliest accounting pricing methods (Cummins, 1990). The most serious deficiencies of accounting models are that they use retrospective method rather than prospective to estimate cash flows. They typically measure policyholder funds (insurance premium) in proportion to loss reserves and unearned premiums. Reserves are not a perfect proxy for the amount and timing of future cash flow since reserves may be considered sunk costs which are irrelevant in pricing future policies.[6] In addition, accounting models use embedded yields to obtain the rate of return on policyholder funds. The embedded yield is also unrelated to pricing insurance contracts since policyholder funds (net of expenses) will be invested at current market rates, not at the embedded yield. Most of the pricing errors of accounting models, which reflect the insurer's retrospective data, can easily be corrected by following the basic principles of capital budgeting set forth in finance texts (e.g., Brealey and Myers,

[6] See Cummins and Chang (1983) for detailed discussion.

2000). The recognition of these defects of the earliest pricing methods has led to development of more appropriate insurance financial pricing models.

2.2 INSURANCE CAPITAL ASSET PRICING MODEL (CAPM)

The insurance CAPM was developed in Biger and Kahane (1978), Fairley (1979), and Hill (1979) to calculate a fair premium rate. The derivation begins with following formula:[7]

$$\tilde{Y} = \tilde{I} + \tilde{\Pi}_u = \tilde{r}_a A + \tilde{r}_u P \qquad (1)$$

Where $\tilde{Y}, \tilde{I}$ = net income and investment income, respectively

$\tilde{\Pi}_u$ = underwriting profit = premium income less expenses and losses

A = invested asset of the firm

P = premiums collected from policyholders

$\tilde{r}_a$ = rate of investment return on assets

$\tilde{r}_u$ = rate of return on underwriting

Tildes indicate stochastic variables. We obtain return on equity by dividing both sides of (1) by equity (G), since invested assets (A) of the firm consists of liability (R) plus equity (G).

$$\tilde{r}_e = \tilde{r}_a \left(\frac{R}{G} + 1 \right) + \tilde{r}_u \frac{P}{G} = \tilde{r}_a (ks + 1) + \tilde{r}_u s \qquad (2)$$

Where $s = P/G$ = the premium-to-equity (or premiums-to-surplus) ratio

$k = R/P$ = the liabilities-to-premiums ratio (funds generating factor)

The insurance CAPM can be determined by equating the CAPM rate of return on the insurer's equity with the expected return given by equation (2) and solving for the expected underwriting profit. The resultant formula of the underwriting profit margin is:

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[7] Notations are taken from Cummins and Phillips (2001).

$$E(\tilde{r}_u) = -kr_f + \beta_u[E(\tilde{r}_m) - r_f] \quad (3)$$

Where $\beta_u = Cov(\tilde{r}_u, \tilde{r}_m)/Var(\tilde{r}_m)$ = the beta of underwriting profits. The first component of equation (3), $-kr_f$ represents an implicit interest payment to the policyholders for the use of their funds during the period between premium payment and loss settlement. The interest payment will reduce required profits on underwriting depending on the size, k, of the policyholder funds and the risk-free interest rate, r_f. The second term is to compensate the insurance company for the systematic risks of underwriting. One of the limitations for this model is that they did not take into account default risk.

2.3 DISCOUNTED CASH FLOW MODEL

The most prominent discounted cash flow (DCF) models developed by Myers and Cohn (1987) and by the National Council on Compensation Insurance (NCCI) are based on concepts of capital budgeting. In capital budgeting, decision rules such as the net present value (NPV) or internal rate of return (IRR) method are utilized to accept or reject projects (Brealey and Myers, 2000). A fundamental principle of finance is that the value of any asset is equivalent to the present value of its cash flows. Because insurance cash flows on a given contract occur at different times, the DCF models provide an accepted approach to pricing insurance contracts.

Under DCF models,[8] all of the cash flows that include premiums, expenses, taxes and loss payments are projected, period by period and are then discounted to the beginning of the policy period by the appropriate discount rate. Myers and Cohn (1987) use a risk-adjusted discount rate, whereas the NCCI model uses an internal rate of return

[8] Cummins (1990) documents that accounting numbers are irrelevant in a DCF analysis except as they directly impact cash flows, implying that loss reserves and loss development factors are not related to DCF models.

to obtain a fair and competitive premium.[9] Both Myers and Cohn and NCCI models are widely used. The former are discussed in this section. Myers and Cohn (1987) determine the fair premium (P) as the present value of (1) loss and expense payments (L), (2) taxes on the investment balance (IBT), and (3) taxes on underwriting profits (UPT):[10]

$$PV(P) = PV(L) + PV(IBT) + PV(UPT) \qquad (4)$$

Premium flows are discounted at the risk-free rate since they are assumed to be riskless. However, loss flows are uncertain and risky, and thus are discounted at the risk-adjusted discount rate. An important feature of Myers and Cohn model is the concept of the surplus flow. Surplus is committed when the policy is written and it is released when the losses are paid. The insurance contract is a promise that compensates policyholders if contingent events occur. The worth of the promise depends on the financial strength of the insurer. The surplus committed by the shareholders supports its promise. The surplus committed to written policies and premiums paid in advance (investment balance) are invested and a tax on the investment income is paid at the end of the time. It is assumed that the funds (surplus plus premium) are invested at the risk-free rate, and therefore the tax on investment income is discounted at that rate. Tax shields that generated from underwriting losses are used to offset taxes on investment income or taxes on insurer's underwriting profits. Assuming that loss and expense payments (L), taxes on the investment balance (IBT), and taxes on underwriting profits (UPT) are paid at the end of the time period, simplified premium formula in a two-period model is:[11]

$$P = \frac{L}{(1+r_L)} + \frac{P\tau}{(1+r_f)} - \frac{L\tau}{(1+r_L)} + \frac{(P+E)r_f\tau}{1+r_f}$$

[9] See Cummins (1990) for detailed comparison between Myers and Cohn and NCCI models

[10] The premium is defined as fair if insurer is indifferent between selling the policy and not selling it in terms of the market value of the insurer's equity.

[11] The model generalizes directly to multiple periods with assumption that claims payouts are proportionally separated each period (Myers and Cohn, 1987)

$$= \frac{L}{(1+r_L)} + \frac{\tau S r_f}{(1-\tau)(1+r_f)} \tag{5}$$

Where S = surplus committed by shareholders at the beginning of the time period

r_L = risk-adjusted discounted rate

r_f = risk-free rate

τ = corporate income tax rate

The Myers and Cohn model is consistent with financial theory. However, how to estimate the risk-adjusted discount rate by line of business and the possibility of firm's default are not considered. In addition, the question of the appropriate level of surplus commitment remains unanswered.

2.4 OPTION PRICING MODEL

The option pricing models have been applied to insurance pricing by several authors (e.g., Doherty and Garven, 1986; Cummins, 1988; Cummins and Danzon, 1992; Cummins, Phillips, and Allen, 1998). These option pricing models not only incorporate insurer's default risk but also estimate key parameters more accurately than the previous pricing models like Myers and Cohn (1987) model.

The basic insurance option pricing models view insurance pricing as analogous to the pricing of risky corporate debt (e.g., Doherty and Garven, 1986; Cummins, 1988). The value of an insurer's promise to policyholders can be considered equivalent to the value of the riskless bond minus a put option written on the value of the firm. Although these option models (single period) studied by Doherty and Garven (1986) and Cummins (1988) provide important insights into insurance pricing, they have some limitations. For example, although most property-liability policies have multiple cash flows, basic option models assume a single payoff. These models also assume that insurers produce only one type of insurance, whereas most real-world insurers write multiple types of coverage such as homeowner's insurance, auto insurance, medical malpractice insurance, and workers' compensation (Cummins and Phillips, 2001).

To remedy these defects, Cummins and Danzon (1997) and Phillips, Cummins and Allen (1998) extend the basic insurance option model to the case of multiple lines of business. The model developed by Phillips, Cummins and Allen (PCA) is discussed in this section.[12] PCA assume that financial markets are competitive and perfect, and there are two groups of potential insurance buyers. It is also assumed that premium, equity, and liabilities follow geometric Brownian motion process:

$$dP_i = \mu_{P_i} P_i dt + \sigma_{P_i} P_i dz_{Pi}$$

$$dG = \mu_G G dt + \sigma_G G dz_G$$

$$dL_i = \mu_{L_i} L_i dt + \sigma_{L_i} L_i dz_{L_i} \qquad (6)$$

Where P_i, G, L_i = premium, equity, market values of liabilities for i=1, 2

$\mu_{P_i}, \mu_G, \mu_{L_i}$ = drift parameters for premium, equity and liabilities for i=1, 2

$\sigma_{P_i}, \sigma_G, \sigma_{L_i}$ =diffusion parameters for premium, equity and liabilities for i=1, 2

dz_{P_i}, dz_G, dz_{L_i} = increments of the Brownian motion processes

for premium, equity and liabilities for i=1, 2

The Brownian processes of liabilities and assets are correlated each other as follows: $dz_{L_1} dz_{L_2} = \rho_{L_1 L_2} dt,\ dz_{L_i} dz_G = \rho_{L_i G} dt,\ dz_{P_i} dz_{L_j} = \rho_{P_i L_j} dt$ for i=1, 2 and j=1, 2. The premium, surplus and liabilities are presumed to be priced according to the intertemporal capital asset pricing model (ICAPM), implying the following expected rates of return relationship:

$$\mu_{P_i} = r_f + \pi_{P_i}, \text{ for premium i=1, 2}$$

[12] Notations are taken from PCA (1998)

$$\mu_G = r_f + \pi_G$$

$$\mu_{L_i} = r_{L_i} + \pi_{L_i} \text{, for liability class i=1,2} \quad (7)$$

Where r_f = risk free rate, r_{L_i} = inflation rate for liability class i, i=1, 2 and π_j = the market risk premium for process $j = P_i, L_i,$ and G, i=1, 2.

If ICAPM is applied to the pricing of assets and liabilities, the risk premium is:

$$\pi_j = \rho_{jm}(\sigma_j / \sigma_m)(\mu_m - r_f) \quad (8)$$

Where μ_m, σ_m = drift and diffusion parameters for the Brownian motion process for the market portfolio and ρ_{jm} = the correlation coefficient between the Brownian motion process for the market portfolio and asset class j, where $j = P_i, L_i,$ and G, and i=1, 2.

Given these premises of the pricing model and assuming that shareholders of the insurer have limited liability, the insurer has an option at the end of period when the payments of liability are due. The insurer can pay off the liabilities (L) if the premium account (or assets, A) exceeds the losses payable to policyholders; shareholders will then receive the residual value. The value of the shareholders' claim on the insurer at the end of period is Max [A-L, 0]. The shareholders' claim can be viewed as a call option on the insurer's assets (A) with exercise price (L). If the insurer's assets are not sufficient to cover the liabilities, the insurer with limited liability can declare bankruptcy and turn its asset over to the policyholders. The policyholders' claim at the end of period is directly analogous of the claim of the bondholders in a levered firm, i.e., Min [L, A] = L-Max [L-A, 0]. Thus, the policyholders' claim is equal to the value of liabilities less the value of a put option known as the insolvency put.

Assuming that there are no frictional costs in the insurance markets, PCA derive the market value of line i's claim on the insurer as follows:

$$P_i = L_i e^{-(r_f - r_{L_i})\tau} - w_{L_i} I(A, L, \tau) \qquad (9)$$

Where P_i = the market value of line i's claim on the firm

L_i = the nominal losses owed to line i

r_f, r_{L_i} = the risk-free rate and the liability inflation rate of line i

τ = time of expiration of the option

$w_{L_i} = L_i / L$

$I(A, L, \tau)$ = the insurer's overall insolvency put

Equation (9) means that the market value of the policyholder' claim for line i is equal to the nominal expected value of loss liabilities at the expiration period, discounted at the risk-free rate, minus the line i's share of the insurer's overall insolvency put option. PCA state that insolvency risk in line i's claim depends on the firm's overall insolvency risk, not just on the line-specific levels of risk since an insurer' entire equity capital is available to any line of business where the losses are larger than expected. Thus, the market value of the line-specific claims on the insurer are not expected to vary after controlling for different liability growth rates by line and controlling for insurer's overall default risk. PCA investigate empirically their theoretical model by using data on the publicly traded property-liability insurance companies. They find that the price measure for the short and long-tail lines within a given firm does not vary after adjusting for line-specific liability growth rates. PCA also provide evidence that the price of insurance is inversely related to firm default risk, consistent with the results of Sommer (1996), and Cummins and Danzon (1997).

Cummins and Phillips (2001) document that option pricing models often depend on the assumptions of no-arbitrage and market completeness which are difficult to justify for some insurance products. Additional research is needed to develop more realistic pricing models in imperfect capital markets with frictions.

2.5 CAPITAL ALLOCAITON AND PRICNG OF THE INTERMEDIATED RISKS UNDER IMPERFECT CAPITAL MARKET

Froot and Stein (1998) model the interaction between the capital budgeting and risk management functions of financial intermediaries under imperfect capital market situations where it is costly for financial intermediaries to raise new external funds on short notice and it is also costly to hold sufficient capital as a cushion for uncertain events. In their model, it is assumed that firms invest in liquid assets that can be frictionlessly hedged in the capital market as well as illiquid assets that can not be easily hedged. The costs associated with raising new external capital are also assumed to be a convex function of the size of the equity capital. The firm has an initial portfolio and chooses its capital structure at time 0. At time 1, the firm can invest in new risky products and makes hedging decisions for both initial portfolio and new risky products. The investment can be financed out of external sources. Uncertain payoffs at time 2 not only affect firm's need to raise costly external funds, but also give an incentive for the firm to care about risk management.

Based on their capital budgeting model, Froot and Stein (1998) demonstrate that the hurdle rate for illiquid, intermediated risks depends on the covariance of business segment with the market portfolio (systematic risk) as well as on the covariance with the firm's pre-existing portfolio of non-tradable risks (unsystematic risk).[13] Intuitively, the price of illiquid assets such as insurance policies reflects the covariance of an individual line of business with the riskiness of an insurer's entire portfolio and an insurer's capital structure, implying that prices across lines of business may vary.

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[13] Froot (2003) recently extends their valuation function model incorporating asymmetrically distributed risks in formal corporate pricing and allocation metrics

The capital allocation literature (e.g., Merton and Perold; 1993, Myers and Read; 2001, Perold; 2001, and Zanjani, 2002) is also related to the pricing of intermediated risks (The details of capital allocation are discussed in sections 2.2 and 2.3). Capital allocation literatures posit that customers of financial intermediaries are strongly risk-averse to firm default risk and thus financial intermediaries have an incentive to reduce insolvency risk by holding more capital, investing in safer assets, obtaining high quality reinsurance, diminishing interest rate risk and diversifying across lines of insurance. Assuming that insolvency risk mostly depends on the amount of capital retained by financial firms, additional capital may benefit financial intermediaries such as banks and insurance companies by increasing the demand for firm's products by consumers who are averse to insolvency risk (Cummins and Danzon, 1997) and by reducing the likelihood that firms lose franchise value(Cagle and Harrington,1995). However, maintaining financial capital is costly due to financial market imperfections such as corporate taxation and agency costs. Thus, because of these costly risk management methods, safer insurance companies may require high price for their products (e.g., Cummins, Harrington and Niehaus, 1994).

In summary, the implication from the brief review of risk management and capital allocation literatures is that the price of given line of business reflects firm capital structure, costly surplus requirements and their allocation to individual lines of business, and the covariability among lines of insurance and between firm's overall assets and liability portfolio.

CHAPTER 3
LITERATURE REVIEW-THEORIES OF M & A MOTIVES

The literature identifies several economic and financial theories that justify M & A activity. In this chapter, we provide an overview of the literature that we use to guide our empirical work.

3.1 EFFICIENCY THEORY

Efficiency theory suggests that M & As can be motivated to achieve synergies. Synergy is the additional value that is generated by combining two firms, creating opportunities that would not have been available to the firms operating independently. A synergy exists if the combined firm is able to operate better or more efficiently than before, even if the separate firms were efficiently managed.

Efficiency is a broad concept that can be applied to many dimensions of a firm's activities. According to narrow technical definitions of the most commonly used indicators of efficiency, a firm is cost efficient if it minimizes costs for a given quantity of output and profit efficient if it maximizes profits for a given combination of inputs and outputs. These definitions focus on how production factors are combined by comparing actual costs or profits of a firm with the costs or profits of the best performed firm. A broader concept of efficiency considers synergies, scale and scope economies. We categorize the potential sources of synergy into two types which are operating synergies and financial synergies.

Operating Synergies: Economies of Scale and Scope

M & As might be explained by the existence of operational synergies. Operational synergies stem from factors such as economies of scale or scope. In some cases, economies of scale are obtained through advanced production technologies which are subject to increasing returns to scale. If scale of the firm is raised, outputs can increase proportionately. Other things equal, this reduces the unit costs of production. A change to such a technology in an industry provides motivation for firms to build additional capacity, resulting in higher outputs, greater profits where lower prices are economically feasible. The efficient-structure (ES) hypothesis suggested by Demsetz (1973, 1974) and Peltzman (1977) states that efficient firms increase in size and market share owing to their ability to yield higher profits, leading to higher market concentration. The ES hypothesis predicts that firm profitability is positively related to concentration, and efficient firms charge lower price than competitors because either superior management or production processes can achieve lower costs.

In the case that market demand in the industry may not large enough to support a large number of the higher scale firms, even at lower unit output prices, the advantages of scale economy can still be achieved through M & As. Firms operating at below-optimal scale may also be able to achieve scale gains more quickly through M & As than through organic growth.

Economies of scale may arise from the development of distribution networks, branding, and IT systems. Large scale also provides insurers with more resources and flexibility to adjust to changing market conditions. Scale economies might be present in the insurance industry because fixed costs are spread over a lager base and thus average costs are reduced as the size of firm increases. Fixed costs are present since insurance firms need for relatively fixed factors of production such as computer systems, managerial expertise and financial capital. Another source of scale efficiency is earnings diversification (Cummins, Tennyson and Weiss, 1999). Operating at larger scale can lead to decrease in firm's cost of capital if earnings volatility is inversely related to firm size.

Studies for US insurance industry have found some evidence in favor of exploiting scale economies. Cummins and Weiss (1993) and Hanweck and Hogan (1996) provide evidence of scale economies for small and intermediate-size firms in the property-liability insurance industry, suggesting that consolidation reduces average costs. Scale economies are also found in the life insurance industry (e.g., Grace and Timme, 1992; Cummins and Zi, 1998).

On the other hand, the argument for economies of scale as a major driver of insurance M & As may be criticized if frictional costs arising from post-merger integration problems outweigh any potential scale efficiency gains due to the organizational diseconomies of operating larger institutions. Larger organizations may be more complex to manage and may not be able to react quickly to changing market conditions, creating the possibility of inefficiency. Studies of US banks find that mergers produce no improvement in cost efficiency, especially for the transactions that involve very large banks (e.g., Akhavein, Berger and Humphrey, 1997; Berger, 2000).

Economies of scope provide another important production theory rationale for M & As. Scope economies can be present for costs or revenues (Berger, et al. 2000). Cost scope economies can arise from the shared use of resources such as information technology, customer databases, managerial expertise, marketing distribution systems, and brand names (e.g., Teece, 1980). Revenue economies of scope are often said to arise from the opportunities of "one-stop shopping" that can reduce consumer search costs and improve service quality (e.g., Gallo, Apilado, and Kolari, 1996).

Financial Synergies

Takeovers occur in order to reap the benefits of financial synergies. Myers and Majluf (1984) assume that management knows more about the firm's value than potential investors. Asymmetric information between firms and capital markets can raise the cost of external funds relative to that of internally generated funds. The assumptions of information asymmetry make the form of financing important, predicting a disadvantage to equity financing and a value to internal financing.

The financial synergy theory of Myers and Majluf (1984) suggests that value may be created in mergers when firms rich in financial slack acquire slack-poor firms. Such gains can be realized if the information asymmetry between potential acquirers and slack-poor firms is lower than that between outside investors and slack-poor firms. More specifically, a combination of a firm with excess cash and limited investment opportunities with a firm that has limited cash and high-return investment opportunities can yield higher value for both slack-rich firms and slack-poor firms. The slack-poor firm could gain from the merger by implementing positive net present value projects that might otherwise have been passed up due to costly external financing. The slack-rich firm can also create value by the investment opportunities brought about by the merger. Since takeovers can increase the values of both acquirers and targets by financing positive net present value projects that cannot be financed as stand-alone entities, M & As can be efficient way to achieve financial synergies. Hubbard and Pahlia (1999) find strong support for the financial synergy hypothesis, where diversifying acquisitions involve target firms that are financially constrained.

Financial synergy is likely to show up by establishing an internal capital market through M & A activity. Weston (1970) states that resource allocation is more efficient in internal than in external capital markets, and thus merging firms lead to a more efficient resource allocation by creating a lager internal capital market. This work was extended by Gertner et al., (1994) and Stein (1997), emphasizing the potential efficiency-enhancing role of internal capital markets. Gertner, Scharfstein, and Stein (1994) argue that takeovers may be value enhancing. In their study of external versus internal capital markets, the authors suggest that takeovers have an advantage in the efficient redeployment of the assets that are performing poorly under existing management. Because internal markets provide senior managers with the residual right of control of the firm's assets, these control rights offer increased monitoring incentives for the firm's senior management as they receive more gains from monitoring. Stein (1997) also documents that firm takeover activities may improve financial efficiency by creating internal capital markets that is less affected by capital market frictions. Houston et al. (1997) state that bank holding companies create internal capital markets to allocate insufficient capital among subsidiaries. They find that the benefits of internal capital markets exceed the additional agency costs involved in coordinating actions within the holding company.

Because insurance companies are required to report transactions with affiliates in mandatory filings to state insurance regulators, the U.S. property-liability insurance industry provides a particularly interesting environment where to analyze internal capital markets. It is very common for insurers to be affiliates of an insurance group and capital transfers are active among affiliated insurers.[14] Powell and Sommer (2004) provide evidence that internal capital markets are more active and play a larger role within groups of insurance companies than in non-financial firms. For example, affiliated insurers can exchange capital by assuming and ceding reinsurance. Because reinsurer pays for some portion of assumed liability shifted from ceding company, reinsurance can be used to increase a ceding insurer's underwriting capacity and thus, increase the insurer's surplus position.[15] Therefore, the ceding company is basically using the reinsurer's capital (surplus) to guarantee unexpected larger payments for such catastrophic losses due to natural disasters and industrial explosions. Eckles et al. (2005) explore the efficiency of internal capital market in the U.S. property-liability insurance industry. They provide evidence that capital is allocated to subsidiaries with best expected performance,

[14] Insurers report capital transfers among affiliates in Schedule Y (Part 2: Summary of the Insurer's Transactions with any Affiliates) of the annual statement.

[15] Insurer can also increase its surplus by selling its assets to affiliates for a price above book value or at the current market value (Eckles et al., 2005).

consistent with efficient internal capital markets. They also find that reinsurance among affiliates is the most common form of internal capital market transfer and dividend payment to affiliates and capital contributions are second most common transactions.[16]

On the other hand, other authors suggest some deficiencies associated with internal capital markets (e.g., Berger and Ofek, 1995; Shin and Stulz, 1998; and Scharfstein, 1998). These studies suggest that M & A activity may lead to inefficient cross-subsidization across segments that allow poor segments to drain resources from better-performing segments. [17] Shin and Stulz (1998) find some evidence of cross-subsidization in diversified conglomerates. They argue that this diversification may be inefficient because it does not appear to depend on the investment opportunities of the subsidized segment. Scharfstein (1998) argues that M & A activities destroy value because management in merging firms does a poor job allocating capital-underinvesting in divisions with relatively good investment opportunities and overinvesting in divisions with relatively poor investment opportunities. Rajan et al., (2000), and Scharfstein and Stein (2000) argue that internal capital markets established by M & A activity can hinder investment efficiency because of agency problem that may generate inefficient subsidization across business segments. Campello (2002) examines the function of internal capital markets in the investment allocation process of financial conglomerates, using data from bank holding companies and produces some of mixed results. He finds that internal capital market result in inefficient cross-subsidization within small bank holding companies, but internal capital markets tend to play an efficiency-enhancing role

[16] Shareholder dividends are dividends paid to affiliates if they own a portion of the reporting insurer's shares. Capital contributions are capital transfers from one affiliate to another in the form of cash, securities, real estate and surplus notes.

[17] Furthermore, Lang and Stulz (1994), and Berger and Ofek (1995) document that merging firms trade at an average discount in U.S. stock markets relative to stand-alone firms.

in large bank holding companies. Despite substantial studies, there is no consensus on whether or not internal capital market is efficient.

3.2 MARKET POWER THEORY

In economic theory, market power is defined as the capability of a firm to raise the price of a good or service without losing all consumers to its competitors. The market power theory suggests that merging firms can increase prices by acquiring varying degrees of market power, allowing firms to increase profits. This rationale is particularly true when the merging firms are direct competitors and their combination results in a substantial increase in market concentration within specified geographical or product markets (e.g., Shepherd, 1982).

The market power theory is associated with the traditional structure-conduct-performance (SCP) hypothesis. The SCP hypothesis suggests a positive relationship between profitability (or price) and concentration. Empirical studies examining bank performance and market concentration argue that banks are able to extract monopolistic rents in concentrated markets by their ability to offer lower deposit rates and to charge higher loan rates (e.g., Berger and Hannan, 1989; Berger, 1995). This reflects the setting of prices that are less favorable to customers in more concentrated markets. This hypothesis derived from the model of the oligopolistic behavior of firms implies that higher market concentration may facilitate collusion arrangements among firms (Stigler, 1964). Collusive synergies represent no efficiency gains but wealth transfers from the firm's customers (Trautwein, 1990).

When direct competitors merge, especially when they already operate in a fairly concentrated market environment, increased market power is likely to be one of the factors motivating the consolidation. M & As that aims at achieving market power may be beneficial from the firm's point of view, but are less favorable to customers due to decreased pricing competition. This is often viewed as socially undesirable; as a result, antitrust policy is introduced with the aim of limiting the ability of firms to accrue market power. A primary goal of US antitrust legislation is to prevent a significant increase in market power by regulating M & A activity.

A few studies have examined the effects of financial sector M & As on prices. The findings of these studies are inconsistent. In a study that examines the market power effects of bank megamergers, Akhavein, Berger and Humphrey (1997) find no evidence of significant price effects attributable to these bank mergers. Their measures of prices are the aggregate of bank loans and deposits from balance sheets. Prager and Hannan (1998) examined the pricing effects of horizontal mergers in the local banking industry. Using deposit interest rates that banks offer their customers as a price measure, they find that banks operating in markets where substantial horizontal mergers took place exhibited greater declines in deposit interest rates than did banks operating only in markets where no such mergers took place. This finding is consistent with market power theory that bank mergers which substantially increase concentration lead to increased market power, resulting in price changes that are not beneficial to customers.

3.3 INDUSTRY SHOCK HYPOTHESIS

Industry shock hypothesis suggests that the extensive M & A and restructuring activity within an industry can occur as the result of industry shocks. Examples of industry shocks include changes in regulation, input price volatility, increased competition, and technological innovations (Mitchell and Mulherin, 1996). To support the proposition that industry shocks play an important role in a firm takeover and in restructuring activity,[18] Mitchell and Mulherin (1996) assume that the structure of an industry, including the number and size of firms, is a function of fundamental factors

[18] The term “Takeover” is used to refer to all types of mergers and acquisitions.

such as technology, government policy, and demand and supply conditions. Thus, major changes in any of these factors cause alterations in industry structure. For example, a shock-driven reduction in demand can induce firms to abandon unprofitable lines of business, but it can also force firms to merge other business lines in order to react to the post-shock optimal size. Mitchell and Mulherin (1996) assert that M & As can be the least-cost method for industry restructuring in response to economic shocks. Andrade and Stafford (2004) find a strong positive relation between industry shocks and own-industry mergers in the 1990s, consistent with recent findings by Mulherin and Boone (2000) and Andrade et al. (2001).

Jensen (1993) documents that most M & As since the mid-1970s has been triggered by technological and supply shocks that improve productivity and create overcapacity. Jensen argues that firm takeover activities are efficient way of eliminating excess capacity since the solution of removing overcapacity by product market forces generates large, unnecessary costs. Andrade and Stafford (2004) provide evidence that excess capacity drives industry consolidation through mergers. The evidence of Andrade and Stafford (2004) suggests that industries restructured and consolidated by M & As as the economy adjusted to a variety of shocks to capacity and competition. In addition, Coase (1937) identified technological change as a major determinant of firm size. Coase predicted, “Changes like the telephone and the telegraph which tend to reduce the cost of organizing spatially will tend to increase the size of the firm.” An implication of Coase’s prediction is that M & A activity is related to technological change. Technological change has occurred at an explosive pace. Computer software applications and internet development have not only impacted all aspects of business, but also have changed the forms and nature of competitive relationships between firms.

Golbe and White (1988) document that M & A movements have occurred when the economy experienced high rates of growth and coincided with particular developments in business environments. They argue that M & As are characterized by resource allocation and reallocation processes in the economy, with firms responding to new investment and profit opportunities arising out of changes in economic conditions and technological innovations.

3.4. THE AGENCY THEORY

The agency theory of M & As, proposed by Jensen (1986), suggests that value-destroying M & A activity is driven by the manager's incentive to grow firm beyond its optimal size. Some managers' interests seem to lie in making their firms the largest and most dominant firms in their industry or even in the entire market. In most acquisition, it is the managers of the acquiring firm who decide whether to carry out the acquisition and how much to pay for it, rather than stockholders of the firm. Given these circumstances, the motive for acquisitions may not be stockholder wealth maximization, but managerial self-interests that pursue manager's private benefits.

In some cases, M & As can result in the rewriting of management compensation contracts. Managers may be motivated to increase their compensation by increasing the size of the firm through non-value maximizing mergers (Jensen and Murphy, 1990). If the potential private gains to the managers from the transaction are large, it might blind them to the costs created for their stockholders.

Shleifer and Vishny (1989) argue that takeovers can be viewed as managerial strategies to achieve entrenchment. Managers choose manager-specific acquisitions so as to make themselves indispensable to their firm at the expense of shareholders. Managers benefit from value-destroying takeovers because of power and prestige associated with managing a larger firm (Jensen 1986; Stulz 1990) and because takeovers may reduce the risk of the mangers' undiversified personal portfolio (Amihud and Lev, 1981)

3.5 MARKET TIMING THEORY

The market timing theory demonstrates that firm takeover activity can occur because of stock market valuation issues (Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004). The market timing theory does not imply that M & As could not be triggered by technological innovations, changes in regulation, or corporate governance issues, etc. Rather, the market timing theory suggests that stock market misvaluation impacts merger waves regardless of the underlying motivations for the mergers.

The market timing theory assumes that the stock market valuation for potential acquirers and potential targets can deviate from true values. The merging firm employs its relatively overvalued stock as currency to purchase the target firm's stock. Such stock market driven M & As may have poor long-run stock performance due to the correction of misvaluation. Market timing theory predicts that stock deal acquirers underperform cash deal acquirers in the long run and that firms with overvalued equity might be able to make acquisitions while firms with undervalued or relatively less overvalued equity become takeover targets.

A few recent papers model M & A activity as a result of stock market valuation. Shleifer and Vishny (2003) theoretically model the impact of market valuations on the decision to acquire and the occurrence of merger waves. They argue that managers understand stock market inefficiencies and take advantage of them by engaging in takeover activity. Stock is used to pay for acquisitions by overvalued acquirers who expect to see negative long-run returns on their shares, but are attempting to make these returns less negative. The model of Shleifer and Vishny (2003) also predicts that merger waves where managers will make stock-based acquisitions occur in high market valuation periods. An implication of this prediction is that M & A activity will be higher in industries and markets with a large variation in stock valuation.

Rhodes-Kropf and Viswanathan (2004) develop a theoretical model where market values for acquirers and targets may deviate from true value. They argue that firm-specific and market-wide misvaluation can cause merger waves in the absence of any underlying reasons for the acquisition, such as synergy. Their model suggests the possibility of mergers increases with market overvaluation. Dong, Hirshleifer, Richardson and Teoh (2003) find that market misvaluation impacts the volume of takeovers and overvaluation for both acquirers and targets influences virtually every aspect of the acquisitions including method of payment and bidder and target announcement period return.

3.6 MANAGERIAL HUBRIS HYPOTHESIS

The managerial hubris hypothesis suggests that M & As may not create value or even destroy value because they may be the result of poor decisions by overconfident managers (Roll, 1986). Roll (1986) argues that acquisitions are motivated by managerial hubris. Managers are more likely to overestimate their own ability to manage an acquisition. Bidding firm managers make mistakes in evaluating target firms but undertake acquisitions presuming that their valuations are correct. They may overvalue the target firm, leading to overbidding, i.e., they will be infected by hubris. Out of over optimism, the bidder pays too much for the target causing a positive gain for target shareholders, but a negative gain for bidders. Each dollar paid to the target shareholders represents a dollar lost to the acquirers' shareholders. The shareholder wealth of acquiring firm declines, while the wealth of target firm rises. Thus, the gains to the target's and bidder's shareholders should be inversely related.

Consistent with managerial hubris hypothesis, Bouwman, Fuller and Nain (2003) find that during periods of high stock market valuation, managers are more likely to suffer from hubris and make poor acquisition decisions. Although the market initially welcomes acquisition announcements during stock market booms, the hubris-driven acquisitions undertaken during high market valuation periods earn negative abnormal returns in the long run. This suggests that the market learns over time as the true quality of the acquisition is revealed.

Rau and Vermaelen (1998) investigate the relationship between firm-level valuation and the long-run firm performance of acquiring shareholders. It is hypothesized that the market overextrapolates the past performance of the bidder when it assesses the value of an acquisition. They find empirically that in "glamour firm" with low book to market ratios, managers are more likely to overestimate their abilities to deal with an acquisition, i.e., they are more likely to be infected by hubris. Such hubris-driven acquisitions destroy shareholder value, and bidders underperform during the three years following the acquisition. On the other hand, in firms with high book to market ratios, managers are more prudent in their acquisition plans. Because these acquisitions are not motivated by hubris, they tend to create shareholder value rather than destroy it.

3.7 CORPORATE CONTROL THEORY

Corporate control theory argues that M & As can be an effective means to replace inefficient managers of the target firm and thereby improve the performance of the assets under its control (e.g., Jensen, 1988; Shleifer and Vishny, 1988). In the absence of any internal method of control, or where such methods are not successfully implemented, the market for corporate control facilitates the dismissal of non-value-maximizing managers (Shleifer and Vishny, 1988). In these takeover contracts, the bidder deals directly with the target's shareholders, rather than with its management. A bidder who gains the required votes assumes control and then gets rid of the incumbent managers.

Other things being equal, the level of a firm's earnings depends on the efficiency and skill of its management. If the present and expected future earnings are below their potential amount due to relatively inefficient or lackadaisical management, the market will underestimate the firm value below the level that the firm's asset would have under a more efficient management. An opportunity then exists for more competent and skillful firm to purchase this underperformed firm at a price below its potential value and make a profit by removing incompetent target management and operating the firm efficiently. Such takeover attempts represent what Manne (1965) termed the "market for corporate control," If the market operates in this fashion, it is socially beneficial because it tends to shift control of corporate assets from less to more efficient management.

CHAPTER 4
HYPOTHESES

4.1 THE IMPACT OF M & A ON INSURANCE PRICES

One primary implication of the option pricing model for insurance is that the price of insurance is inversely related to firm default risk (e.g., Cummins and Danzon, 1997; Phillips, Cummins and Allen, 1998). As capital allocation literatures (e.g., Merton and Perold; 1993, Myers and Read; 2001, Perold; 2001, and Zanjani, 2002) point out, customers of financial intermediaries are strongly risk-averse to firm default risk and thus customers are willing to pay higher premium for safer firms. Given that the firm default risk generally depends on the amount of capital retained by insurers relative to liabilities, financial intermediaries have an incentive to reduce insolvency risk by holding more capital. As the amount of capital held increases, the frictional costs of holding capital increase due to capital market imperfections. Thus, insurers that properly manage the frictional costs of capital will have a competitive advantage in pricing. Insurers have a motivation to manage capital costs through M & A activity by engaging in a portfolio of businesses that more efficiently utilizes the capital of the firm.

A frequently stated motive for mergers and acquisition activity is a desire to diversify the firm by pooling uncorrelated risks. Most property-liability companies write multiple lines of insurance. The multi-line insurer may reduce insolvency risk by diversifying its exposures across lines of business or geographic locations since the businesses in the portfolio coinsure one another. For instance, risk characteristics and loss variability of property insurance are likely to differ from those of liability insurance. Both property and liability insurance may have a function of offsetting underwriting risks. Therefore, diversification enables firms to reduce its overall underwriting risk and thus can lower the amount of capital that insurer should hold to support insurance risks if the lines of businesses are not perfectly correlated with one another (Merton and Perold, 1993).

An important implication of diversification effect is that the risk of the portfolio of businesses will be less than the sum of the stand-alone risks of the businesses; firms, then, would be required to hold less capital to support uncertain events since a particular line that may have high capital requirement on a stand-alone basis but has offsetting risks with other lines of business in the context of portfolio of businesses (Merton and Perold, 1993). Myers and Read (2001) show that if each line of business is assumed to be organized as a stand-alone firm, total surplus requirements for those lines increase because of loss of diversification. If we do not consider the effect of diversification when allocating capital by lines of business, we may overestimate the cost of capital for that specific line, leading to overpricing of that risk. Perold (2001) argues that diversification across business segments diminishes the firm's deadweight cost of risk capital. The marginal capital allocation formula proposed by Myers and Read (2001) illustrate that diversification by adding more lines of business with low covariability with the insurer's current loss portfolio (or high covariability of loss portfolio with asset portfolio) can decrease the overall capital requirements of the insurer. This implies that firms that engage in M & A activity in an attempt to acquire a portfolio of businesses utilize the capital of the firm more efficiently. Thus we hypothesize that the price of insurance for newly formed insurers decreases following the M & As since the price of insurance across lines in the newly formed insurer reflects the lower capital costs. Diversified firms across lines of business or geographic locations can reduce its overall underwriting risk and, thus, can lower the amount of capital that the insurer is required to hold to support insurance risks if the businesses in the portfolio coinsure one another. Accordingly, we predict that diversified firms will charge lower prices than less diversified insurers.

In the classical theoretical paradigm of the perfect capital market with perfect information and without taxes, transaction costs and bankruptcy costs, the pricing of specific risks should be constant across all financial institutions and should not depend on the characteristics of an individual financial firm's portfolio. In reality, financial markets do not operate without frictions such as taxation, regulatory environment and asymmetric information between managers and outside investors. Because holding capital is costly due to these market frictions, financial institutions may not hold sufficient capital to eliminate all insolvency risk. When financial intermediaries have to raise capital externally, imperfect capital markets impose deadweight costs that must be covered by the cash flows of a business line. Therefore, in order for insurers to survive in imperfect capital markets with frictions, insurance price by line of business should reflect firm capital structure, the covariance among lines of business and between asset and liability portfolios as well as the amount of marginal capital allocated to each line of business. The recent empirical study by Cummins, Lin, Phillips (2006) provides evidence that insurance prices are directly related to the marginal capital allocations suggested by the Myers and Read (2001) model and also related to the covariability of losses across lines of insurance predicted by Froot and Stein (1998).

The economic literature suggests other hypotheses in observing the setting of prices. For example, the market power (MP) hypothesis states that mergers may be motivated by the firm's desire to set prices that are less favorable to consumers, earning higher profits.[19] Berger and Hannan (1989), and Hannan (1991) provide evidence that support the market power hypothesis by examining the relationship between price and

[19] A related hypothesis is the structure-conduct-performance (SCP) hypothesis. The SCP hypothesis asserts that consumers are treated less favorably in more concentrated markets as a result of anti-competitive price settings in these markets (Berger, 1995). In many of these studies, profitability is regressed against concentration and/or market share. Some argue that the finding of a positive, dominating coefficient estimate for market share and an insignificant coefficient for concentration explains the market power (MP) hypothesis, which relates market share to market power (Shepherd, 1982; Kurtz and Rhoades, 1991).

concentration or market share. They find that retail deposit rates are set less favorably for consumers in more concentrated markets or with larger market shares. Sapienza (2002) examines the effects of banking mergers on individual business borrowers. He finds that if the merger is between banks previously operating in the same geographical area (in-market mergers) and such mergers involve the acquisition of banks with small market shares, interest rates charged by the consolidated banks decrease substantially, which are beneficial to borrowers. This result is consistent with the view that horizontal mergers generate efficiency gains. However, as the local market share of the target bank increases, the efficiency effect is offset by market power. He also provides evidence that if the merger is between banks previously operating in different geographical areas (out-of-market mergers), then the decrease in interest rates is not as significant. His findings support the view that in-market mergers achieve higher efficiency gains than do out-of-market mergers.

The efficiency-structure hypothesis argues that more efficient firms charge lower prices than competitors, gaining large market shares that may result in high levels of concentration since these firms with superior management or production technologies have lower costs (Demsetz, 1973, 1974; Peltzman, 1977). The efficient-structure (ES) hypothesis posits that cost efficiency and scale efficiency are driving forces for price and profit after controlling for the impact of other variables (Berger, 1995; Goldberg and Rai, 1996).

Tests that exclude efficiency and market power variables in observing the determinants of insurance price differences across lines of business may be problematic if insurance price, efficiency and market power variables are jointly determined; and omitted variables significantly affect the differences in insurance prices across lines. Thus, we hypothesize that insurance price differences by line of business may reflect the joint effects of marginal capital allocation, efficiency, and market power. We attempt to identify a number of possible determinants of insurance price changes across different lines by incorporating efficiency, and market power variables into the existing empirical literature on insurance price. In this dissertation, we focus on testing three specific hypotheses (capital allocation, efficient-structure, and market power hypothesis) to indicate whether these hypotheses are valid in determining insurance price differences across lines of business. Specifically, we hypothesize that variations in prices by lines of business are directly related to corresponding variations of marginal capital allocation if capital allocation theory holds. This hypothesis is related to the proposition of Myers and Read (2001) and Zanjani (2002) that differences in marginal capital allocation by lines of business generate price differences across lines of insurance. In addition, we test whether both efficiency structure and market power hypothesis is valid. If the efficiency structure hypothesis holds, we expect negative relationship between insurance price and cost efficiency, while positive relationship between price of insurance and market share is predicted under the market power hypothesis.

4.2 THE EFFECT OF M & A ON EFFICIENCY AND FIRM PERFORMANCE

Since the early 1990s, the U.S. property-liability insurance industry has experienced significant changes of market structure. In response to rapid changes in new computer and communications technologies and regulatory framework, insurance firms have attempted to improve their efficiency and attract new customers by increasing their geographical access and the range of products they offer through M & A activity. Furthermore, the intensification of competition brought on by technological change and increased exposure to catastrophic risk have constricted profit margins and have put pressure on insurers to seek ways to reduce costs and improve efficiency.

It is documented that M & As are value-increasing events (e.g., Shepherd, 1982; Myers and Majluf, 1984; Hubbard and Pahlia, 1999; Berger, DeYoung, and Udell, 2001). Value increasing may arise from economies of scope or scale, increases in managerial efficiency, creation of market power, improvements in production techniques, lower income volatitlity, or financial synergies. Economies of scope provide an important production rationale for M & As. Scope economies can be present for costs and revenues. Joint production of outputs can lead to lower costs and higher revenues than production by separate firms. Cost scope economies can arise from the shared use of resources such as information technology, customer database, managerial expertise, marketing and distribution systems, and brand names across several businesses within the firm (Teece, 1980). Revenue economies of scope may arise from the opportunities of “one-stop shopping” that can reduce consumer search costs and improve service quality (Berger, et al. 2000).

Firms operating at a below-optimal scale can achieve scale gains through M & A. Insurers that expand their size by merging with others to obtain optimal operating scale are able to allocate fixed costs such as the cost of information and technology systems and advertising expenses over a larger volume of output, thus reducing average costs and improving profitability. Large scale not only provides insurers with more resources and flexibility to adjust to changing market conditions, but also makes it easier to change product focus and exit or sell unprofitable lines of business. Studies for US insurance industry have found some evidence in favor of exploiting scale economies. Cummins and Weiss (1993) and Hanweck and Hogan (1996) provide evidence of scale economies for small and intermediate-size firms in the property-liability insurance industry, suggesting that consolidation reduces average costs. Scale economies are also found in the life insurance industry (e.g., Grace and Timme, 1992; Cummins and Zi, 1998). Cummins and

Santomero (1999) also find that economies of scale exist in the life insurance industry. They find that the majority of small insurers operate at a level where increasing returns to scale apply.

The source of scale efficiency may be particularly applicable to insurers, because the essence of insurance is risk diversification through pooling. By increasing the magnitude of the insurance pool through geographical or product diversification, expected losses become more predictable and earnings volatility can be reduced. There is no question that, as long as the prospective earnings of the combining insurers are not perfectly correlated, the newly formed insurer will yield an income stream for its owners having a lesser degree of dispersion than was attainable only from one of its predecessors (Lewellen, 1971). The less volatile earnings that reduce the expected costs of financial distress or bankruptcy may permit insurers to hold less equity capital for risks underwritten, providing a potentially significant source of cost reduction (Cummins, Tennyson and Weiss, 1999).

On the other hand, the argument for economies of scale and scope as a major driver of insurance M & As may be criticized if frictional costs arising from post-merger integration problems outweigh any potential scale efficiency gains due to the organizational diseconomies of operating larger institutions. Larger organizations may be more complex to manage and may not be able to react quickly to a changing market conditions, creating the possibility of inefficiency. Studies of US banks find that mergers produce no improvement in cost efficiency, especially for the transactions that involve very large banks (e.g., Akhavein, Berger and Humphrey, 1997; Berger, 2000).

M & A activity can also lead to increase in costs due to the aggravated agency problems and inefficiencies of internal capital market. As firms become larger and more complex, managerial monitoring becomes more difficult and thus the costs of governance will increase. In addition, managers are more likely to engage in activities that maximize their private benefits and to subsidize poor business segments since larger internal capital market enables managers to avoid the market discipline that comes with external financing (Easterbrook, 1984; Berger and Ofek, 1995).

The agency theory states that M & A activity is driven by the manager's incentive to grow firm beyond its optimal size and the motive of M & As may not be stockholder wealth maximization, but managerial self-interests that may increase manager's perquisite consumption (Jensen, 1986). The managerial hubris hypothesis suggests that M & As may not create value or even destroy value because they may be the result of poor decisions by overconfident managers (Roll, 1986). Bidding firm managers motivated by managerial hubris are likely to overestimate their own ability to manage an acquisition and overvalue the target, leading to overbidding. As a result, the hubris hypothesis predicts a negative gain for bidders.

The recent study by Cummins and Xie (2005b) investigate scale economies in the US property-liability insurance industry. They provide evidence that the majority of small to medium-size firms operate with increasing returns to scale and most large insurers show scale diseconomies, implying that large insurers with decreasing returns to scale are already too large to be scale efficient. Cummins and Xie (2005a) provide evidence that larger insurers are more likely to be acquirers. They also argue that scale economies were not a predominant motive for M & A since non-decreasing returns to scale is unrelated to being an acquirer. This provides a rationale for the hypothesis that the efficiency of acquiring insurers is likely to decrease following M & A perhaps due to scale diseconomies and increased frictional costs associated with post-merger managerial integration and agency problems.

Other things being equal, the level of a firm's earnings depends on the efficiency and skill of its management. Thus, we hypothesize that the performance of acquiring insurers (measured by ROA or ROE) is also likely to decrease following an M & A if the agency theory and the managerial hubris hypothesis are predominant motives for M & As. On the other hand, the performance of acquiring insurers is likely to improve following an M & A if M & A activity is driven by value maximizing motivations such as economies of scale and scope, financial efficiency and earnings diversification.

CHAPTER 5
CAPITAL ALLOCATION RATIONALE AND METHODOLOGY

We discuss the rationale of capital allocation and Myers-Read capital allocation methodology in this chapter.

5.1 THE RATIONALE OF CAPITAL ALLOCATION

Because most policyholders purchase insurance policies to protect against adverse financial contingencies and they are strongly risk-averse with respect to insurer default on contractually-promised payoffs, insurers need to hold capital in order to secure policyholders' unexpected claims (Merton and Perold, 1993). The principal role of holding capital in the insurance company is to keep the probability of bankruptcy low by increasing ability to pay insurance claims even under adverse circumstances. However, holding capital is costly because of frictional costs that include double taxation, regulatory and agency costs.[20] More precisely, when shareholders provide capital to insurance companies, the investment return is first taxed at the corporate level as insurer's taxable income and then again as part of shareholder's taxable income when distributed as dividends.[21] Regulatory costs occur due to regulatory restrictions that may require insurers to hold minimum levels of capital or in the form of conservative reserving standards. Shareholders may demand an additional return on their investment due to these frictional costs and thus in order to be profitable, insurers need to issue insurance policies with more than their production costs including frictional capital costs (Hancock, et al., 2001; Myers and Read; 2001).

Given that holding capital is costly and insurers should keep a specified level of capital to meet regulation requirements, managing the cost of capital is of particular importance in providing insurance policies, especially catastrophe insurance that needs

[20] Froot, Scharfstein, and Stein (1993) and others illustrate that the costly external finance and frictional costs of holding capital are the driving force behind the firm's motivation to manage risk.
[21] Smith and Stulz (1985) note how nonlinear (or convex) tax schedules give rise to a rationale for hedging.

large amounts of supporting capital. As the amount of capital held increases, the frictional costs of holding capital may consist of large portions of the insurance premium (Zanjani, 2002). Thus, insurers that properly manage frictional costs will have a competitive advantage in pricing.

Insurers have an incentive to manage capital costs through risk management. Effective risk management not only promotes stability, but also provides a protection against unexpected losses. This protection is obtained primarily through the maintenance of an appropriate level of economic capital by financial institution. The risk management process involves estimating how much risk each business segment contributes to the total risk of the firm and thus to overall capital requirements. Capital held by the firm is then allocated across lines of business reflecting the varying risk level of individual lines of business. All else equal, more (less) risky lines may require more (less) capital and thus demand higher (lower) prices. Because policyholders are concerned about counterparty default risk on contractual promised payments, they prefer insurer's strong financial strength that guarantees to pay unexpected losses and thus, are willing to pay more for that.

Myers and Read (2001) argue that the essential rationale of the capital allocation is to allocate the frictional costs of holding capital to the individual lines of business depending on the marginal contribution of individual lines of business to firm's overall default value. Specifically, if a new line of business through M & A activity is added to the existing portfolio, additional capital that is needed to obtain an insurer's desired default value will be determined. Once this additional capital amount is known, the cost of surplus due to adding a new line of business can be calculated.[22] The additional capital summed up over insurer's all lines of business yields the total amount of equity capital of

[22] Cummins and Phillips (2005) develop the estimation model of cost of capital by lines of business in the property-liability insurance industry using full information industry beta approach.

the insurer. Thus, capital allocation can be considered a way to represent the allocation of the costs of holding capital.

5.2 METHODS OF CAPITAL ALLOCATION

It is well documented in the financial pricing of insurance literatures that option pricing model is utilized in analyzing firm default risk and surplus requirements (e.g., Doherty and Garven, 1986; Cummins, 1988, and Phillips et al,1998). The option pricing model is also adopted to calculate marginal capital allocation (Merton and Perold, 1993; Myers and Read, 2001). Both Merton-Perold and Myers-Read provide a capital allocation rule based on a default insurance concept.

Merton-Perold capital allocation is conducted using incremental method. For example, assume there are firms with three lines of business; the first step is to calculate the risk capital required by firms that combine two of business lines.[23] The second step is to calculate the risk capital required for the full portfolio of businesses of the firms, i.e., adding the excluded business to the two-business firms. Marginal capital allocation by line of business is then the difference between the risk capital of two-business firms obtained from the first step and the required risk capital for all three businesses. Merton and Perold show that the risk capital of a multi-line business firm is less than the aggregate risk capital of the business on a stand-alone basis when the businesses are not perfectly correlated with one another. Merton-Perold method is appropriate when considering entering new businesses or getting out of existing businesses since their methodology allows for discrete changes in the portfolio of businesses of the insurer. However, the key deficiency of their model is that 100 percent allocation is not feasible across the lines of business.

[23] Merton-Perold(1993) define risk capital as the smallest amount that can be invested to insure the value of the firm's net assets against a loss in value relative to the risk-free investment of those net assets.

Unlike Merton-Perold method, Myers-Read method (2001) uniquely allocates 100 percent of total capital of the firm. Relying on the assumption that insurer's future losses and asset values are lognormally or normally distributed, [24] Myers and Read use the Black-Scholes option pricing model to estimate insurer's insolvency put value. Assuming an entity with limited liability, an insurance company does not pay losses if loss liabilities exceed insurer's assets. The insurer defaults and the payoff to the policyholder is loss minus max (L-V, 0) where L represents losses and V is assets. Insolvency put value is measured as max (L-V, 0). It can be said that the insurer holds an option to put the default costs to the policyholders. As the insurer has the option to default on their liabilities in the event of insolvency, this insolvency put option can be an asset to the insurer, but lowers the present value of insurance policy and the premium a policyholder is willing to pay for it. As mentioned earlier, maintaining solvency ability to a specified level causes frictional costs for an insurer.

Myers-Read (2001) argue that marginal contribution of individual lines of business to firm's overall default value does vary and surplus (equity capital) should be allocated by lines of business based on these marginal contributions such that the marginal contribution to firm's overall default value is equal across all lines of insurance. They find a unique capital allocation method that leads to the "adding up" property; the equity capital allocated to the individual lines of business "add up" to the overall equity capital of the insurer. In their model, although the total capital requirement of the insurer is not explicitly specified, it could be taken to be the amount of capital to keep up the desired safety level of the insurer.

Zanjani (2002) develops multi-line insurance pricing and capital allocation model. He demonstrates that capital costs have a significant impact on the prices of

[24] Myers and Read emphasize that their result is independent of the distribution assumptions for the insurer's entire losses and assets portfolio(2001, p.573)

intermediated risks, based on three key assumptions that (1) insurers are exposed to default risk due to uncertain loss events, (2) it is costly for insurers to hold capital, (3) consumers care about the insolvency risk of insurers. Capital market frictions provide an economic rational for risk management and capital allocation by lines of business depends on the contribution of an individual line of business to the overall firm insolvency risk. Consumer demand for product quality may lead firms to charge high prices for high-risk segments, which is driven by high marginal capital requirements (Merton and Perold; 1993; Myers-Read, 2001). Zanjani proposes that “price differentials across market are explained by differences in marginal capital requirements. Segments with risk that threatens company solvency will have higher marginal capital requirements and higher prices due to implicit capital costs, even if that risk is unrelated to the broader securities markets.” which is consistent with the results of Froot-Stein (1998), and Myers-Read (2001).

We employ Myers-Read methodology to calculate marginal capital allocation by line of business in the present paper. We first describe the estimation of volatility and correlation matrix between asset and liability portfolio that are needed to implement capital allocation. We then discuss Myers-Read’s formula to estimate insolvency put value and marginal capital allocation.

5.2.1. THE ESTIMATION OF VOLATILITY AND CORRELATION MATRIX BETWEEN ASSET AND LIABILITY PORTFOLIO

The critical parameters that need to be estimated to implement Myers-Read capital allocation are the volatility and the correlation matrix for both asset portfolio returns and liability portfolio returns. Other things equal, insurer’s insolvency risk is related to the amount of capital that insurer holds. Given the certain amount of capital, the insolvency put value of the insurer depends on the respective volatility of asset return and loss return series, the correlation between loss return series across lines of business, the correlation between asset portfolios return series, and correlation between asset portfolio return and liability portfolio return series (Myers and Read, 2001).

The respective volatility for asset portfolio returns (σ_V) and liability portfolio returns (σ_L) and covariance of the log losses returns and log asset returns (σ_{VL}) are estimated by the following expressions: [25]

$$\sigma_V^2 = \sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_j \rho_{V_iV_j} \sigma_{V_i} \sigma_{V_j} \tag{10}$$

$$\sigma_L^2 = \sum_{i=1}^{M}\sum_{j=1}^{M} x_i x_j \rho_{L_iL_j} \sigma_{L_i} \sigma_{L_j} \tag{11}$$

$$\sigma_{LV} = \sum_{i=1}^{N}\sum_{j=1}^{M} y_i x_j \rho_{V_iL_j} \sigma_{V_i} \sigma_{L_j} \tag{12}$$

Where $x_i = L_i / L$ is the proportion of losses from line i, $y_i = V_i / V$ is the proportion of assets from asset type i, $\rho_{V_iV_j}$ is the correlation between log asset type i and log asset type j, $\rho_{L_iL_j}$ is the correlation between log line i losses and log line j losses, $\rho_{V_iL_j}$ is the correlation between log asset type i and log line j losses, σ_{V_i} is the volatility of asset type i, and σ_{L_j} is the volatility of log line j losses

We aggregate each insurer's lines of business into four categories such as personal property, personal liability, commercial property and commercial liability line. We use NAIC quarterly time series data available from 1991-2004 to calculate underwriting return series. The quarterly underwriting return series are adjusted for seasonality using the U.S. Census Bureau's X11 procedure. The underwriting return series defined as the natural logarithm of the present value of incurred losses and loss

[25] As in Myers and Read (2001), we assume that the distribution of loss return series and asset return series is joint lognormal.

adjustment expenses divided by the earned premium for each quarter. We estimate the volatility and correlation matrix at the individual line of business with industry-wide underwriting return series. Similar to Cummins, Lin, and Phillips (2006), individual insurer's liability portfolio volatility and correlation matrix were then calculated as weighted averages of the elements of the overall by-line volatility and correlation matrix. The sum of present value of expected loss payments and the unearned premium reserve are employed as weights.

The asset portfolio is classified into seven categories: stocks, government bonds, corporate bonds, real estate, mortgages, cash and other invested assets, and non-invested assets. The quarterly estimates of the asset returns on the first six categories are obtained from the standard rate of return series. The return series for the other assets are calculated by the natural logarithm of the gross quarterly percentage change in the total market value of asset of the insurance industry net of the market value of the first six asset categories.

Finally, we can calculate the respective volatility and the respective correlation matrix for both asset portfolio returns and liability portfolio returns and between asset portfolio and liability portfolio returns using industry-wide quarterly data.

5.2.2. THE ESTIMATION OF MYERS-READ INSOLVENCY PUT VALUE AND MARGINAL CAPPITAL ALLOCATION

Myers and Read propose a capital allocation model based on an options pricing framework. A key element of their model is the value of the default put option. The underlying variables for the default option are the market value of assets (V) and the present value of loss liabilities (L). The amount of capital (S) can be expressed as V - L. Assuming with the limited liability, shareholders hold an option to put the default costs to the policyholders if the assets are insufficient to cover the loss liabilities. The insurer can declare bankruptcy if $L > V$ at the end of period. The default amount is L - V . Let D represent the market value of default amount, $D = PV[(Max(L - V, 0)]$. The default value, D is also called the insolvency put value.

The value of default option is a function of the market value of assets, the present value of loss liabilities and the volatility of the asset-to-liability ratio: $D = f(V, L, \sigma)$. Myers and Read are modeling a multiple-line insurance company. If an insurer writes M lines of business, the insurer's total losses are the sum of loss of each line ($L = \sum_{i=1}^{M} L_i$, where L_i =present value of loss liabilities for line i and M represents the number of lines of business). In this paper, assets are also classified into N categories, $V = \sum_{i=1}^{N} V_i$, where V_i =the amount of asset of type i and N represents the number of asset categories.

As Myers and Read point out, if the aggregate losses and asset values are jointly lognormal distributed, the relevant measure of firm portfolio risk is the volatility of the asset to liability ratio (σ): $\sigma = \sqrt{\sigma_V^2 + \sigma_L^2 - 2\sigma_{LV}}$, where σ_V =the volatility of insurer's assets, σ_L =the volatility of insurer's loss liabilities, and σ_{VL} =the covariance of the natural logarithms of assets and losses values.

To calculate the default-value-to liability ratio, Myers and Read applied the following formula:

$$d = N\{z\} - (1 + s)N\{z - \sigma\} \tag{13}$$

where $z = \dfrac{-\log(1 + s) + \sigma^2 / 2}{\sigma}$

Myers-Read shows that marginal default values can be a marginal capital allocation base. Their marginal default values by line of business(d_i) is obtained by taking partial derivatives of insolvency put value, D with respect to loss liabilities for line i , L_i :

$$d_i = d + \left(\frac{\partial d}{\partial s}\right)(s_i - s) + \left(\frac{\partial d}{\partial \sigma}\right)\left(\frac{1}{\sigma}\left[(\sigma_{L_iL} - \sigma_L^2) - (\sigma_{L_iV} - \sigma_{LV})\right]\right) \tag{14}$$

According to their unique "add up" property, the insolvency put value for the company (D) can be obtained by the sum of products of line-by-line liabilities and marginal default values.

$$D = \sum_{i=1}^{M} L_i d_i \tag{15}$$

Myers and Read (2001) propose to allocate insurer's surplus to each lines of insurance business to equalize marginal default values since insurer's entire surplus is available to pay the claims from any specific policy or line of business where it is needed and policyholders have a preference for protection against default on their claims based on the insurer's total amount of surplus. Assuming the same default value to liability ratio across all lines of insurance ($d_i = \partial D / \partial L_i = d$), Myers and Read marginal capital allocation by line of business (s_i) is derived by:

$$s_i = s - \left(\frac{\partial d}{\partial s}\right)^{-1}\left(\frac{\partial d}{\partial \sigma}\right)\left(\frac{1}{\sigma}\left[(\sigma_{L_iL} - \sigma_L^2) - (\sigma_{L_iV} - \sigma_{LV})\right]\right) \tag{16}$$

Where s_i $(= \partial S / \partial L_i)$ is the surplus allocated per dollar of loss liability in line i, $s(= S/L)$ is the insurer's aggregate surplus-to-liability ratio, $d(= D/L)$ is the insurer' insolvency put per dollar of total liabilities, σ is the volatility of the asset to liability ratio, $\partial d / \partial s$ is the partial derivative of d with respect to s (the option delta), $\partial d / \partial \sigma$ is the partial derivative of d with respect to volatility of the asset to liability ratio (the option vega), σ_{L_iL} is the covariance of log losses in line i with log losses of liability portfolio values, σ_{L_iV} is the covariance of log losses in line i with log assets portfolio values, σ_{LV} is the covariance of log losses of liability portfolio values with log assets portfolio values.

The important implication of Myers-Read's marginal capital allocation formula is that geographic diversification or diversification by adding more lines of business that have low correlation with losses of other lines of business (or that have high correlation with asset portfolio returns) may reduce insurer's overall capital requirement. Diversification reduces required capital because it can offset risks if both newly added and existing lines are not perfectly correlated with one another. However, administrative, operating, and agency costs also increase due to diversification such as M & A activity. Myers and Read (2001) argue that the net financial gains from such diversification are high in the beginning for an insurer starting one or a few highly correlated lines of business. As more new lines and geographical areas are added, these net gains decrease when administrative, operating, and agency costs outweigh the costs of reduced capital requirement. Thus, efficient composition of business proceeds until the marginal benefit from reducing required surplus is equivalent to the marginal cost (Myers and Read, 2001). [26]

Using estimated volatility and correlation matrix for both asset portfolio returns and liability portfolio returns, we estimate both the ratio of marginal capital allocation-to-liability ($MCA_{i,g,t}$) and the ratio of insolvency put value-to-liability ($IPV_{g,t}$) that are used to test our hypothesis.

[26] Myers and Read (2001) also state that "Efficient diversification does not minimize required surplus. It minimizes the total cost of issuing, administering, and collateralizing policies. This establishes the efficient composition of business."

CAHPTER 6
EFFICIENCY METHODOLOGY

This chapter begins by discussing the concepts of frontier efficiency. We then present DEA estimation methodology used to create efficiency scores. We also describe the measurement of outputs, output prices, inputs and inputs prices utilized in our analysis.

6.1 FRONTIER EFFICIENCY CONCEPTS

Efficiency is often used as one of tools that measure firm performance. The basic idea of efficiency analysis is to split firms that perform well from those that perform unsuccessfully. This is related to a benchmarking method called frontier efficiency methodology (Lovell, 1993 and Grosskopf, 1993). The frontier methodology measure the performance of each firm relative to "best practice" frontiers derived from firms in the industry. The frontier efficiency method summarizes the overall performance of a firm into a single statistic that takes account of different multi-dimensional production process among firms. A firm is considered fully efficient (with efficiency scores of 1.0) if it operates on the frontiers, while any departure from the frontiers is measured as inefficiency (with efficiency scores between 0 and 1.0).

There are several types of efficiency measurement that convey different information about firm performance. Efficient production, and cost frontiers are estimated providing measures of cost, technical, and allocative efficiency for each firm. Cost efficiency for a given firm is defined as the ratio of the costs of a fully efficient firm (i.e., a firm operating on the efficient cost frontier) to the given firm's actual costs employed to produce the same output quantities. Given output quantities and input prices, a firm is considered fully efficient if its actual input usage equals optimal input usage while a firm is measured as inefficient if actual input usage exceeds optimal input usage.

Cost efficiency includes both technical efficiency, which reflects the ability of a firm to reduce its input usage to produce a given set of outputs by adopting the best practice technology, and allocative efficiency, which reflects the ability of a firm to use the cost minimizing combination of inputs to produce a given amount of output.

Technical efficiency can be decomposed into two components, one due to pure technical efficiency and one due to scale efficiency. The fact that it is socially and economically optimal for firms to operate at constant returns to scale provides the rationale for separating pure technical and scale efficiency (Cummins and Weiss, 2001). Pure technical efficiency is measured relative to a variable returns to scale (VRS) production frontier. This is the proportion by which the firm could reduce its input usage by implementing the state of the art technology characterized by the VRS frontier. However, a firm operating on the VRS frontier, i.e., a frontier represented by increasing, and/or decreasing returns to scale is scale inefficient because it can improve its efficiency by moving to a constant returns to scale (CRS) frontier. Scale efficiency can be calculated by the ratio from the CRS to the VRS production frontier.

6.2 DEA ESTIMATION METHODOLOGY

We estimate efficiency of firms using data envelopment analysis (DEA). DEA is a mathematical programming (non-parametric) approach that compares each firm to a "best-practice" cost and production frontiers formed by convex combination of the most efficient firms in the sample (Cooper, Seiford, and Tone, 2006).[27] The frontier efficiency method summarizes the overall performance of a firm into one score by taking account of the multi-dimensional production process of the firm. A firm is considered fully efficient

[27] While the econometric frontier efficiency methodology requires the specification of functional form such as the translog to estimate the frontier and requires the distributional assumptions about error term, DEA method avoids this type of the specification error since it is not necessary to specify a functional form or distributional assumptions. Accordingly, the econometric approach may potentially confounds the efficiency estimates with specification error if it uses the wrong functional form or distributional assumptions for the error terms. (Cummins and Weiss, 2001)

(with efficiency scores equal to 1) if it operates on the frontiers, while any departure from the frontiers is measured as inefficiency (with efficiency scores between zero and 1).

DEA provides a convenient way for decomposing efficiency into its components.[28] For example, cost efficiency can be easily decomposed into pure technical, scale, and allocative efficiency. DEA is expected to yield more accurate results if the objective is to study the performance of specific units of observation, because the optimization is conducted separately for each decision making unit (DMU). Cummins and Zi (1998) find that DEA estimates of efficiency are more highly correlated with conventional performance measures such as return on assets than are the estimates of econometric approach in the U.S. life insurance industry.

Detailed descriptions of the DEA methodology are provided in Ali and Seiford (1993), Charnes, et al. (1994), Seiford (1996), Zhu (2003) and Cooper, Seiford, and Tone (2006). DEA technical efficiency is measured by estimating "best practice" production frontiers, employing the input-oriented distance function (Shephard, 1970). The purpose of DEA is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier. Suppose producers use input vector $x = (x_1, x_2, ..., x_k)^T \in \Re_+^k$ to produce output vector $y = (y_1, y_2, ..., y_m)^T \in \Re_+^m$, where k is the number of inputs, m is the number of outputs, and T denotes the vector transpose operator. A production technology that converts inputs into outputs can be modeled by an input correspondence $y \to V(y) \subseteq \Re_+^k$. For any $y \in \Re_+^m$, $V(y)$ denotes the subset of all input vectors $x \in \Re_+^k$, which yield at least y. The input-oriented distance function for a specific decision making unit (DMU) is defined by

[28] An econometric model is more difficult to decompose efficiency into its components (see the Cummins and Weiss (2001) for more detailed discussion about advantages and disadvantages of the econometric and the mathematical programming approaches).

$$D(x,y) = \sup\left\{\theta : \left(y, \frac{x}{\theta}\right) \in V(y)\right\} = \left(\inf\left\{\theta : (y, \theta x) \in V(y)\right\}\right)^{-1} \quad (17)$$

The input-oriented distance function is the reciprocal of the minimum equi-proportional contraction of the input vector x, given outputs y, i.e., Farrell's (1957) measure of input technical efficiency. Input technical efficiency $TE(x,y)$ is therefore defined as $TE(x,y) = 1/D(x,y)$.

Technical efficiency for each year is estimated independently for each firm in the sample by solving linear programming problems. The following formulation is one of the standard forms for DEA linear programming of i-th DMU:[29]

$$\left(D(x_i, y_i)\right)^{-1} = TE(x_i, y_i) = \min \theta_i$$

$$\text{subject to } Y\lambda_i \geq y_i,\ X\lambda_i \leq \theta_i x_i,\ \lambda_i \geq 0 \quad (18)$$

where X is a $K \times I$ input matrix and Y an $M \times I$ output matrix for all DMUs in the sample, x_i is a $K \times 1$ input vector and y_i an $M \times 1$ output vector of firm i, and λ_i is an $I \times 1$ intensity vector for firm i, and I =the number of firms in the sample ($i = 1, 2, ..., I$). The first constraint forces the i-th DMU to produce at least many outputs as the peers of i-th DMU. The second constraint finds out how much less input the i-th DMU would need. Hence, it is called input-oriented. The factor used to scale back the inputs is θ and the value of θ_i is the efficiency score for the i-th DMU. It will satisfy $\theta \leq 1$, with a value of 1 indicating a point on the frontier and hence a technically efficient DMU. A DMU with θ less than one is not operating on the "best practice" frontier and should be able to reduce the consumption of all inputs by 1- θ without reducing output. The linear programming problem of this form must be solved I times, once for each DMU in the sample. A value of θ is then obtained for each DMU.

[29] There are other ways to formulate DEA technical efficiency problem such as the ratio approach or the dual form (e.g., Coelli, 1998).

The constraint $\lambda_i \geq 0$ imposed on the equation (18) produces a constant returns to scale (CRS) production frontier. The CRS assumption is only appropriate when all DMU's are operating at an optimal scale (i.e., equivalent to the flat part of the LRAC curve). However, firms may not be operating at optimal scale due to imperfect competition or capital market imperfection with frictions. Banker, Charnes and Cooper (1984) extended CRS DEA model to account for variable returns to scale (VRS) that firms operate with increasing returns to scale (IRS), constant returns to scale (CRS) or decreasing returns to scale (DRS). We estimate VRS production frontier by adding the convexity constraint $N1'\lambda = 1$ to the equation (18), where $N1$ is an $N \times 1$ vector of ones. A non-increasing returns to scale (NIRS) production frontier that firms operate either with CRS or DRS can be estimated by substituting the $N1'\lambda = 1$ restriction with $N1'\lambda \leq 1$.

Technical efficiency (TE) can be decomposed into pure technical efficiency (PTE) and scale efficiency (SE), where TE=PTE*SE. PTE is measured relative to the VRS production frontier. If there is a difference in the two TE scores by conducting both a CRS and a VRS DEA for a particular DMU, then this indicates that the DMU has scale inefficiency, and that scale efficiency can be obtained from the ratio of the CRS TE score to the VRS TE score. If TE equals PTE, the DMU operates with CRS. If TE does not equal PTE and the NIRS score is equal to the VRS TE score, the DMU is operating with DRS. However, if TE does not equal PTE and the NIRS score is unequal to the VRS TE score, then IRS exist for that DMU (Aly, et al., 1990).

The DEA cost efficiency is estimated by using input-oriented linear programming models. A firm's objective is assumed to be the minimization of cost by choosing input quantities while holding constant the input prices w and output quantities y . The cost efficiency (CE) is calculated by first solving the linear programming problem for each firm i ($i = 1, 2, ..., I$):

$$\underset{x_i,\lambda_i}{Min}\ w_i^T x_i^*$$

$$\text{subject to } Y\lambda_i \geq y_{ij},\ \ j = 1, 2, ..., M \qquad (19)$$

$$X\lambda_i \leq x_{ir},\ \ r = 1, 2, ..., K$$

$$\text{and } \lambda_i \geq 0$$

The solution vector x_i^* is the cost minimizing input vector for the input price vector w_i and the output vector y_{ij}. The cost efficiency of the firm i is then the ratio of frontier costs (minimum costs) to actual costs, CE = $\frac{w_i^T x_i^*}{w_i^T x_i}$, where $0 \leq \text{CE} \leq 1$ and if CE score is equal to 1, the firm is considered fully efficient. Cost efficiency of a firm consists of both technical efficiency (TE) and allocative efficiency (AE), where allocative efficiency reflects the ability of a firm to use the inputs in optimal proportions given their respective prices and can be calculated as $\frac{\text{CE}}{\text{TE}}$. A firm might not be cost efficient if it is not allocatively efficient and/or if it is technically inefficient.

Another important objective of firms is to maximize revenue efficiency by choosing optimal output quantities, taking as given input quantities and output prices. Revenue efficiency is estimated based on an output-oriented approach. The linear programming problem for each firm in each year of the sample period is estimated as follows:

$$\underset{y_i,\lambda_i}{Max} \sum_{j=1}^{M} p_{ij} y_{ij}^*$$

$$\text{subject to } Y\lambda_i \geq y_{ij},\ \ j = 1, 2, ..., M \qquad (20)$$

$$X\lambda_i \leq x_{ir},\ \ r = 1, 2, ..., K$$

$$\text{and } \lambda_i \geq 0$$

The optimal solution for firm i is the revenue maximizing output vector y_i^*. Then the revenue efficiency is defined in ratio form, RE= $\frac{p_i^T y_i}{p_i^T y_i^*}$ where p_i^T is the transpose of the output price vector for firm i and y_i is the vector of actual output quantities for firm i. The revenue efficiency score can be interpreted as the ratio of actual revenue to maximum possible revenue given output prices and input levels. A score of one indicates that the firm is fully revenue efficient, while inefficient firms have RE between 0 and 1.

6.3 MEASUREMENT OF OUTPUTS AND INPUTS

In this section, we discuss the measurement of the outputs, inputs and their prices used in estimating efficiency.

Outputs and Output Prices

The definition or identification of the outputs produced by the financial institution is critical to the measurement of its performance. Three alternative approaches have been used to define and measure outputs in financial firms: the asset approach, the user cost approach, and the value-added approach. The asset approach considers property-liability insurers as pure financial intermediaries that collect funds from policyholders and intermediate these funds into loans and other assets. However, the asset approach is not optimal to identify the output because property-liability insurers provide many other services in addition to financial intermediation (Berger and Humphrey, 1992; Cummins and Weiss, 2000). The user cost approach involves classifying financial products into output and input categories based on their user costs or signs of their derivatives in a profit function (Hancock, 1985). The user cost approach is not appropriate for the insurance industry because specific data required on product revenues and opportunity costs are not available due to the fact that insurance policies bundle together many services which are implicitly priced. The value-added approach considers all liability and asset categories to have some output characteristics rather than separating inputs from outputs in a mutually exclusive way. The value-added approach is regarded most suitable method to measure insurance outputs among the alternative methods.

We employ a modified version of the value-added approach to define insurance outputs, consistent with most of recent financial institutions efficiency literature (e.g., Berger and Humphrey, 1992; Cummins and Weiss, 2000). Three main services provided by property-liability insurers are specified as a basis of defining outputs.

- Risk-pooling and risk-bearing: Insurance provides a mechanism through which individuals and businesses exposed to losses can engage in risk reduction through pooling. The actuarial, underwriting, claim settlement and related expenses involved in risk pooling and risk bearing constitute a main element of value added in the insurance industry. While pooling reduces uncertainty, unexpected losses may still arise, potentially jeopardizing the insurer's ability to meet its obligations. Thus, insurers recognize the need for holding equity capital that serves as a buffer against unexpected future losses on their portfolios. Holding capital can add value by providing financial security against unexpected underwriting and investment losses.

- Financial Intermediation: Insurance companies are generally viewed as liability-driven financial intermediaries. As corporations issue bonds to raise debt capital, insurers issue debt (premiums) in the form of insurance policies and some of the premiums received from policyholders are invested in financial markets to pay future claims if uncertain event occurs. The net interest margin between the rate of return earned on invested assets and the rate credited to policyholders represent the value added from the intermediation function.

- Real financial services relating to insured losses: Property-liability insurers provide a variety of real services for policyholders including risk surveys, coverage design, and loss prevention and loss reduction services in addition to fundamental indemnification function. By contracting with insurers to provide these services, policyholders can benefit from insurers' expertise in reducing the costs of managing risk. Because transactions flow data such as the number of policies issued and the number of claims settled for each insurer and for each line of business are not publicly available, a number of recent studies proposed the present value of real losses incurred as the most common proxy for output quantity of risk pooling and real insurance services provided by property liability insurers (Berger, Cummins and Weiss, 1997; Cummins, Weiss and Zi, 1999, Cummins and Weiss, 2001, Cummins and Xie, 2005).[30] Losses incurred are defined as the losses that are expected to be paid as insurer obligations for policy claims during a specific period of time. Losses incurred are composed of losses paid during the year, plus loss reserves existing at the end of the year, minus loss reserves existing at the beginning of the year. Insurance is created when individuals pool their resources to protect themselves from the effects of a loss. Pooling is the spreading of losses incurred by the few over the entire group, so the effects of the loss to any individual can be minimized. Because the basic idea of risk pooling is that each policyholder in the group shares a part of the risk by making a payment into a fund and receives compensation from that fund when loss occurs, it is argued that losses incurred provide a good proxy for the risk pooling. Losses are also an appropriate proxy for the quantity of real services provided, since the amount of claims settlement and risk management services are highly correlated with loss aggregates (Cummins and Nini, 2002).

Since lines of coverage provided by property liability insurers have different risks and the payout patterns vary depending on the characteristics of lines of business and

[30] Premiums were employed as the measure of output on the early insurance efficiency research. However, premiums represent revenues (i.e., price times quantity) rather than quantity. Because price differences across firms may result in distortions in performance measures, premiums are not a suitable proxy for output (Yuengert, 1993).

insurers' claims handling procedures, lines of insurance with similar features are grouped together. Four insurance outputs are calculated: present value of real losses incurred in personal property (short-tail) lines, personal liability (long-tail) lines, commercial property (short-tail) lines, and commercial liability (long-tail) lines. The payout tail proportions for each line of business are estimated based on Schedule P of annual statement data using Taylor separation method (Taylor, 2000). Using bootstrap method, U.S. Treasury spot rate (zero rate) curve from the constant maturity treasury yields obtained from the Federal Reserve Economic Data (FRED) database of the Federal Reserve Bank of St. Louis is estimated to calculate loss discounting factors.

Consistent with recent efficiency studies (Cummins and Nini, 2002; Cummins and Xie, 2005), the price of insurance output is obtained based on following formula: $P_i = \frac{PE_i - PV(L_i)}{PV(L_i)}$, where P_i is the price of insurance output i, PE_i is the premiums earned for line i, and $PV(L_i)$ is the present value of losses and loss adjustment expenses incurred of line i, $i = 1,...,4$ for personal short-tail, personal long-tail, commercial short-tail, and commercial long-tail. The present value of losses and loss adjustment expenses incurred is employed to calculate the price of insurance output because premiums reflect implicit discounting to account for insurer's investment of policyholder funds between the premium payment and the loss payment dates. Thus, consistency is preserved by taking into account the time value of money both in the premium and loss elements of the price. A potential problem may exist in using the losses incurred as outputs because losses are random and this random component may distort insurance output. Therefore it is necessary to consider methods to manage the potential "errors in variables" problem. The smoothing procedure is adopted for both incurred losses and output prices.

The average of the beginning and end of year invested assets are used to measure the quantity of the intermediation output. The values of losses incurred and invested assets are deflated to real 2000 values based on the consumer price index (CPI). The price of the intermediation output is obtained from the measure of the expected rate of return on the insurer's invested assets. Interest-bearing assets (mostly bonds and short-term debt instruments) and equities are main components of invested assets for property-liability insurers. Accordingly, the price of the intermediation is the weighted average of expected investment returns, which are equal to the expected return on equities weighted by the proportion of invested assets in equities, plus the expected return on interest-bearing assets weighted by the proportion of the portfolio in this asset type. The expected return on equities is obtained from the average 30-day Treasury bill rate in year t plus the long-term (1926 to the end of the preceding year) average market risk premium on large company stocks from Ibbotson Associates. The method assumes that insurers have equity portfolios with a market beta coefficient of 1.0. Because the expected return on interest-bearing assets is generally close to the actual income return, we use their realized income return to represent the expected rate of return on the debt component of the portfolio. The realized return on interest-bearing assets equals the total net investment income of the insurer, minus dividends on equities, divided by the average amount of interest-bearing assets during the year. Therefore, the price of the intermediation output varies across insurers.

Inputs and Input Prices

Insurance inputs will be represented by a combination of operating expenses and available measures of capital. Insurance inputs are classified into four principal categories: administrative labor (home office labor), agent labor, business services and materials (including physical capital), and financial equity capital.[31] Administration labor and agent labor are treated separately because the two types of labor have different prices and each insurer use them in different proportions. Because insurers do not report publicly detailed information for the quantities of labor (such as the number of employees or hours worked) and materials used, they are imputed from the dollar value of related expenses. The quantity of an input is defined as the current dollar expenditures associated with the particular input divided by its current price.

Current dollar expenditures for administrative labor are obtained from insurers' regulatory annual statements as the sum of salaries, payroll taxes, and employee relations and welfare. The price of administrative labor is calculated from the U.S. Department of Labor data on average weekly wage rates for property-liability insurer Standard Industrial Classification (SIC 6331). The quantity of administrative labor is acquired from the total expenditures divided by its price. Current dollar expenditures for agent labor are the sum of net commissions, brokerage fees and allowances to agents. The price of agent labor comes from the U.S. Labor Department's weekly wage rate for insurance agent (SIC 6411). We use national average weekly wage rate for both administrative and agent labor to reduce missing observations.

The quantity of business services and materials input is imputed from total expenditures and prices. Current dollar expenditures for business services and materials are calculated as the difference of the total expenses incurred from the regulatory annual statement and the total labor expenses of the insurer. The price of business services and materials input is used by a national average price index for business services from U.S. Department of Labor.

[31] Because physical capital such as buildings accounts for only a small fraction of total insurer expenses, we do not define physical capital as a separate input.

Financial equity capital is included as an important input, consistent with the theory of firm and financial institutions efficiency studies (McAllister and McManus, 1993; Berger, Cummins and Weiss, 1997; Hughes and Mester, 1998; and Hughes, Mester and Moon, 2001). Because policyholders are strongly risk-averse with respect to insurer default risk, insurers need to hold equity capital in order to ensure payment against unexpected losses. Financial equity in the insurance company plays a significant role in keeping the probability of bankruptcy low. As insurance prices reflect capital costs, capital levels ultimately affect the revenue and profit of an insurer.

Financial equity capital of a property-liability insurer is defined as the statutory policyholders surplus deflated to real 2000 values by the CPI. The quantity of this input is measured by the real value of the average of the beginning and end-of-year capital level. Although the ideal price of financial equity capital is the market return of equity capital, market equity returns are not observed for most firms in the sample because the majority of insurers are not publicly traded. Following Cummins and Nini (2002), we adopt an approach that assumes a constant cost of equity across all firms in the industry. The price of financial equity capital in the year t is set equal to the average 90-day Treasury bill rate in year t, plus the long-term (1926 to the end of year t-1) average market risk premium on large company stocks from Ibbotson Associates.

CAHPTER 7
DATASET AND DESCRIPTIVE STATISTICS

7.1 DATA AND SAMPLE SELECTION

The empirical analysis is conducted with pooled cross-sectional and time-series data of U.S. property-liability insurers over the sample period 1989-2004. Annual financial statement data are obtained from the National Association of Insurance Commissioners (NAIC). Our initial sample includes all firms in the NAIC database. Insurance companies may structure as an unaffiliated single insurer or as an affiliate of a large insurance group. Because corporate strategies such as M & A decisions and investment strategies are likely performed at the group level (Berger et al. 2000), affiliated insurance companies that belong to the same group are aggregated as one observation unit in our sample. In the case where multiple insurers are grouped as one unit, the values of indicator variable (i.e. organizational structure or distribution systems) on the groups are chosen from the largest insurer in the group based on the size of assets.

This study focuses on mergers and acquisitions in the U.S. property-liability insurance industry. The initial samples involved in M & As are identified through list of Best's Insurance Reports-Property/Casualty. We investigate each of these M &A related insurers through NAIC demographic files to identify insurance company codes and then cross-check the list of M &A related insurers from Best's Insurance Reports against NAIC demographic files. Those M &A related insurers which could not be verified in NAIC demographic files are excluded from the sample. Thus, our final list of M &A involved insurers should exist both in NAIC demographic files and in the Best's Insurance Reports.

Some sample selection criteria are imposed to ensure that insurance firms analyzed are actively engaged in the writing insurance contracts as ongoing concerns, and thus, reported financial data are meaningful measures of insurer price and capital structure. Accordingly, the insurers that report positive values for premiums written, surplus and total admitted assets are included in our initial sample. Because we are unable to estimate values for some key variables such as economic premium ratio for those insurance companies that report non-positive values, they are excluded. Mergers and acquisitions of shell, inactive, or run-off companies are excluded from the sample since the focus of the study is on the viable operating entities. We also omit insurers that were retired, or put into liquidation or receivership at merger and acquisition or within two years thereafter.

We initially identified 538 firms that were involved in mergers and acquisitions during the period, 1990-2003 through a search of Best's Insurance Reports. We first exclude any acquirer that merges with a shell company (44 firms) or with reinsurers (24 firms). Also excluded from the sample were insurers that merge into inactive firms, or put into liquidation within one or two years after M & A (21 firms).[32] Some insurers are involved in multiple M & A transactions within the same year or within two years before or after the transactions. We omit them (53 firms) to prevent double counting in the sample. The 66 firms are eliminated because the company codes of those merging or acquiring firms are not found in the NAIC demographic files. The 51 firms that exhibit negative premiums, negative economic equity, or unusual financial ratios are also excluded because we are unable to estimate the economic premium ratio and calculate Myers-Read capital allocation. We also exclude 82 insurers that have negative outputs and inputs and negative prices in calculating efficiency scores. A total of 190 firms are eventually considered as insurers that pass our sample selection criteria.

[32] For example, some insurers merge into inactive firms in other states even merged firms do not operate with no assets or premiums because acquiring firms may want to move their headquarters to other states.

To analyze insurance prices, we aggregate each insurer's lines of business into four categories: personal property lines of business, personal liability lines of business, commercial property lines of business, and commercial liability lines of business.[33]

We also utilize the NAIC by-line quarterly data (1991-2004) to estimate underwriting returns, which are used to obtain estimates of industry-wide volatilities, and correlation matrix between the asset and liability portfolios. Data for the input prices used to estimate efficiency are obtained from the U.S. Bureau of Labor Statistics. The quarterly time series of returns of asset classes are obtained from the standard rate of return series: Stocks- the total return on the Standard & Poor's 500 stock index; government bond-the Lehman Brothers intermediate term total return; corporate bond-Moody's corporate bond total return; real estate-the National Association of Real Estate Investment Trusts (NAREIT) total return; mortgages-the Merrill Lynch mortgage backed securities total return; and cash and other invested assets-30 day U.S. Treasury bill rate. A.M. Best's ratings and data on the variable measuring market distribution systems are obtained from Best's Key Rating Guide for each year of sample period.

7.2 DESCRIPTIVE STATISTICS

The number of insurers and the economic value of assets of the U.S. property-liability insurance industry for the sample period 1989-2004 are presented in the table1. The number of insurers has remained relatively unvarying even though the insurance industry has experienced a significant wave of merger and acquisition activity. The reason is due to the fact that the numbers of firms that withdraw from the market due to

[33] Personal property lines of business include Homeowners, Farmowners, Earthquake, and Auto Physical Damage. Personal liability line includes Private Passenger Auto Liability. Commercial property lines include Fire, Allied Lines, Commercial Multiple Peril, Mortgage Guaranty, Inland Marine, Financial Guaranty, Group Accident and Health, Credit and Other Accident and Health, Fidelity, Surety, Burglary and Theft, Credit. Commercial liability lines include Medical Malpractice, Other Liability, Product Liability, Workers' Compensation, Ocean Marine, Commercial Auto Liability, Aircraft, Boiler and Machinery, International, Reinsurance.

merger have been partially offset by the formation of new insurers (Cummins, Tennyson, and Weiss, 1999).

The economic value of assets is defined as the book value of total assets minus the book value of stocks, government bonds, and corporate bonds plus the market value of stocks, government bonds, and corporate bonds. Assets such as stocks, government bonds, and corporate bonds are adjusted to market values based on NAIC statutory accounting standards. However, other assets are reported at NAIC annual statement book values. Table1 shows yearly and average values of several asset classes. Government bonds in the industry averages 38.5 percent of total economic assets, whereas stocks and corporate bonds account for 21.3 and 14.6 percent, respectively. Cash and short-term investments tend to be around 7 percent. Other assets including reinsurance recoverable on loss and loss adjustment expense payments, receivable from subsidiaries and affiliates, and agent’s balances or uncollected premiums average around 17.2 percent.

Table2 shows the economic value of liabilities and equity for the U.S. property-liability insurance industry. The reserves for each line of business are adjusted to the present values by discounting the expected future loss cash flows with the estimated U.S. Treasury spot-rate curve. The payout tail proportions for each line of business and for each year of the sample period are estimated based on Schedule P of annual statement data using Taylor separation method (Taylor, 2000). Other liabilities are defined as total liabilities of the industry minus reserves for unpaid loss and loss adjustment expenses of commercial liability, commercial property, personal liability, and personal property after discounting. The commercial liability reserves account for a significant proportion of total unpaid loss reserves. The economic equity is 34.4 percent of total economic assets on average. Notably, the amount of equity capital in the industry has increased from 33.4

percent in 2002 to 36.4 percent in 2004 because insurers may increase holding capital to avoid insolvency risk following a large loss shock such as 9/11.

The industry-wide volatility and correlation matrix that are determined by the quarterly time series of returns of seven asset classes and of the underwriting returns of twelve aggregated insurance lines are estimated as shown in Table3, 4, and 5.[34] Table 3 shows the estimated industry-wide volatility and correlation matrix based on the NAIC quarterly underwriting returns data. Special property (includes earthquake insurance), fidelity and surety, and homeowners insurance lines exhibit the highest volatility. Of the pair-wise correlations between returns of twelve insurance lines, the pairs of medical malpractice and auto liability and the pairs of commercial multiple peril and special property show the highest positive correlations with 85.6 and 64.3 percent, respectively. High correlations between them may be justified since their businesses are similar in nature. The correlation between medical malpractice and special liability is negative 79.5 percent. It can be argued that special liability lines that cover damage to ocean marine or boiler and machinery are less likely to be correlated with medical malpractice line that provides coverage for bodily injuries.

Table 4 displays the correlation matrix for asset and liability portfolios. The returns of stocks have negative correlations with the returns of all loss liability lines, implying that investment in stocks does not provide a hedge against losses in liability lines. However, the returns of government bonds, corporate bonds, and real estate are positively correlated with several important lines of insurance, suggesting that investment in these types of assets provides effective hedges against some losses in liability lines.

[34] Classification of lines of business into 12 is based on Schedule P of the NAIC regulatory annual statement. For example, special property (SP) lines include fire, allied lines, inland marine, earthquake, burglary and theft. Accident, health, financial guaranty (AH) include mortgage and financial guaranty, group accident and health, credit accident and health, other accident and health, and credit insurance. Special liability (SP) includes ocean marine, aircraft, and boiler and machinery insurance. Miscellaneous liability includes international insurance.

In table 5, stocks among asset classes show the highest volatility, 15.8 percent, consistent with common perception. The correlations between asset classes are also presented in table 5. The returns of government bonds and mortgages are strongly positively related each other, 92.5 percent correlations. Insurers may have an incentive to reduce asset portfolio risk by investing both in stocks and government bonds since both stocks and government bonds returns are inversely related each other, with 28.3 percent correlations.

Table6 provides an illustration of Myers-Read insolvency put value and capital allocations for the U.S. property-liability insurance industry. We measure insurer's default risk by the Myers-Read insolvency put value. The default-to-liability ratio is calculated to obtain the insolvency put value. For instance, the average default value of industry during the period 1989-2004 is $28.83 million or 4.67E-05 percent of the present values of industry liabilities. We allocate the economic capital across the four aggregated insurance lines and other liabilities based on the economic values of the assets and liabilities in Table1 and 2, and the estimation of industry-wide volatility and correlations shown in Table3, 4, and 5. The capital-to-liability ratio indicates the marginal capital requirement for each line. In other words, the marginal increase in the present value of losses for the line requires the marginal increase in capital requirement for that line. On average, the capital-to-liability ratio for commercial liability, commercial property, personal liability, and personal property line is 110 percent, 47 percent, 40 percent, and 50 percent, respectively, compared to 19 percent of other liabilities. The right column of Table6 shows that the amount of total economic capital is 100 percent allocated by lines of business.

We use five outputs and four inputs to estimate insurer's efficiency scores. Table 7 shows the summary statistics of inputs, input prices, and expenses over the sample period, 1989-2004 for the groups and unaffiliated companies. Among the insurance inputs, administrative labor represents about 12.1% of total expenses, agent labor represents 23.6%, materials and business services represents 40.4%, and financial equity capital represents approximately 23.9%.

Summary statistics on outputs, output prices and revenues of insurance groups and unaffiliated companies for the period 1989-2004 are presented in Table 8. The quantity of insurance output in the personal lines outweighs the amount in commercial lines. The intermediation output accounts for a considerable proportion of total outputs. The prices of commercial lines are higher than those of personal lines, implying that commercial lines are likely to be more risky and complex than personal lines. Revenues are defined as the products of output quantities and prices. The last section of the table shows the percentage of total revenues attributable to the intermediation function and by line of business. Among them, intermediation output is the largest source of total revenues in the industry, representing about 24.4% of total insurance revenues. Personal short-tail and personal long-tail constitute 23.1% and 16.6% of the total revenues on average, while commercial short-tail and commercial long-tail represent approximately 18.2% and 17.6% of insurance revenues.

Table10 and 11 report summary statistics on the economic premium ratio, firm performance, marginal capital allocation by lines of business, efficiency scores and financial and operating characteristics for all the insurers in the sample and acquiring insurers, respectively. On average, the economic premium ratios (EPR) in the personal property and commercial property line for the entire sample of insurers is higher than those for acquiring insurers, whereas the EPR of personal liability and commercial liability lines for all insurers is lower than those for acquirers. Acquirers have higher ROA (return on asset) than the entire sample of insurers (0.045 versus 0.034) while ROE (return on equity) of all insurers are higher than the ROE of acquirers (0.066 versus0.054). Acquiring insurers have higher underwriting performance than all insurers across all lines except commercial property line, indicating that acquiring firms have higher loss ratio and underwriting expense ratio than all insurers.

The average of overall firm capital-liability ratio for acquirers is lower than that of non-acquirers from 0.715 to 0.842. Notably, marginal capital requirements (line capital-to-liability ratio) and relative marginal capital allocation for all insurers are higher than those of acquirers across all lines except the commercial liability line. Acquirers exhibit higher portfolio risk than all insurers on average (14.2% versus 12.9%). Acquiring insurers are more cost efficient than all insurers while all insurers are more revenue efficient than acquirers. Acquiring insurers are more diversified over product lines and geographical areas than all insurers, as measured by Herfindahl indices, based on premium written across all lines and 51 states, respectively.

The size of acquiring firms is on average much larger than those of all insurers with mean assets of $1.8 billion for acquirers versus $632 million for all insurers. Table10 and 11 also demonstrates that underwriting leverage measured by premium written relative to firm overall equity capital for all insurers is higher than acquirers (1.275 versus 1.228). 40.6% of acquirers are mutual insurers, compared to 38.7% for all insurers. Only 22.6% of acquirers are unaffiliated single firms, compared to 57.5% for all insurers and 69% of acquirers have independent marketing systems, compared to 61.2% for all insurers. On average, acquirers have higher A.M. Best’s ratings than all insurers.

CAHPTER 8
INSURANCE PRICE ANALYSIS

We begin by discussing the estimation of the price of insurance. Next, we specify regression methodology that enables us to test hypotheses developed in the previous chapter. We also define explanatory variables and discuss expected relationship between dependent and explanatory variables and then present the results.

8.1. THE ESTIMATION OF PRICE OF INSURANCE

We use the economic premium ratio as the price of insurance following the insurance literature (e.g., Cummins and Danzon, 1997; Phillips et al., 1998, and Cummins et al., 2005). The economic premium ratio for a line of insurance is defined as premiums written for the line net of dividends to policyholders and underwriting expenses divided by the present value of losses and loss adjustment expenses incurred. More precisely, the economic premium ratio is as follows:

$$EPR_{i,t} = \frac{NPW_{i,t} - DIV_{i,t} - EXP_{i,t}}{(NLI_{i,t} + LAE_{i,t}) \text{ x } PVF_{i,t}} \tag{21}$$

where $EPR_{i,t}$ = the economic premium ratio for line i, in year t

$NPW_{i,t}$ = net premium written for line i, in year t

$DIV_{i,t}$ = dividends to policyholders incurred for line i, in year t

$EXP_{i,t}$ =underwriting expense incurred for line i, in year t

$NLI_{i,t}$ =net loss incurred for line i, in year t

$LAE_{i,t}$ =net loss adjustment expense incurred for line i, in year t

$PVF_{i,t}$ = present value factor for line i, in year t

$PVF = \sum_{t=1}^{T} w_t \left(\frac{1}{1+r_t}\right)^t$ where w_t represents the proportion of losses and loss adjustment paid at time t with assumption of $0 < w_t \leq 1$, and $\sum w_t = 1$. r_t is U.S Treasury spot rate at time t and T represents the number of periods in the payout tail.

We assume premiums are paid at the beginning of the year and the losses and loss adjustment expenses are paid at the end of the time period. Premiums are measured net of dividends to policyholders and underwriting expenses because the purpose is focusing on the part of premiums that reimburse the insurer for bearing risks (Cummins et al., 2005). The cost of acquiring and underwriting both new and renewal insurance business is a substantial element of expenses for most property-liability insurers and also varies significantly across lines of business. The underwriting expense includes commissions to agents that are generally the largest portion of underwriting expenses.

Losses and loss adjustment expenses incurred are discounted based on two present value factors: (1) the pattern of loss and loss adjustment expense payment, and (2) the discount interest rate. The pattern of loss payment (payout tail) depends on the characteristics of lines of business that insurer writes and its claims handling procedures. For example, the losses of short-tail lines such as property insurance are fully developed or ultimately paid in one or two years. Long-tail liability claims such as auto liabilities are fully developed in three to five years, while medical malpractice and workers compensation may develop for ten years or longer. The payout tail proportions for each line of business and for each year of the sample period are estimated based on Schedule P of annual statement data using Taylor separation method (Taylor, 2000).

We also estimate U.S. Treasury spot rate (zero rate) curve from the constant maturity treasury data using bootstrap method. The present value factor for each year is calculated by summing up the estimated payout tail proportions divided by the estimated zero curves for the number of periods in the payout tail. Thus, the present value of losses and loss adjustment expenses incurred is obtained by multiplying the total losses and loss adjustment expenses by the present value factor. The economic premium is calculated separately for each insurer and for each year of the sample period. The present value factor calculated for each line and each year are shown in Figure 1. Figure 1 presents that the commercial liability lines are more heavily discounted than the personal property lines over the sample period, consistent with the view that commercial lines develop longer than short-tail lines.

8.2. REGRESSION METHODOLOGY

We conduct regressions using a series of pooled, cross-sectional, and time-series data to test hypotheses developed in Chapter 4. We also examine several exogenous factors that affect the insurers' price differences across lines of business. One-way and two-way fixed effects model regressions are conducted to control for unobserved heterogeneity problems. The regressions are based on the unbalanced panel data to maximize the number of observations included in the analysis and to avoid survivor bias. The estimated regression model has the following specifications:

$$EPR_{ikt} = \alpha_0 + \alpha_1 MA_{kt} + \alpha_2 MCA_{ikt} + \alpha_3 Cost_{kt} + \alpha_4 Share_{kt} + \alpha_5 IPV_{kt} + \alpha_6 GeoHHI_{kt} + \alpha_7 ProdHHI_{kt} + \gamma' X_{kt} + d_t + f_k + \varepsilon_{ikt} \quad (22)$$

where EPR_{ikt} = the economic premium ratio charged at time t by insurer k for line i

MA_{kt} = indicator variable equal to 1 in t+1, t+2, and t+3 years after M & A if the insurer is an acquiring firm, and otherwise is zero.[35]

MCA_{ikt} = the marginal capital allocated-to-liability ratio for line i, and insurer k in year t

$Cost_{kt}$ = cost efficiency score for insurer k, in year t

$Share_{kt}$ = market share for insurer k, in year t

IPV_{kt} = the insolvency put value-to-liability ratio for insurer k, in year t

$GeoHHI_{kt}$ =Geographical Herfindahl for insurer k, in year t

$ProdHHI_{kt}$ =Product line Herfindahl for insurer k, in year t

[35] t+1 indicates one year after M & A transaction, t+2 is two years after M & A, and t+3 is three years after M & A .

X_{kt} = a vector of firm characteristics for insurer k, in year t

d_t = a vector of time fixed-effects

f_k = a vector of firm fixed-effects

ε_{ikt} = error term for insurer k, in year t

The dependent variable in our analysis is the economic premium ratio across different lines of business. Similar to Sapienza (2002), we use the indicator variable, MA_{kt} to examine the insurance price change of acquiring firms before and after M & A. A positive (negative) value for α_1 indicates that insurance price of acquiring insurers increases (decreases) following M & A.

Following Cummins, Lin, Phillips (2006), the marginal capital allocated-to-liability ratio is included as the explanatory variable in the regression to test the hypothesis that the marginal capital allocated across lines are reflected in the line-by-line price differences. As the amount of capital allocated to specific lines increase, insurance price that reflects increased capital cost will go up. Thus, we expect positive relationship between the insurance price and marginal capital allocation across lines of business.

To examine whether efficiency structure (ES) hypothesis is valid, we incorporate cost efficiency measure into the regression model. The negative sign for cost efficiency is expected under the ES hypothesis. The variable of market share is included to control for the market power hypothesis. Market share is defined as the proportion of total premiums accounted for by insurer k, in year t. If the market power hypothesis holds, we predict positive coefficient for market share.

To control for firm insolvency risk, we include the insolvency put value-to-liability ratio, calculated from Myers-Read (2001) methodology. We predict insurance prices are inversely related to the insolvency put values, consistent with Phillips et al. (1998), Zanjani (2002), and Cummins et al. (2006). As an alternative measure of insurer financial strength, A. M. Best's ratings for the firms are included in the regressions. Insurers that have higher A. M. Best ratings are expected to charge higher prices.

Geographical and product line Herfindahl index are included as explanatory variables in the regression equation to test the hypothesis that diversified insurers charge lower prices due to the risk diversification benefits. Product line Herfindahl index is calculated by the sum of the squares of the percentages of direct premium written across all lines of business for each insurer. An insurer that focuses on writing only one or a few lines of business has a higher Herfindahl index, whereas a firm that offers a wider range of product lines has a lower Herfindahl index, indicating higher diversification. Geographic Herfindahl index is measured based on direct premiums written across 51 states. If geographic diversification or adding more lines of business that coinsure each other tend to reduce the capital requirements of acquiring insurer, more diversified insurers will charge lower prices. Thus, we expect that both geographic and product line Herfindahl index are positively related to the insurance price.

Other firm characteristics are also expected to affect the price of property-liability insurance. The natural log of firm assets is used as a proxy for firm size. The expected sign on this variable is ambiguous a prior. Because large firms tend to have lower insolvency risk and are safer than smaller firms, risk-averse policyholders are likely to pay higher prices for large insurers. We expect a positive relationship between firm size and the price of insurance. On the other hand, a negative relationship between firm size and the price of insurance is predicted. Since large firms are likely to be more diversified and better accessible to capital markets than smaller firms, large firms should require relatively lower capital to achieve a given level of insolvency risk and thus may demand lower price.

We include the ownership form variable, set equal to one for mutual firms and to zero for stock firms. Mutual firms eliminate the owner-policyholder conflict because policyholders are both customers and owners. However, benefits from control of owner-policyholder conflict are offset by less efficient control of owner-manager conflict (Mayers and Smith, 2001). The owner-manager conflict is more severe for mutual insurers than for stock firms since mutual managers are not well monitored in capital markets as compared to mangers of stock insurers. Because cost of controlling management in mutual insurer is greater than in stock firms, mutual insurers should be more prevalent in lines of insurance where lower managerial discretion is required. In other words, mutual insurers have a comparative advantage in writing business lines with less underwriting risk, requiring less capitalization. Thus, the expected sign on this variable is negative.

A dummy variable is included, equal to one if the firm is an unaffiliated single company and zero otherwise. The managers of an unaffiliated company are likely to be more risk averse because group insurers may be able to diversify underwriting risk across member companies in a more efficient manner than unaffiliated single firms. Because an unaffiliated company tends to engage in less risky activities to avoid insolvency risk and may hold more capital, the expected sign on this variable is positive. A dummy variable equal to one if the insurer is licensed in New York and zero otherwise is used to proxy for regulatory restrictions. If regulatory restrictions function to depress insurance price, the predicted sign on this variable is negative. To control for the insurance industry's underwriting cycle, we use year dummy variables with 1989 as the base year.

8.3. RESULTS

The regression results are presented in Table 12, 13, 14, and 15. Four lines of business are estimated separately: personal property, personal liability, commercial property, and commercial liability lines of business. Several variants of the model are estimated with different variables included and with the time and firm fixed effects included and excluded.

The results generally provide support for the hypothesis that the price of insurance for newly formed insurers decreases following the M & As. The coefficients for MA_{kt} are negative and statistically significant across all models in personal property line and in the year fixed and firm fixed effects model of personal liability line, indicating that insurance price changes are negatively correlated with M & A activity in these lines. However, indicator variables for MA_{kt} are not significant in commercial property and liability lines.

The regressions shown in Table 12, 13, 14, and 15 provide the results of testing three specific hypotheses (capital allocation, efficient-structure, and market power hypothesis). The results provide strong support for the capital allocation theory that variations in prices by lines of business are directly related to corresponding variations of marginal capital allocation. The coefficients of marginal capital allocation (line capital-to-liability ratio) are positive and statistically significant in the personal property (models 1, 3, 4, and 5), personal liability line (model 1), commercial property line (models1, 3, and 4), and commercial liability lines (across all models), implying that insurance lines that hold more capital charge higher prices. The result is consistent with the findings of Cummins, Lin, Phillips (2006).

The price of insurance is inversely related to cost efficiency in all lines except for the commercial liability line. This relationship is significant at the 1 percent level and thus strongly supports the efficiency structure hypothesis. The coefficient for market share is negative and significant at the 10 percent level only in the OLS models of personal property line and is not significant generally across other lines of business. The negative and/ or insignificant signs for the market share variable indicate that market power hypothesis is not valid with our sample data. If market power is the driving force behind mergers and acquisitions, it is predicted that M & As result in increased market power, leading in turn to price changes that are not beneficial to consumers. This reasoning is particularly true when the merging firms are direct competitors and their combination results in a substantial increase in market concentration within specified geographical or product markets (e.g., Shepherd, 1982). However, the market power theory overlooks the possibility of entry. If combined firm increases price to a more profitable level, this may attract other insurers to enter the market. The firm will eventually lose both its market share to other rivals and ability to control the price. The only way the dominant firm could maintain the high price and profits would be by colluding with its rivals to form a cartel. The formation of cartels through takeovers can not be achieved as a result of U.S. antitrust legislation, which precludes excessive increases in market power by regulating M & A activity. Another possible explanation for the negative relationship between market share and insurance price is that if insurer's motivation is to gain market share through M & As, consolidated insurers may try to attract more customers by decreasing prices.

The coefficients of geographical and product line Herfindahl index are positive and significant across all lines of business with the exception of product line Herfindahl index in the commercial liability line. The positive signs on both Herfindahl index strongly support the hypothesis that diversified insurers that may have lower overall capital costs due to the effect of risk diversification charge lower prices than less diversified insurers. The result is also consistent with Myer-Read' propositions that diversification by adding more new lines and geographical areas that have low covariability with the insurer's current loss portfolio or high covariability of loss portfolio with asset portfolio leads to more efficient use of capital, resulting in lower prices.

The signs of other control variables are generally consistent with the predictions. The coefficients of firm insolvency put value are negative and statistically significant across all lines, suggesting that lower capitalization is related to higher insolvency risk, resulting in lower prices. Our result is consistent with the findings of Cummins and Danzon(1997), Phillips, Cummins and Allen(1998), and Cummins, Lin, Phillips (2006). The regressions that include A. M. Best's ratings instead of firm insolvency put value also provide evidence that the price of insurance is inversely related to firm insolvency risk. Similar to Cummins, Lin, Phillips (2006), three indicator variables-set equal to one for insurers with Best's ratings of A or A-, B++ or B+, and B or lower, respectively, and set equal to zero otherwise-are used as an alternative measure of insurer financial strength. Insurers with Best's ratings of A++ or A+ are omitted as a reference group to avoid multicollinearity. The coefficients of the Best's rating are negative and significant across all lines, suggesting that safer firms charge higher prices. The results also show that the magnitude of the coefficients of Best's ratings become monotonically smaller as the Best's ratings move down, implying that progressively lower ratings are related to higher firm insolvency risk.

Firm size is positive and statistically significant only in personal property line, as expected if larger firms have lower insolvency risk and are safer than smaller firm. Other possible explanations for why larger firms demand higher prices may be due to brand name recognition by consumers. However, firm size is significant and inversely related to insurance price in other lines. Recall that the expected signs for firm size variables were indeterminate. The possible explanation for the negative sign is that large firms require relatively lower capital to achieve a given level of insolvency because large firms tend to be more diversified and to have better access to capital markets than smaller firms and thus may demand lower price.

The coefficient of mutual is negative and significant in personal property and commercial property line, as predicted if mutual insurers have a comparative advantage in writing business lines where lower managerial discretion is required, requiring less capitalization and demanding lower prices. However, the mutual variable is significant and positively related to insurance prices in the commercial liability line where greater managerial discretion is required, implying that greater owner-manager agency costs exceed any benefits associated with the reduction in owner-policyholder agency costs; therefore, the higher cost of controlling management leads to higher insurance prices.

The dummy variable for unaffiliated firm is positive and significant in all lines of business, consistent with expectation that unaffiliated firms charge higher prices if an unaffiliated company tends to engage in less risky activities to avoid insolvency risk and thus may hold more capital than diversified firms. A New York dummy variable is significantly inversely related to insurance price, suggesting that strict regulations lead to price reduction, which is favorable for consumers.

CAHPTER 9
EFFICIENCY ANALYSIS

This chapter specifies the empirical model used to test the hypotheses developed in the chapter 4 and then define the variables to be used in the estimation. We also present efficiency regression results in this chapter.

9.1 REGRESSION METHODOLOGY

In order to test our hypothesis that the efficiency of acquiring insurers is likely to decrease following M & A, we conduct regressions using a series of pooled, cross-sectional, and time-series data. Because the characteristics of firms' exogenous variables may affect the differences in efficiency scores between before and after M & A, we also examine several exogenous factors that determine insurer's efficiency. We analyze the relationship between efficiency scores and firm characteristics using unbalanced panel data to avoid survivor bias and to maximize the number of observations included in the analysis. We control for some types of unobserved heterogeneity problems by employing one-way and two-way fixed effects models because the estimates of coefficients derived from OLS regression may be biased if there is some unknown variable or variables that cannot be controlled for that affect the dependent variable (Kennedy, 2003 and Greene 2003).[36] With panel data, the functional form of two-way fixed effects model is as follows:

$$Y_{it} = \beta_0 + \beta_1 MA_{it} + \beta' X_{it} + d_t + f_i + v_{it} \tag{23}$$

where i indexes firms and t represents year. The dependent variables of regression, Y_{it}, are five different efficiency scores (cost, revenue, pure technical, scale, and allocative efficiency scores). The indicator variable, MA_{it}, is equal to one in t+1, t+2, and t+3 years after M & A if the insurer is an acquiring firm, and zero otherwise is used to examine the

[36] The Hausman testing shows that these models fit better to the data.

relationship between M & A activity and insurers' efficiency.[37] X_{it} is a vector of control variables described below. β_0 is the estimated intercept terms; β_1 and β' are the estimated parameters. d_t is a vector of time fixed-effect and f_i is a vector of firm fixed-effects. v_{it} is error term. Similar to Sapienza (2002), we include non-M & A involved firms as a control group in the regression to control for economy-wide factors and changes in the regulatory framework that influence firm efficiency change. The MA_{it} indicator for these firms is always equal to zero.

Firm characteristics that may be systematically related to efficiency change are incorporated as explanatory variables in the regression. The natural logarithm of total assets is included to control for firm size. We control for insurer's business mix by including the percent of losses incurred in personal property lines, the percent of losses incurred in personal liability lines, the percent of losses incurred in commercial liability lines.[38] Geographical and product line Herfindahl indices are included as explanatory variables in the regression equation to control for the effects of diversification.

Geographic Herfindahl index is defined as the sum of the squares of the percentages of premium written by state for each insurer. Geographic Herfindahl index is measured based on direct premiums written across 51 states. A firm with a high geographic Herfindahl index has a significant portion of its business concentrated in one or a few states, whereas firms with lower Herfindahl index are likely to be more geographically diversified. Product line diversification is measured using a Herfindahl index of direct premiums written across all lines of business. Lower Herfindahl indices imply higher diversification. The expected signs of Herfindahl indices are ambiguous a prior. Geographical and product line Herfindahl indices are predicted to have a positive

[37] It is argued that the gestation period of restructuring following a merger can be as long as three years (Berger et al. 1998).
[38] The percent of losses incurred in commercial property lines is omitted as the reference category.

sign if diversification benefits are offset by the additional costs associated with agency conflicts and administrative problems arising from operating multiple lines and states. On the other hand, geographical and product line Herfindahl indices could have a negative sign if consolidated firms are more efficient by offering multiple lines of business, either due to the benefits of risk diversification or revenue scope economies with customers who are willing pay higher prices for “one-stop shopping.”

The ratio of net premium written to policyholders’ surplus is included in the regression to control for the effects of underwriting leverage on efficiency change. To control for company’s ability to meet its anticipated short- and long-term obligations to policyholders and other creditors without having to resort to selling long-term investments or affiliated assets, liquidity ratio measured by the proportion of liabilities covered by cash and investments that can be quickly converted to cash is included.

We control for efficiency variation that is induced by different distribution systems. The property-liability insurance is distributed by a variety of distribution systems: insurance contracts are sold through direct writers, independent agents, brokers and mixed systems. Direct writing includes exclusive agents and insurer employees. An exclusive agent represents a single insurer, but is not technically insurer’s employee. An independent agent represents more than one insurer. A broker represents the customer, negotiates with multiple insurers and tends to focus more on the commercial lines of business for larger-scale customers. These systems have coexisted in insurance markets for many decades, despite evidence that independent agency-insurers have higher costs than direct writers. Previous empirical studies find that independent agency insurers have higher expense margins than exclusive dealing insurers (e.g., Barrese and Nelson, 1992; Kim, Mayes, and Smith 1996) and thus may be considered less efficient in delivering products to consumers. In contrast, according to the product-quality hypothesis, the higher costs of independent-agency insurers are associated with producing higher-quality product or service differences. The product-quality hypothesis implies that independent agency insurers are compensated by higher revenues, with customers who are willing to pay higher prices for greater service intensity and the reduced search costs (Kim, Mayes, and Smith 1996; Regan and Tennyson, 1996). Berger, Cummins and Weiss (1997) provide evidence supporting for the product-quality hypothesis. They estimate both cost and profit efficiency for independent-agency and direct-writing insurers using econometric efficiency methods. Berger, Cummins and Weiss (1997) find that independent-agency and direct-writing insurers generate almost the same profitability for delivering the same mix and quantity of outputs and are approximately equal in revenue and profit efficiency. Their empirical results support the view that independent-agency insurers are less cost efficient on average than direct-writing insurers.

We revisit the issue of the coexistence of multiple distribution systems for insurance industry by breaking them into direct writing, independent agency, brokerage, and mixed distribution using more recent data.[39] Independent agency is omitted in the regression as a reference category. We predict that insurers with direct writing distribution systems are more efficient than insurers using independent agents because direct writing insurers can easily recognize cost savings by advanced technology and automated customer database. In addition, insurers using independent sales agents pay a greater proportion of commissions for their role in risk assessment and renewals of policies, especially where insurance products are complicated and risks are heterogeneous, and thus agent information is a valuable supplement to standardized underwriting inputs. Because the broker is the legal agent of the customer and not the insurer, insurance firms with brokerage distribution systems are even less vertically

[39] Mixed distribution includes using both independent agency and direct writing or using both brokerage and direct writing.

integrated. Insurers using brokerage are likely to be more efficient than other independent agency insurers because brokers are generally larger than independent agencies, offer a wider array of services to more sophisticated clients, and have advantages over independent agent in more complex lines.

We include dummy variables equal to one for mutual firms and zero for stock insurers to control for organizational form. An indicator variable equal to one for unaffiliated insurers and zero for groups is also used. Regulatory restrictions may increase insurer costs in the form of conservative reserving standards or minimum levels of capital requirements and thus contribute to firm cost and revenue efficiency. The state of New York is generally recognized as the state that has the most rigid insurance regulations in the United States (Sommer, 1996). A dummy variable equal to one if the insurer is licensed in New York and zero otherwise is used to proxy for regulatory restrictions.

9.2 REGRESSION RESULTS

The regression results using each of the estimation techniques are presented in Tables 16 and 17. Model 1 (or year) indicates one-way fixed effects regression, which controls for time-specific effects that are not otherwise controlled for by other variables, while model 2 (or year+firm) controls for both time and company fixed effects.[40] F statistic is presented for all regressions to investigate whether there is company and time fixed effects. The large F statistic rejects the null hypothesis in favor of the fixed effect model ($p<.0000$).[41]

We conduct overall regressions for cost and revenue efficiency and analyze the decomposition of cost efficiency by also conducting regressions where the dependent

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[40] We also estimated regressions using one-way and two-way random effects model. The results of random effect models are consistent with those of the fixed-effect models.

[41] The null hypothesis is that parameters of company and time dummies are zero: $H_0 = \mu_1 = ... = \mu_{n-1} = 0$ and $\tau_1 = ... = \tau_{T-1} = 0$.

variables are pure technical, scale, and allocative efficiency, respectively. Although technical and allocative efficiency provide important indicators, the discussion is mainly focused on the cost and revenue efficiency regressions because they determine the profitability of firms and provide the best measures of overall firm performance.

The regressions, shown in Table 16, reveal significant differences in cost and revenue efficiency of acquiring firms between before and after M & A. The coefficients on MA_{it} in both cost and revenue efficiency are negative and significant, supporting the hypothesis that acquiring firms experience significantly larger losses in cost and revenue efficiency after M & A. This result suggests that expansion of the firm through M & As has the potential to create inefficiencies. As firms become larger and more complex, diversification benefits are offset by the additional costs. Administrating and operating over wider geographical areas and integration of different information systems can lead to higher costs. Bonding different organizations have more potential to create managerial conflict and agency costs since managerial monitoring becomes more difficult.

The signs of explanatory variables are generally consistent with theoretical predictions. The coefficients estimated on firm size are positive and significant in all types of efficiency, with the exception of scale efficiency, indicating that larger firms tend to experience more efficiency than smaller firms. This result is consistent with prior findings (Cummins and Zi, 1998). However, firm size is negatively related to scale efficiency. A possible explanation for this result is that as Cummins and Xie (2005) find that the majority of firms above median size are operating with decreasing returns to scale, firms with DRS may not attain scale efficiency.

We document a significant and positive relationship between the percentage of loss incurred in both personal property and personal liability lines and cost efficiency. Thus, it appears that insurers with a higher proportion of business in personal property and personal liability lines obtain greater cost efficiency than those with more business in commercial property lines, suggesting that types of business and their combination has an important role in improving insurer's efficiency.[42] This result is consistent with Cummins and Xie (2005). Surprisingly, the percentage of loss incurred in commercial liability lines are inversely related to cost efficiency, indicating that firms with emphasizing commercial liability lines are likely to create cost inefficiency. As shown in Table 17, the decomposition regression shows that the primary source of cost efficiency gains in personal property and personal liability lines is pure technical efficiency, suggesting that automated systems are more advantageous in the personal lines. Because long-tail commercial liability lines such as medical malpractice and workers compensation are more complex and the pattern of loss payment are more uncertain, allocating resources and adopting new technology and marketing systems are relatively difficult in commercial liability lines.

The percentage of loss incurred in personal property lines and personal liability lines is significantly negatively related to revenue efficiency. Thus, firms with a higher proportion of business in personal lines are less advantageous in output-oriented revenue efficiency. The negative relation may be induced by the fact that personal property lines that include homeowners and earthquake insurance are highly exposed to catastrophic property risks from hurricanes and earthquakes. In addition, because personal liability lines such as primary personal auto liability is written as a compulsory insurance along with auto physical damage, it may be more difficult to choose optimal output combinations to maximize revenue efficiency.

The coefficient on the geographical Herfindahl index is positive and significant in both cost and revenue efficiency, supporting the pro-focus arguments that geographically

[42] To investigate whether our results are robust to a different measure of business mix, we repeat our regression analysis using the percentage of premiums written in personal property lines, personal liability lines, and commercial liability lines and observe similar results.

focused insurers are able to achieve greater cost and revenue efficiency than geographically diversified insurers. This result implies that potential benefits from risk diversification are likely to be offset by the extra costs associated with greater managerial discretion, inefficient allocation of resource, and additional administrative and regulatory issues that are required to deal with when operating across different states. The product line Herfindahl index is significant and positively related to cost efficiency. However it is not significant in revenue efficiency. The product line Herfindahl index is negative and significant as related to allocative efficiency, consistent with pro-conglomeration arguments that diversified insurers are more advantageous in choosing cost minimizing combinations of inputs than focused insurers.

The underwriting leverage measured as premium revenues net of reinsurance transactions relative to policyholders' surplus is significant and positively related to cost and revenue efficiency. The net premium-to-surplus ratio is inversely related to the capacity of an insurer to write additional business because new policies generate liabilities, which must be supported by surplus due to regulatory accounting rules. The positive relationship between cost efficiency and underwriting leverage ratio is primarily attributable to pure technical efficiency, which offsets a negative effect of allocative efficiency, implying that insurers with higher premium-to-surplus ratios employ less capital input relative to premium revenues. The liquidity ratio calculated by dividing liquid assets (cash and marketable securities) by total liabilities is significantly negatively related to all types of efficiency. A high degree of liquidity enables an insurer to meet unexpected financial needs without the untimely sale of investments or fixed assets, which may result in substantial realized losses due to temporary market conditions or tax consequences. The negative sign on this variable suggests that firms with higher liquidity ratio to meet financial obligations to pay off reserves by holding cash and quickly convertible investments have lower cost and revenue efficiency.

As predicted, the coefficient on the direct marketing indicator variable is significantly positive in both cost and revenue efficiency. This results support the hypothesis that direct marketing distributions are more cost and revenue efficient than independent agency distributions. This result is contrary to the finding of Berger, Cummins, and Weiss (1997) who provide evidence that there is no difference in revenue efficiency between direct writing and independent agency. The regression results also show that brokers are more cost efficient than independent agents, but indicator variable for mixed distribution is not significant in cost efficiency. The advantage of direct marketing and brokerage over independent agency is mostly attributable to pure technical efficiency which also offset the negative effect of allocative efficiency. We also find that mixed distribution is more revenue efficient than independent agency distribution.

Mutual variable has a positive and significant coefficient in cost efficiency, as predicted if mutual insurers have a comparative advantage in writing less complex business lines where lower managerial discretion is required, requiring fewer inputs. There is no significant difference in revenue efficiency between mutual firms and stock firms. The unaffiliated single firms are significantly positively related to all type of efficiency, with the exception of allocative efficiency. Group insurers may be able to diversify risks across member companies, whereas unaffiliated single firm may not have diversification opportunities. Thus, managers of an unaffiliated company are likely to be more risk averse and may have more incentive to minimize costs and maximize revenues than those of stock firms. The negative sign on allocative efficiency may indicate that less resource allocation is conducted at an unaffiliated company level. The coefficient on firms licensed in New York is significant and negative, suggesting that stricter regulation leads to cost and revenue inefficiencies, perhaps due to the imposition of regulatory costs.

CAHPTER 10
FIRM PERFORMANCE ANALYSIS

In this chapter, we discuss our regression methodology for the analysis of firm performance and then present estimation results.

10.1 REGRESSION SPECIFICATION

To further examine the relationship between M & A activity and financial performance and to explore the differences in performance across lines of insurance, we conduct a panel data regression with a series of pooled, cross sectional, time-series data. We control for unobserved heterogeneity using time and company fixed effect model. In addition to the fixed effects model, other estimation techniques are also utilized for robustness of estimation results. We also investigate several factors that affect insurers' performance by including firm and industry characteristics as explanatory variables.

We use return on assets (ROA) and return on equity (ROE) as dependent variables to measure insurer performance.[43] ROA and ROE are widely used in diversification-performance literature (e.g., Browne et al., 2001; Greene and Segal, 2004). ROA is defined as net income after policyholder dividend but before taxes divided by total assets and ROE is the ratio of net income after policyholder dividend but before taxes to insurer's equity capital.[44]

A revenue efficiency variable is included as an explanatory variable based on the hypothesis that revenue efficient firms tend to have higher returns because they dissipate less of their potential revenues due to inefficiency than do inefficient firms. Because revenue efficiency variable is expected to be jointly determined with the dependent

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[43] Finance literatures use Tobin's Q to proxy for firm performance. Tobin's Q is the ratio of the market value of a firm's financial claims to the replacement value of its assets. We can not estimate Tobin's Q because very few insurers are publicly-traded at the subsidiary level.

[44] We also used ROA and ROE before policyholder dividends and taxes and after dividends and taxes. Both support the same conclusions regarding the effects of M & A on firm performance.

variable (ROA and ROE), OLS estimation model would result in inconsistent parameter estimates. The most common test for endogeneity is the Hausman(1978) method (Wooldridge, 2002). If Hauman test rejects the null hypothesis that revenue efficiency variable is exogenous, this implies that the feedback effects between insurer performance and revenue efficiency are significant. To correct for this endogeneity, we employ two-stage least squares methods using instrumental variables. Thus, the specific empirical model with endogeneous variable is:

$$\Psi_{kt} = \beta_0 + \beta_1 MA_{kt} + \beta' X_{kt} + \delta \hat{I}_{kt} + \varepsilon_{kt}$$

$$I_{kt} = \pi_0 + \pi' Z_{kt} + \nu_{kt} \qquad (24)$$

Where k indexes firms and t indexes the time periods. The dependent variable Ψ_{kt} is firm k's performance measures. X_{kt} is a vector of control variables. $\hat{I}_{kt}$ is the predicted revenue efficiency values from a first-state regression. I_{kt} is a true revenue efficiency value. Z_{kt} is a vector of instrumental variables. β_0 and π_0 are the estimated intercept terms. β_1, β', δ, and π' are the estimated parameter vectors. ε_{kt} and v_{kt} are error terms. To test whether M & As improve firm performance also included in the performance regression is an indicator variable (MA_{it}) equal to 1 in t+1, t+2, and t+3 years after M & A if the insurer is an acquiring firm, and zero otherwise.

Instrumental variables used in the first-stage regression should satisfy two conditions. First, the instrumental variables must be highly correlated with revenue efficiency, and second, they must be uncorrelated with firm performance measures. The commonly suggested instrumental variables consist of lagged or historically averaged measures of firm characteristics, industry growth, and general economic growth (e.g., Campa and Keida, 2002). Accordingly, the instrumental variables that are relatively uncorrelated with ROA and ROE but correlated with revenue efficiency include average firm size for the prior five years, five-year average percentage of premium written in personal property lines, five-year average percentage of premium written in personal liability lines and five-year average percentage of premium written in commercial property lines, as well as lagged revenue efficiency scores.

Because insurer's profitability is influenced by both underwriting results and investment returns, we also consider underwriting performance as an alternative performance measure. The underwriting performance measured by combined ratio in each line is regressed on firm characteristics to examine the effect of M & A on line by line performance change. The combined ratio is calculated by the sum of loss ratio (incurred loss/premium earned)[45] and expense ratio (underwriting expense/net premium written).[46]

Firm characteristic variables employed in the preceding efficiency regression are also included as control variables in the main regression. We use the natural logarithm of assets as a measure for firm size. We expect firm size to be positively related to firm performance since larger firms are likely to have lower insolvency risk and greater potential to gain revenue scope economies. Revenue scope economies may be realized due to firm-specific intangible assets such as brand reputation recognized by customers. The ratio of equity capital to total assets is included to control for the effects of capitalization on firm performance. The predicted sign on this variable is positive since firms will be rewarded from safety benefits of holding the additional capital.

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[45] Earned premium is determined by insurance pricing and reporting convention that combines revenues from policies priced in the current period as well as policies priced in earlier periods. Thus, if policies cover one-year periods, earned premium for year t, EP_t, will be a weighted average of prices from years t and t-1(P_t and P_{t-1}). In particular, $EP_t = (1-\alpha_t) P_t + \alpha_t P_{t-1}$, where α_t, the weight for policies priced in year $t-1$, is the fraction of policies sold in t-1 that were unexpired at the beginning of period t.
Incurred loss can be written as the sum of three variables: unexpected payments during year t for premiums earned prior to t, revisions to outstanding liabilities for premiums earned prior to year t, and estimated liabilities for premiums earned in period t. The first two components reflect differences between expected payments and actual payments.

[46] Underwriting expenses include commission and brokerage expenses incurred, licenses and fees incurred, administrative expense incurred, and other acquisition, field supervision and collection expenses incurred (Insurance expense exhibit Part II of NAIC annual statement).

The predicted sign on some explanatory variables is ambiguous a prior. To capture the effect of M & A on risk-adjusted performance, we include the standard deviation of ROA and ROE over the past 5 years as a control variable of risk measure in the regression, following previous literature (e.g., Lai and Limpaphayom, 2003; Liebenberg and Sommer, 2005). The advantage of this approach is that it allows for direct interpretation of the magnitude of the effect of M & A on the dependent variable. The standard deviation of returns is likely to be inversely related to the firm performance if it captures firm insolvency risk, or may be positively related if higher performance may simply be the result of higher risk activities.

There is little consensus in the insurance literature about the benefits of diversification in different lines of business versus focusing on one or a few specialized area. We investigate this controversy using product line and geographical Herfindahl index as explanatory variables in the regression equation. Cummins and Nini (2002) find a positive relationship between ROE and product line Herfindahl index in the property-liability insurance industry, consistent with the strategic focus hypothesis. Meador, Ryan, and Schellhorn (2000) conducted efficiency analysis to investigate the effects of product diversification for U.S. life insurers. Their results suggest that diversified life insurers are more X-efficient than their more focused counterparts. Pro-focus arguments state that firms can maximize value by focusing on core businesses and core competencies where the firm has a comparative advantage. It is also argued that conglomeration may aggravate agency problems by allowing cross-subsidization to poor subsidiaries (Jensen, 1986). Thus, we predict that product line Herfindahl index is likely to be positively related to firm performance under the strategic focus hypothesis. In contrast, pro-conglomeration arguments suggest that operating multiple lines of business can add value, either because of diversification benefits or because of revenue scope economies in offering "one-stop shopping" to customers who are willing to pay more. Thus, product line Herfindahl index will have a negative sign if conglomeration hypothesis holds.[47]

Similarly, geographic Herfindahl index will have a positive sign if geographically focused insurers are able to achieve efficiencies associated with market specialization in core businesses and avoid costly monitoring that is required when operating across different states, or geographic Herfindahl index will have a negative sign since geographically diversified insurers have less volatile earnings due to coinsurance effects and thus are able to charge higher prices as a result of their lower risk.

Firm performance will be affected by different distribution systems. The predicted sign on direct marketing system is positive because the commission structure for an independent agency system may impose higher costs than direct writers. We do not have strong predictions on brokerage and mixed distributions. However, firms with brokerage distribution systems are likely be more performance enhanced than firms using independent agency systems because brokers are more technically advanced and have a greater advantage over independent agents in more complex lines.

We include the percent of premium written in personal property lines, the percent of premium written in personal liability lines, and the percent of premium written in commercial property lines to control for possibility that insurer's performance varies by business mix. The percent of premium written in commercial liability lines is omitted as the reference category. We predict that firms with a higher proportion of business in personal lines are less advantageous in profitability than insurers emphasizing commercial lines because personal property lines are highly exposed to catastrophic property risks such as hurricanes and earthquakes.

[47] For further discussion of the strategic focus and conglomeration hypotheses please see Berger, Cummins, Weiss, and Zi (2000).

We use an indicator variable equal to one for mutual firms and zero for stock insurers to control for forms of ownership structure. The relationship between ownership structure and performance is ambiguous. It is argued that mutual managers are not well monitored in capital markets as compared to mangers of stock insurers and the pressure to maximize firm value is far less in a mutual firm since the role of owner and policyholder functions are merged (Colquitt, Sommer, and Godwin, 1999). Thus, stock insurers are likely to have incentives to yield better performance, other things equal. On the other hand, mutual insurers are likely to be better performed because they tend to underwrite less risky and complex policies requiring less managerial discretion. A dummy variable is included, set equal to one for unaffiliated single companies and zero otherwise. An unaffiliated company is likely to be more risk averse than the affiliated firm of groups because the unaffiliated insurer may not have diversification opportunities. Thus, managers of unaffiliated firms may have more incentive to minimize costs and maximize revenues than those of affiliated groups, predicting positive sign on this variable. We also control for performance variation that is induced by insurers operating in different regulatory stringency. A dummy variable equal to one if the insurer is licensed in New York and equal to zero otherwise is included to test the regulatory costs hypothesis. New York is recognized as the state that has most stringent licensing and solvency surveillance system (Cummins and Sommer, 1996). We predict a negative sign for this variable because stricter regulation leads to revenue inefficiencies due to the imposition of regulatory costs.

10.2 EMPIRICAL RESULTS

The regression analysis consists of four equations with dependent variables equal to ROA, ROE, combined ratio, and expense ratio, respectively. We first present ROA and

ROE regression results and then turn to a discussion of the underwriting performance regressions.

Return on Assets (ROA) and Return on Equity (ROE)

The ROA and ROE regressions are designed to provide additional information on the relationship between M & A activity and insurers' overall financial performance. The results are shown in Table 18 and 19. The first two equations are estimated using one-way (year) fixed effects model omitting revenue efficiency variable and the third equation is an instrumental variables version (IV) that includes potentially endogenous variable, revenue efficiency. The first two equations use different risk measures-standard deviation of returns or firm portfolio risk as an explanatory variable. Although fixed effects estimation with panel data is useful to control for unobserved heterogeneity in the presence of time-constant omitted variables, panel data methods may not be enough to solve the problem of time-varying omitted variables that are correlated with the dependent variable.[48] A test for the endogeneity was performed using Hausman (1978) method. The test rejects the null hypothesis that revenue efficiency variable is exogenous at the 1% level. A rejection of the null suggests that firm performance and revenue efficiency are contemporaneously determined and thus two-stage least squares estimation is required. The standard errors reported in the IV version are robust to the presence of serially correlated errors as well as heteroskedastic errors.[49]

We focus most of the discussion on the IV version of the ROA equation, although fixed effects and IV models provide the similar results in both ROA and ROE regressions. The coefficient estimates on MA_{it} are negative and significant in fixed effects and IV estimation in both ROA and ROE equations, supporting our hypothesis that the

[48] More detailed discussions are shown in Wooldridge (2002), pp484-514.

[49] The Durbin-Watson statistics for the regressions ranged from 0.89 to 1.52. Estimation uses the Newey and West (1987) procedure with one lag to correct for serial correlation and heteroskedasticity.

performance of acquiring insurers decreases following M & As possibly due to scale diseconomies and increase frictional costs associated with post-merger managerial integration.

The results with other explanatory variables are mostly consistent with expectations. Firm size is positively and significantly related to performance across all models, consistent with the view that larger firms tend to have lower insolvency risk and greater potential to gain revenue scope economies. The ratio of equity capital to total assets is significantly positively related to ROA and ROE, as predicted if better capitalized firms are more likely to charge higher prices and higher prices will translate into higher performance.

The types of business that insurers write are found to be relevant to insurer performance. Firms with a higher proportion of business in commercial property lines exhibit greater ROA and ROE than those with more business in commercial liability lines. The coefficient on the percent of premium written in personal property lines in the IV version of ROE equation is significant and negative, consistent with the expectation that firms emphasizing personal property lines are less advantageous in profitability than insurers with a higher proportion of business commercial liability lines.

The product line Herfindahl indices are significant and positive across all models in both ROA and ROE, consistent with the findings of Cummins and Nini (2002). The positive relationship suggests that more focused insurers are rewarded with higher performance. This result supports the strategic focus hypothesis that the insurer can maximize value by focusing on one or a few specialized area where the firm has a comparative advantage. However, geographic Herfindahl index is not significant in all equations.

The sign on direct marketing system is positive and significant, consistent with the view that insurers using direct marketing system have higher financial returns than insurers with independent agency system because independent agency distributors are likely to have higher costs than direct writers. The coefficient on mixed distribution is negative and significant only in the fixed effect model of ROE, indicating that firms using independent agency distribution tend to have better performance than firms using mixed distribution systems. The coefficient on brokerage indicator variable is not significant in all regression, indicating that there is no considerable difference in performance measure between firms with brokerage distribution and firms using independent agency distribution.

The mutual variable has a significant negative sign across all models, consistent with the argument that mutual insurers have less incentive than stock firms to maximize firm value perhaps due to merged function of owner and policyholder. An unaffiliated single firm indicator is positive and significant in all regressions, which supports the argument that an unaffiliated company is likely to be more risk averse and managers of unaffiliated firms may have more incentive to minimize costs and maximize revenues than those of affiliated insurance groups. A New York dummy variable is significantly inversely related to firm performance, indicating that stringent regulatory costs result in a negative impact on a insurer’s financial performance. The coefficient on the standard deviation of returns is negative and significant, suggesting that higher volatility of earnings may imply higher firm insolvency risk. Finally, revenue efficiency variable has a significant positive coefficient in the IV version of both the ROA and ROE equations, consistent with the hypothesis that revenue efficient firms are likely to earn higher financial returns.

Underwriting Performance

The underwriting performance regressions are designed to examine the relationship between M & As and the differences in performance across lines of insurance. We conduct line by line regressions using both combined ratio and expense ratio as dependent variables. The expense ratio regressions provide additional evidence of the relationship between M & A activity and line by line performance.

The results are presented in Tables 20 and 21 and are generally consistent with our hypotheses. The coefficient of M & A indicator variable is significant and positive in both personal property and commercial liability lines in combined and expense ratio regressions, indicating that loss ratio and underwriting expense ratio of acquiring insurers tend to increase after M & As. This result reinforces the conclusion of ROA and ROE regressions that the performance of acquiring insurers decreases after M & As. Since incurred loss and underwriting expenses are major costs of insurance company, it is important to keep in mind that combined ratio and expense ratio are an inverse measure of insurer's pricing and profitability.

The coefficients of explanatory variables in the combined and expense ratio regressions generally strengthen the results presented in the ROA and ROE regressions. For example, the coefficients of both geographic and product line Herfindahl index are significant and inversely related to combined ratio across all lines only with the exception of product line Herfindahl index of personal liability line. Similarly, geographic and product line Herfindahl index is significant and negative in the expense ratio regression across all lines except the personal liability line. The negative relationship between underwriting performance and Herfindahl index indicates that loss ratio and expense ratio tend to be higher in more diversified firms than less diversified insurers, which, as a result, leads to lower financial performance for diversified firms.

Firm size is negatively and significantly related to combined ratio in the personal property and personal liability lines, indicating that larger firms experience lower loss and expense ratio. However, the coefficient on the firm size is positive in the commercial liability line, indicating that larger firms undergo higher combined ratios than smaller firms. The coefficients of firm size are significant and negative in the expense ratio regressions across all lines. The dummy variables for direct marketing are significant and negative across all lines in both the expense ratio and the combined ratio regressions except the personal liability line, implying that direct writers tend to use less costs than independent agency distributors, and, this supports the results that insurers using direct marketing system have higher financial performance than insurers with independent agency system. The coefficient on brokerage is negative and significant only in the commercial property line of expense ratio regression, indicating that firm with brokerage distribution systems are likely to use less expenses than insurers with independent agency systems in the commercial property line. Mixed distribution is also inversely and significantly related to expense ratio across all lines except the personal liability line.

The indicator variable for unaffiliated single firms is significantly negatively related to both combined ratio and expense ratio across all lines. The negative relationship is consistent with the view that unaffiliated insurers are likely to be more risk averse and thus have more incentive to reduce costs because they do not have opportunities to obtain diversification benefits. The coefficients for firms licensed in New York are significantly positively related to the combined ratio across all lines except commercial liability line and also have significant and positive relationship with expense ratio in the personal property and commercial liability lines, suggesting that stricter regulations impose higher regulatory costs, leading to lower financial performance.

10.3 ROBUSTNESS OF PERFORMANCE RESULTS

We estimate several variants of the model to investigate the robustness of the results. First, to examine whether our results are robust to a different performance measure, we repeat our regression analysis with alternative performance measures by replacing ROA with ROE. As shown in Table 19, indicator variable for MA_{it} is significantly inversely related to performance across all models, consistent with the results of ROA regression. The results for other explanatory variables are also unaffected by an alternative performance measure.

Financial theory argues that higher risk activities earn higher returns. Thus, it is important to consider the effect of M & A on risk-adjusted performance. As in the preceding section, the first approach utilized to capture risk-return relationship is to include a risk measure as a control variable in the regressions. In addition, we examined the robustness of our results to different risk measures by replacing standard deviation of returns with firm portfolio risk. Firm portfolio risk is calculated based on the option pricing model.[50] Firm portfolio risk is also significantly inversely related to ROA and ROE as in Table 18 and 19.

An alternative approach suggested in the literature is to use risk-adjusted performance as a dependent variable in the regression. The risk-adjusted performance is calculated by dividing the relevant performance measure by its volatility over a given time period (Brown et al, 2001; Liebenberg and Sommer, 2005). We calculated risk-adjusted ROA and ROE again by dividing an insurer's ROA and ROE by its standard deviation of returns over the past 5 years following Liebenberg and Sommer (2005). We repeat regressions using this measurement as dependent variables. Results are shown in Table 22. Consistent with the first approach, the coefficient on MA_{it} is significant and

[50] Details of the calculation on the firm portfolio risk measure are discussed in Chapter 5.

negative in both ROA and ROE regressions. The results for other explanatory variables are generally similar to those presented in Table 18 and 19.

Although the Hausman test rejects the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator, we repeated regressions using one-way and two-way random effects models with the assumption that the unobserved effect is the random variable to estimate. The key results are unaffected.

CAHPTER 11
SUMMARY AND CONCLUSION

This dissertation provides some of the first evidence on the relationship between M & As activity and the changes in the price of insurance across lines of business and the line-by line performance change in the U.S. property-liability insurance industry. Because U.S. antitrust policy is primarily concerned with the potential for collusive behavior due to M & As and one principal objective of antitrust regulation is to prevent M & As that would lead to a substantial increase in market power, our findings have important policy implications.

Using the sample of U.S. property-liability insurers that engaged in M & A activity over the period 1990-2003, we conduct one-way and two-way fixed effects model regressions where dependent variable is the insurance price for each line and where explanatory variables include the marginal capital allocation for each line, firm insolvency put value, cost efficiency, market share, and geographical and product line Herfindahl index. We incorporate cost efficiency and market share variable into the regression model to examine whether efficient structure and market power hypotheses are valid. We include geographical and product line Herfindahl index as explanatory variables to provide further evidence on the related hypothesis that diversified insurers charge lower prices.

The results of regression analysis provide evidence that the price of insurance for newly formed insurers decreases following the M & As, which are favorable to consumers. We also find that diversified insurers charge lower prices than less diversified firms. Our result is consistent with several possible explanations. One possibility is that acquiring insurers reduce overall underwriting risks and more efficiently manage the frictional costs of capital through geographical and/or product line diversification by engaging in the M&A transaction and therefore gain a competitive advantage in pricing.

Alternatively, the result is also consistent with acquiring firms, on average, purchasing target firms that are underperforming in terms of price and therefore the newly combined firms charge a lower average price. Finally, the result is also consistent with acquiring firms purchasing targets which tend to underwrite less risky clients and therefore the target, prior to the merger, is charging fair premiums but to a different segment of the market than which the acquiring firm operates.

Our analysis also reveals a number of other interesting results. The regression analysis provides support for the capital allocation theory that variations in prices by lines of business are directly related to corresponding variations of marginal capital allocation. We find that insurance price is positively related to marginal capital allocation across all lines, consistent with the findings of Cummins, Lin, and Phillips (2006). Consistent with prior studies on the relation between insurance price and firm insolvency risk, we find that insurance price is inversely related to firm insolvency put value. This result implies that market discipline is present in insurance markets. For example, an insurer that pursues market share aggressively and thus takes on high levels of portfolio risk may suffer lower capitalization, charges lower prices, and thus loses firm profits. This firm will be restricted to risk-taking, even without regulation. Furthermore, these results show the importance of incorporating insolvency risk and marginal capital costs in pricing lines of insurance business.

We also find that the price of insurance is inversely related to cost efficiency, consistent with the efficiency structure hypothesis. The results indicate that it is important to control for cost efficiency in examining price determinants in insurance industry. However, the negative and/ or insignificant signs for the market share variable indicate that market power hypothesis is not valid with our sample data. Thus, the implication of the result suggests that market power that can arise from M & A activity may not be a big concern for insurance regulators.

Next, the dissertation explores the relationship between M & A activity and insurer's efficiency and firm performance changes using more recent data. The regression results reveal the negative relationship, indicating that acquirers' overall cost and revenue efficiency and financial performances such as ROA and ROE decrease following M & As. One possible explanation is that expansion of the firm through M & As has the potential to create inefficiencies, even though acquisition targets are financially healthy firms. As firms become larger and more complex, diversification benefits tend to be offset by the additional costs. Administrating and operating over wider geographical areas and integration of different information systems can lead to higher costs. Bonding different organizations has more potential to create managerial conflict and agency costs since managerial monitoring becomes more difficult. An alternative explanation for this result is that the target firms may be considerably badly performing and thereby acquiring firms appears to perform poorly after the transaction because it takes time to improve the performance of the target.

In addition to the studies on the M & A-performance relationship, we also investigate the performance effects of geographic and product-line diversification within the U.S. property-liability insurance industry. We test two alternative hypotheses-strategic focus hypothesis and conglomeration hypothesis-regarding diversification's effect on firm performance. The results provide support for the strategic focus hypothesis that more focused insurers outperform the diversified insurers. Our results are consistent with the findings of recent studies of the diversification-performance relation (e.g., Cummins and Nini, 2002; Liebenberg and Sommer, 2005). We also find that the results are robust to alternative performance measure, risk-adjusted ROA and ROE. It is worth noting that we measure performance using risk-adjusted returns while most prior literature did not incorporate risk factor.

To provide evidence on line-by-line performance differences, we conduct regressions using both combined ratio and expense ratio as dependent variables. The results indicate that loss ratio and underwriting expense ratio tend to increase after M & A. Because loss ratio and expense ratio are an inverse measure of insurer's pricing and profitability, the result reinforces the conclusion of ROA and ROE regressions that acquirers' performance decreases after M & As.

In order to explain price declines for newly formed insurers following the M & As, future work can analyze whether firms that engage in M & A activity utilize the capital of the firm more efficiently and thus reflect lower overall capital costs by comparing overall capital requirement relative to the liability for both newly formed insurers and combined acquiring and target firms before and after M & As. We could also investigate the efficiency and financial performance of the targets relative to the industry prior to the M & A to figure out whether the decrease of efficiency and financial performance for newly formed insurers following the M & As is attributable to the firm characteristics of target insurers. Furthermore, there is potential for sample selection bias if one argues firms that engage in M & A transactions are more or less likely to be good (or bad) performers (e.g. Campa and keida, 2002; Villalonga, 2004; Liebenberg and Sommer, 2005). To control for potential self-selection and to gain more insights, additional exploration using "treatment effects" may be necessary.

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Figure1. Present Value Factor By Line of Business

The Figure1 presents the present value factors that are used to calculate the present value of loss and loss adjustment expense incurred. The economic premium ratio for a line of insurance is defined as premiums written for the line divided by the present value of losses and loss adjustment expenses incurred. Losses and loss adjustment expenses incurred are discounted based on two present value factors: (1) the pattern of loss and loss adjustment expense payment, and (2) the discount interest rate. The payout tail proportions for each line of business and for each year of the sample period are estimated based on Schedule P of annual statement data using Taylor separation method (Taylor, 2000). We also estimate U.S. Treasury spot rate (zero rate) curve from the constant maturity treasury data using bootstrap method. The present value factor for each year is calculated by summing up the estimated payout tail proportions divided by the estimated zero curves for the number of periods in the payout tail. The present value of losses and loss adjustment expenses incurred is obtained by multiplying the total losses and loss adjustment expenses incurred by the present value factor.

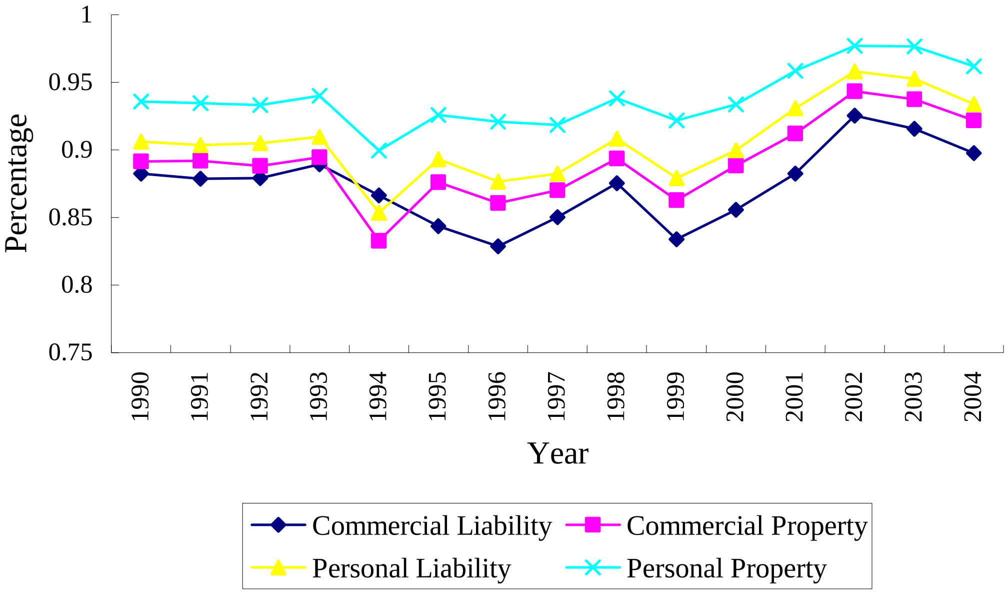

Table1. Economic Value of Assets for the U.S. Property-Liability Insurance Industry, 1989-2004 (Unit: $Millions)

Table shows the economic value of assets for the U.S. property-liability insurance industry over the sample period 1995-2004. Assets are adjusted to market values based on NAIC statutory accounting standards. Stocks, government bonds, and corporate bonds are reported at market values. However, other assets are described at NAIC annual statement book values. The economic value of assets is defined as the book value of total assets minus the book value of stocks, government bonds, and corporate bonds plus the market value of stocks, government bonds, and corporate bonds.

Year	Number of Company	Stocks	%	Government Bonds	%	Corporate Bonds	%	Real Estate	%	Mortgages	%	Cash+ Invested	%	Other Assets	%	Economic Assets
1989	2596	115,609	0.188	255,473	0.415	76,786	0.125	6,171	0.010	6,499	0.011	39,449	0.064	115,446	0.188	615,434
1990	2649	112,924	0.174	277,062	0.426	81,878	0.126	6,996	0.011	6,916	0.011	44,986	0.069	119,929	0.184	650,690
1991	2668	131,780	0.185	305,942	0.429	96,567	0.135	7,710	0.011	6,537	0.009	39,541	0.055	125,522	0.176	713,600
1992	2669	134,383	0.179	321,752	0.429	96,340	0.128	8,476	0.011	5,710	0.008	48,393	0.064	135,307	0.180	750,361
1993	2655	145,354	0.182	359,540	0.451	102,449	0.129	9,086	0.011	4,525	0.006	48,097	0.060	128,037	0.161	797,088
1994	2681	154,534	0.195	347,949	0.440	100,352	0.127	9,441	0.012	3,813	0.005	46,135	0.058	128,694	0.163	790,920
1995	2688	186,129	0.209	379,726	0.427	121,060	0.136	9,273	0.010	2,857	0.003	56,209	0.063	134,403	0.151	889,661
1996	2708	201,990	0.217	386,251	0.416	135,770	0.146	9,623	0.010	2,544	0.003	56,683	0.061	136,613	0.147	929,469
1997	2721	257,936	0.251	403,769	0.392	154,531	0.150	9,472	0.009	2,315	0.002	59,788	0.058	141,695	0.138	1,029,506
1998	2757	282,565	0.262	393,125	0.365	166,333	0.154	9,188	0.009	2,045	0.002	69,853	0.065	154,241	0.143	1,077,355
1999	2708	293,569	0.277	349,494	0.330	169,096	0.160	9,532	0.009	2,197	0.002	66,569	0.063	168,031	0.159	1,058,491
2000	2679	267,784	0.254	343,561	0.326	177,461	0.168	9,646	0.009	1,645	0.002	81,568	0.077	171,725	0.163	1,053,393
2001	2699	249,362	0.226	344,673	0.312	191,549	0.173	9,329	0.008	2,554	0.002	83,502	0.076	224,514	0.203	1,105,485
2002	2680	229,278	0.193	389,675	0.328	196,025	0.165	9,532	0.008	2,588	0.002	112,345	0.095	248,327	0.209	1,187,773
2003	2699	273,158	0.205	436,372	0.328	216,052	0.162	9,280	0.007	2,715	0.002	127,536	0.096	267,290	0.201	1,332,406
2004	2727	301,135	0.207	497,056	0.342	228,786	0.158	9,329	0.006	3,108	0.002	130,726	0.090	281,947	0.194	1,452,089
Average	2687	208,593	0.213	361,964	0.385	144,440	0.146	8,880	0.010	3,661	0.004	69,461	0.070	167,608	0.172	964,608

Table2. Economic Value of Liabilities and Capital for the U.S. Property-Liability Insurance Industry, 1989-2004 (Unit: $Millions)
Table shows the economic value of liabilities and equity for the U.S. property-liability insurance industry over the sample period 1995-2004. The reserves for each line of business are adjusted to the present values by discounting the expected future loss cash flows with the estimated U.S. Treasury spot-rate curve. The expected future loss cash flows are based on the pattern of loss and loss adjustment expense payment. Other liabilities are defined as total liabilities of the industry minus all reserves of commercial liability, commercial property, personal liability, and personal property after discounting.

Year	Number of Company	Personal Property	%	Personal Liability	%	Commercial Property	%	Commercial Liability	%	Other Liabilities	%	Economic Liabilities	%	Economic Equity	%	Economic Liab+Equity
1989	2596	12,404	0.020	66,159	0.107	31,039	0.050	139,988	0.227	187,217	0.304	436,807	0.710	178,627	0.290	615,434
1990	2649	12,278	0.019	70,208	0.108	32,916	0.051	151,833	0.233	192,877	0.296	460,112	0.707	190,578	0.293	650,690
1991	2668	12,484	0.017	74,131	0.104	34,230	0.048	165,012	0.231	208,347	0.292	494,204	0.693	219,396	0.307	713,600
1992	2669	13,759	0.018	77,543	0.103	37,715	0.050	177,303	0.236	222,183	0.296	528,503	0.704	221,858	0.296	750,361
1993	2655	12,244	0.015	81,035	0.102	38,925	0.049	187,479	0.235	224,926	0.282	544,609	0.683	252,479	0.317	797,088
1994	2681	12,911	0.016	77,952	0.099	38,939	0.049	182,893	0.231	246,668	0.312	559,363	0.707	231,557	0.293	790,920
1995	2688	12,766	0.014	64,168	0.072	43,462	0.049	201,820	0.227	258,986	0.291	581,204	0.653	308,456	0.347	889,661
1996	2708	13,025	0.014	63,529	0.068	44,397	0.048	205,276	0.221	274,150	0.295	600,378	0.646	329,090	0.354	929,469
1997	2721	12,424	0.012	63,242	0.061	45,194	0.044	203,047	0.197	285,505	0.277	609,414	0.592	420,091	0.408	1,029,506
1998	2757	13,893	0.013	64,199	0.060	49,222	0.046	208,093	0.193	293,866	0.273	629,276	0.584	448,078	0.416	1,077,355
1999	2708	14,241	0.013	61,968	0.059	49,153	0.046	188,292	0.178	322,932	0.305	636,588	0.601	421,902	0.399	1,058,491
2000	2679	15,433	0.015	64,480	0.061	49,519	0.047	186,409	0.177	330,511	0.314	646,355	0.614	407,038	0.386	1,053,393
2001	2699	17,361	0.016	68,202	0.062	57,726	0.052	197,159	0.178	381,402	0.345	721,852	0.653	383,632	0.347	1,105,485
2002	2680	19,494	0.016	73,913	0.062	60,768	0.051	220,915	0.186	416,455	0.351	791,547	0.666	396,225	0.334	1,187,773
2003	2699	20,908	0.016	76,631	0.058	62,907	0.047	240,739	0.181	464,060	0.348	865,247	0.649	467,158	0.351	1,332,406
2004	2727	21,893	0.015	77,215	0.053	67,856	0.047	259,577	0.179	497,633	0.343	924,176	0.636	527,912	0.364	1,452,089
Average	2687	14,845	0.016	70,286	0.077	46,498	0.048	194,740	0.207	300,482	0.308	626,852	0.656	337,755	0.344	964,608

Table3. Liability Volatility and Correlation Matrix, 1991-2004

Table3, 4, and 5 provide industry-wide volatilities and correlation matrix that are determined by the quarterly time series of returns of seven asset classes and of the underwriting returns of four aggregated insurance lines over the period, 1991-2004. The quarterly estimates of the asset returns on the first six categories are obtained from the standard rate of return series (Stocks- S & P 500 index; government bond-Lehman Brothers intermediate term total return; corporate bond-Moody's corporate bond total return; real estate-NAREIT total return; mortgages-Merrill Lynch mortgage backed securities total return; cash and others invested-30-day U.S. Treasury bill rate). The return series for other assets are calculated by the natural logarithm of the gross quarterly percentage change in the total market value of asset of the insurance industry net of the market value of the first six asset categories. The quarterly underwriting return series adjusted for seasonality with the U.S. Census Bureau's X11 procedure are defined as the natural logarithm of the present value of incurred losses and loss adjustment expenses divided by the earned premium for each quarter.

Liability Class	Volatility	HO	APD	AL	CMP	SP	FS	AH	MM	WC	OL	SL	ML
Homeowners/Farmowners(HO)	0.302	1.000	-0.312	-0.192	0.569	0.562	-0.130	0.491	-0.282	0.054	0.136	0.544	-0.036
Auto Physical Damage(APD)	0.124		1.000	0.235	0.208	0.136	0.396	0.128	-0.166	0.006	0.275	0.360	0.278
Auto Liability(AL)	0.125			1.000	-0.047	-0.764	0.236	-0.090	0.856	0.245	-0.345	-0.685	0.141
Commercial Multiple Peril(CMP)	0.189				1.000	0.643	0.188	0.011	0.019	-0.045	0.190	0.261	0.001
Special Property(SP)	0.481					1.000	-0.180	-0.014	-0.087	0.123	0.053	0.276	-0.124
Fidelity/Surety(FS)	0.430						1.000	-0.091	0.277	-0.133	0.438	-0.085	0.177
Accident, Health, Fin. Guaranty(AH)	0.088							1.000	-0.143	0.027	0.238	0.343	-0.127
Medical Malpractice(MM)	0.164								1.000	0.188	-0.283	-0.795	0.002
Workers' Compensation(WC)	0.207									1.000	-0.527	-0.066	-0.097
Other Liability(OL)	0.221										1.000	0.369	-0.046
Special Liability(SL)	0.207											1.000	-0.078
Miscellaneous Liability(ML)	0.053												1.000

Table4. Asset and Liability Correlation Matrix, 1991-2004

	HO	APD	AL	CMP	SP	FS	AH	MM	WC	OL	SL	ML
Stocks	-0.175	-0.018	-0.009	-0.248	-0.150	-0.072	-0.151	-0.180	-0.125	-0.065	-0.025	-0.028
Government Bonds	-0.092	-0.079	0.173	-0.153	-0.313	-0.106	0.199	0.161	-0.141	0.026	-0.149	0.006
Corporate Bonds	0.012	-0.059	0.031	-0.346	-0.248	-0.230	0.239	-0.066	0.064	-0.213	-0.038	0.106
Real Estate	0.207	0.054	0.005	-0.084	-0.044	-0.072	0.173	-0.041	-0.194	0.113	0.014	-0.185
Mortgages	-0.189	-0.059	0.003	-0.296	-0.395	-0.087	0.181	0.075	-0.097	0.038	-0.112	0.020
Cash & Others Invested	-0.403	-0.105	0.037	-0.227	-0.240	-0.217	-0.336	-0.072	-0.190	-0.311	-0.189	0.198
Other Assets	0.018	0.095	-0.155	0.200	-0.016	0.174	0.139	-0.086	-0.185	0.312	0.190	-0.076

Table5. Asset Volatility and Correlation Matrix, 1991-2004

Asset Class	Volatility	Stocks	Government Bonds	Corporate Bonds	Real Estate	Mortgage	Cash & Others Inv.	Other Assets
Stocks	0.1581	1.0000	-0.2833	0.5570	0.2946	-0.0907	0.1952	-0.1972
Government Bonds	0.0373	-0.2833	1.0000	-0.0146	0.0493	0.9250	0.1966	-0.0141
Corporate Bonds	0.0682	0.5570	-0.0146	1.0000	0.2662	0.1354	0.1013	0.0767
Real Estate	0.1211	0.2946	0.0493	0.2662	1.0000	0.1247	0.0684	-0.1591
Mortgages	0.0065	-0.0907	0.9250	0.1354	0.1247	1.0000	0.2809	0.0051
Cash & Others Invested	0.0061	0.1952	0.1966	0.1013	0.0684	0.2809	1.0000	0.0307
Other Assets	0.0704	-0.1972	-0.0141	0.0767	-0.1591	0.0051	0.0307	1.0000

Table6. Insolvency Put Value and Capital Allocations for the U.S. Property-Liability Insurance Industry, 1989-2004 (Unit: $Millions)

The table displays insolvency put value for the U.S. property-liability insurance industry and amount of economic capital allocated across five lines of business based on Myers and Read (2001) methodology. CL represents commercial liability, CP commercial property, PL personal property, PP personal property, and OL other liabilities. The column of default-to-liability ratio is calculated to obtain insolvency put value. The column of capital-to-liability ratio shows the marginal capital requirement for each line in response to the marginal increase in the present value of losses for the line.

	Insolvency Put		Marginal Capital Requirement and Allocation															Economic Capital
	Insolvency/Liability	Insolvency	Capital-To-Liability Ratio					The Amount of Capital Allocated By Line and % of Industry Capital										
Year	Ratio	Put Value	CL	CP	PL	PP	OL	CL	%	CP	%	PL	%	PP	%	OL	%	
1989	6.20E-05	27.08	0.84	0.33	0.36	0.38	0.12	117,153	0.656	10,372	0.058	23,724	0.133	4,679	0.026	22,697	0.127	178,627
1990	6.18E-05	28.43	0.85	0.33	0.35	0.37	0.11	128,929	0.677	10,776	0.057	24,769	0.130	4,499	0.024	21,603	0.113	190,578
1991	3.70E-05	18.26	0.91	0.34	0.37	0.39	0.12	150,014	0.684	11,787	0.054	27,488	0.125	4,831	0.022	25,275	0.115	219,396
1992	5.68E-05	30.03	0.86	0.33	0.34	0.37	0.11	152,932	0.689	12,346	0.056	26,632	0.120	5,030	0.023	24,915	0.112	221,858
1993	3.45E-05	18.76	0.95	0.35	0.37	0.38	0.12	177,807	0.704	13,648	0.054	30,100	0.119	4,709	0.019	26,212	0.104	252,479
1994	3.65E-05	20.43	0.86	0.33	0.34	0.37	0.12	156,548	0.676	12,984	0.056	26,537	0.115	4,770	0.021	30,717	0.133	231,557
1995	6.41E-05	37.26	1.10	0.42	0.36	0.45	0.15	222,639	0.722	18,133	0.059	22,839	0.074	5,720	0.019	39,123	0.127	308,456
1996	5.29E-05	31.76	1.14	0.44	0.37	0.47	0.17	234,414	0.712	19,508	0.059	23,347	0.071	6,158	0.019	45,672	0.139	329,090
1997	5.18E-05	31.57	1.44	0.57	0.47	0.61	0.23	291,561	0.694	25,858	0.062	29,999	0.071	7,581	0.018	65,094	0.155	420,091
1998	3.73E-05	23.46	1.48	0.61	0.49	0.64	0.24	307,076	0.685	29,898	0.067	31,462	0.070	8,893	0.020	70,748	0.158	448,078
1999	4.77E-05	30.35	1.37	0.63	0.51	0.67	0.29	257,211	0.610	31,082	0.074	31,362	0.074	9,520	0.023	92,726	0.220	421,902
2000	5.53E-05	35.76	1.30	0.61	0.50	0.65	0.28	243,010	0.597	30,284	0.074	32,006	0.079	10,079	0.025	91,657	0.225	407,038
2001	6.62E-05	47.82	1.10	0.55	0.43	0.58	0.25	217,284	0.566	31,659	0.083	29,049	0.076	10,021	0.026	95,618	0.249	383,632
2002	4.09E-05	32.36	1.05	0.50	0.39	0.54	0.22	233,024	0.588	30,468	0.077	28,798	0.073	10,484	0.026	93,451	0.236	396,225
2003	1.98E-05	17.12	1.14	0.53	0.41	0.58	0.25	274,538	0.588	33,608	0.072	31,563	0.068	12,184	0.026	115,265	0.247	467,158
2004	1.14E-05	10.57	1.21	0.56	0.42	0.61	0.26	314,274	0.595	38,237	0.072	32,382	0.061	13,385	0.025	129,634	0.246	527,912
Avg.	4.60E-05	27.56	1.10	0.47	0.40	0.50	0.19	217,401	0.653	22,540	0.065	28,254	0.091	7,659	0.023	61,900	0.169	337,755

Table7. Inputs and Expenses-Groups and Unaffiliated Companies, 1989-2004

	N	Mean	Median	Std. Dev.	Min	Max
Input Quantities (000s)						
Administrative Labor	10,643	2,871	131	14,131	0.011	262,171
Agent Labor	10,643	6,619	348	31,851	0.096	679,788
Materials and Business Services	10,643	15,279	783	92,820	20	2,554,499
Financial Equity Capital	10,643	332,830	12,611	2,124,947	705	55,868,199
Input Prices						
Administrative Labor	10,643	6.928	7.076	0.663	5.958	7.932
Agent Labor	10,643	5.277	5.140	0.345	4.925	6.039
Materials and Business Services	10,643	4.372	4.186	0.400	3.965	5.075
Financial Equity Capital	10,643	0.111	0.114	0.029	0.060	0.166
Expenses (000s)						
Administrative Labor	10,643	20,150	912	101,104	0.065	2,011,635
Agent Labor	10,643	35,184	1,830	172,190	0.486	3,929,143
Materials and Business Services	10,643	67,233	3,385	411,901	80	10,655,961
Financial Equity Capital	10,643	34,956	1,350	220,750	51	6,715,357
Percent of Total Expenses						
Administrative Labor	10,643	12.1%	11.9%	8.8%	0.001	83.8%
Agent Labor	10,643	23.6%	23.5%	17.2%	0.001	97.9%
Materials and Business Services	10,643	40.4%	39.4%	17.2%	0.019	99.8%
Financial Equity Capital	10,643	23.9%	18.1%	18.3%	0.001	100.0%

Table8. Outputs, Prices, and Revenues-Groups and Unaffiliated Companies, 1989-2004

	N	Mean	Median	Std. Dev.	Min	Max
Output Quantities (000s)						
Personal Short-Tail	7,259	172,007	20,625	839,914	344	14,741,160
Personal Long-Tail	5,176	164,879	14,081	732,146	187	11,535,170
Commercial Short-Tail	7,786	91,398	9,484	258,510	4	3,262,982
Commercial Long-Tail	7,314	149,098	8,841	503,577	6	10,793,424
Intermediation	10,643	2,277,673	209,573	7,321,154	11,057	94,700,304
Output Prices						
Personal Short-Tail	7,259	0.241	0.204	0.112	0.002	4.966
Personal Long-Tail	5,176	0.273	0.221	0.134	0.001	4.753
Commercial Short-Tail	7,786	0.713	0.622	0.498	0.003	4.991
Commercial Long-Tail	7,314	0.474	0.352	0.223	0.001	4.981
Intermediation	10,643	0.079	0.074	0.061	0.001	2.176
Revenues (000s)						
Personal Short-Tail	7,259	88,654	9,457	318,045	30	8,961,194
Personal Long-Tail	5,176	73,499	8,244	314,838	134	7,266,213
Commercial Short-Tail	7,786	74,306	9,540	211,724	3	2,753,662
Commercial Long-Tail	7,314	85,582	8,313	308,014	1	7,971,607
Intermediation	10,643	169,573	15,798	600,242	1,210	9,735,310
Revenues: Percentage of Insurance Revenues						
Personal Short-Tail	7,259	23.1%	21.6%	15.1%	0.01%	81.1%
Personal Long-Tail	5,176	16.6%	14.5%	13.0%	0.03%	80.8%
Commercial Short-Tail	7,786	18.2%	15.6%	13.9%	0.01%	90.6%
Commercial Long-Tail	7,314	17.6%	13.2%	16.2%	0.01%	87.9%
Intermediation	10,643	24.4%	23.1%	10.7%	0.50%	98.1%

Table9. Number of M & A Transactions and Sample Selection Criteria, 1990-2003

Sample Selection Criteria/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total
M & As initially identified in Best's Reports	26	36	35	44	38	44	49	44	33	40	36	38	34	41	538
Less Merge with shell target	4	4	1	3	4	1	5	5	5	4	0	3	2	3	44
Reinsurer M & A	1		2	4	1	2	1	7	1	1	1	0	1	2	24
In liquidation after M & A	1	1	2					1	2		1	1	1	1	11
Remerge within 2 years			1		1		3		1		2		2	1	11
Merge with life insurer, reinsurer	1	1		1	2			1				1			7
Merge into inactive insurer	1	1		1	2	1	1			1			1	1	10
Involve in multiple M & A	1		1	1	2	4	5	4	4	3	4	3	7	3	42
Not identified on NAIC database	3	8	9	4	5	5	7	6	4	4	7	1	1	2	66
Negative premium/loss/surplus	3	2	3	6	3	5	4	3	2	4	4	6	1	5	51
Negative input/output or prices	4	4	7	8	2	7	10	7	3	6	5	6	6	7	82
Sample used in the regression analysis	7	15	9	16	16	19	13	10	11	17	12	17	12	16	190

Data source: Best's Insurance Reports and NAIC database

Table10. Summary Statistics for All Groups and Unaffiliated Companies: 1989-2004

Variables	Obs.	Mean	Median	Std. Dev.	Min	Max
Economic Premium Ratio						
Personal Property(PP) Line	7259	1.106	1.057	0.440	0.012	4.000
Personal Liability(PL) Line	5176	1.051	1.029	0.408	0.010	3.982
Commercial Property(CP) Line	7786	1.383	1.271	0.617	0.014	3.995
Commercial Liability(CL) Line	7314	1.243	1.145	0.589	0.011	3.999
Firm Performance						
Return On Asset	10643	0.034	0.037	0.098	-1.357	4.145
Return On Equity	10643	0.066	0.085	0.300	-5.937	10.594
Risk-Adjusted Return On Asset	10643	1.045	0.910	1.483	-5.581	9.719
Risk-Adjusted Return On Equity	10643	0.983	0.842	1.434	-8.838	9.006
PP Line Underwriting Performance	7259	0.904	0.905	0.300	0.012	4.211
PL Line Underwriting Performance	5176	0.947	0.930	0.318	0.028	4.129
CP Line Underwriting Performance	7786	0.873	0.862	0.294	0.020	4.502
CL Line Underwriting Performance	7314	0.942	0.908	0.382	0.010	4.642
PP line Expense to Premium Ratio	7259	0.281	0.287	0.155	0.001	0.996
PL line Expense to Premium Ratio	5176	0.254	0.264	0.140	0.001	0.995
CP line Expense to Premium Ratio	7786	0.360	0.339	0.181	0.001	0.998
CL line Expense to Premium Ratio	7314	0.372	0.347	0.188	0.002	0.999
Capital Allocation						
PP Line Capital Allocation	10643	0.862	0.605	0.805	0.011	3.990
PL Line Capital Allocation	10643	0.676	0.538	0.637	0.014	3.982
CP Line Capital Allocation	10643	0.835	0.590	0.780	0.013	3.987
CL Line Capital Allocation	10643	0.884	0.699	0.719	0.011	3.999
Relative PP Line Capital Allocation	10643	1.256	1.157	0.791	0.012	3.988
Relative PL Line Capital Allocation	10643	1.002	1.007	0.724	0.010	3.800
Relative CP Line Capital Allocation	10643	1.093	1.018	0.671	0.013	3.988
Relative CL Line Capital Allocation	10643	1.310	1.408	0.677	0.010	3.985
Efficiency Scores						
Pure Technical Efficiency	10643	0.589	0.546	0.274	0.006	1.000
Scale Efficiency	10643	0.843	0.923	0.192	0.002	1.000
Allocative Efficiency	10643	0.696	0.722	0.198	0.005	1.000
Cost Efficiency	10643	0.335	0.302	0.199	0.001	1.000
Revenue Efficiency	10643	0.408	0.400	0.192	0.001	1.000

Note: We exclude observations when economic premium ratio is greater than 4 or less than 0.01. We also exclude observations when either line capital allocation is greater than 4 or less than 0.01.

Table10. Continued

Variables	Obs.	Mean	Median	Std. Dev.	Min	Max
Firm Characteristics						
Total Assets ($ million)	10643	632	40	3,343	2.003	84,405
Total Premiums ($ million)	10643	329	19	1,832	0.101	47,762
Equity Capital ($million)	10643	333	13	2,135	0.001	57,977
Firm Insolvency Put Value	10643	0.002	0.000	0.015	0.000	0.833
Firm Portfolio Risk(Sigma)	10643	0.129	0.128	0.034	0.003	0.741
Firm Capital/Total Assets	10643	0.465	0.421	0.193	0.012	0.998
Firm Capital/Firm Liability	10643	0.842	0.599	0.709	0.013	3.997
Net Premium/Surplus	10643	1.275	1.164	0.776	0.006	3.992
Liquidity Ratio	10643	0.309	0.154	0.438	0.002	4.792
Advertising Expenses/Total Expenses	10643	0.007	0.002	0.017	0.001	0.581
Standard Deviation of ROA	10643	0.058	0.045	0.051	0.002	1.507
Standard Deviation of ROE	10643	0.127	0.097	0.121	0.001	1.653
Industry Concentration	10643	0.057	0.053	0.045	0.003	0.832
Market Share	10643	0.002	0.000	0.008	0.000	0.187
Geographic Herfindahl Index	10643	0.637	0.766	0.379	0.001	1.000
Number of States Operated	10643	12.418	2.000	17.828	0.000	51.000
Product Line Herfindahl Index	10643	0.503	0.394	0.321	0.003	1.000
Number of Product Line	10643	8.016	6.000	7.425	0.000	31.000
Percent of Premiums Written in PP Line	7259	0.249	0.178	0.259	0.001	1.000
Percent of Premiums Written in PL Line	5176	0.152	0.102	0.221	0.001	1.000
Percent of Premiums Written in CP Line	7786	0.286	0.168	0.327	0.001	1.000
Percent of Premiums Written in CL Line	7314	0.316	0.113	0.380	0.003	1.000
Percent of Losses Incurred in PP Line	7259	0.256	0.171	0.272	0.001	1.000
Percent of Losses Incurred in PL Line	5176	0.162	0.001	0.234	0.002	1.000
Percent of Losses Incurred in CP Line	7786	0.267	0.139	0.325	0.001	1.000
Percent of Losses Incurred in CL Line	7314	0.315	0.101	0.382	0.001	1.000
Percent of Mutual Companies	10643	0.387	0.000	0.487	0.000	1.000
Percent of Unaffiliated Companies	10643	0.575	1.000	0.494	0.000	1.000
Percent of Independent Agent	10643	0.612	1.000	0.487	0.000	1.000
Percent of Direct Writing	10643	0.180	0.000	0.384	0.000	1.000
Percent of Brokerage	10643	0.059	0.000	0.233	0.000	1.000
Percent of Mixed Distribution	10643	0.058	0.000	0.234	0.000	1.000
Percent of New York Domicile	10643	0.088	0.000	0.283	0.000	1.000
Percent Insurers with A++ or A+ Rating	10643	0.132	0.000	0.338	0.000	1.000
Percent Insurers with A or A- Rating	10643	0.377	0.000	0.485	0.000	1.000
Percent Insurers with B++ or B+ Rating	10643	0.157	0.000	0.364	0.000	1.000
Percent Insurers with B or Below B	10643	0.077	0.000	0.266	0.000	1.000

Table11. Summary Statistics for Acquiring Groups and Unaffiliated Companies: 1989-2004

Variables	Obs.	Mean	Median	Std. Dev.	Min	Max
Economic Premium Ratio						
Personal Property(PP) Line	149	1.079	1.034	0.349	0.251	2.678
Personal Liability(PL) Line	113	1.053	1.045	0.340	0.010	3.977
Commercial Property(CP) Line	156	1.333	1.262	0.512	0.060	3.488
Commercial Liability(CL) Line	168	1.244	1.141	0.503	0.013	3.938
Firm Performance						
Return On Asset	190	0.045	0.038	0.079	-0.279	3.656
Return On Equity	190	0.054	0.060	0.170	-1.105	4.983
Risk-Adjusted Return On Asset	190	0.940	0.691	1.408	-3.229	6.951
Risk-Adjusted Return On Equity	190	0.645	0.659	1.303	-3.676	6.024
PP Line Underwriting Performance	149	0.943	0.932	0.260	0.109	2.426
PL Line Underwriting Performance	113	0.974	0.947	0.239	0.370	2.359
CP Line Underwriting Performance	156	0.870	0.845	0.274	0.038	3.293
CL Line Underwriting Performance	168	0.985	0.963	0.372	0.001	3.857
PP line Expense to Premium Ratio	149	0.290	0.286	0.137	0.001	0.947
PL line Expense to Premium Ratio	113	0.282	0.288	0.127	0.001	0.728
CP line Expense to Premium Ratio	156	0.322	0.305	0.145	0.013	0.939
CL line Expense to Premium Ratio	168	0.381	0.348	0.166	0.001	0.981
Capital Allocation						
PP Line Capital Allocation	149	0.836	0.595	0.758	0.018	3.649
PL Line Capital Allocation	113	0.673	0.525	0.636	0.011	3.270
CP Line Capital Allocation	156	0.725	0.567	0.650	0.038	3.904
CL Line Capital Allocation	168	0.936	0.824	0.602	0.040	3.873
Relative PP Line Capital Allocation	149	1.106	1.091	0.638	0.012	3.156
Relative PL Line Capital Allocation	113	0.878	0.783	0.603	0.012	2.152
Relative CP Line Capital Allocation	156	0.927	0.925	0.431	0.106	2.059
Relative CL Line Capital Allocation	168	1.440	1.608	0.594	0.012	3.306
Efficiency Scores						
Pure Technical Efficiency	190	0.621	0.594	0.242	0.107	1.000
Scale Efficiency	190	0.809	0.855	0.183	0.244	1.000
Allocative Efficiency	190	0.746	0.777	0.157	0.210	1.000
Cost Efficiency	190	0.358	0.352	0.157	0.015	0.975
Revenue Efficiency	190	0.406	0.407	0.160	0.083	1.000

Note: We exclude observations when economic premium ratio is greater than 4 or less than 0.01. We also exclude observations when either line capital allocation is greater than 4 or less than 0.01. The statistics refer to the calendar year prior to the M & As

Table11. Continued

Variables	Obs.	Mean	Median	Std. Dev.	Min	Max
Firm Characteristics						
Total Assets ($ million)	190	1,822	187	4,105	2.000	23,956
Total Premiums ($ million)	190	929	103	2,114	0.611	14,905
Equity Capital ($million)	190	1,026	139	2,164	0.822	11,163
Firm Insolvency Put Value	190	0.001	0.000	0.003	0.000	0.037
Firm Portfolio Risk(Sigma)	190	0.142	0.137	0.029	0.055	0.261
Firm Capital/Total Assets	190	0.467	0.425	0.194	0.128	0.997
Firm Capital/Firm Liability	190	0.715	0.575	0.470	0.108	3.147
Net Premium/Surplus	190	1.228	1.120	0.649	0.170	3.904
Liquidity Ratio	190	0.277	0.138	0.296	0.011	3.404
Advertising Expenses/Total Expenses	190	0.006	0.003	0.011	0.000	0.101
Standard Deviation of ROA	190	0.069	0.052	0.119	0.012	1.272
Standard Deviation of ROE	190	0.138	0.105	0.131	0.010	0.969
Industry Concentration	190	0.059	0.054	0.041	0.016	0.436
Market Share	190	0.004	0.000	0.008	0.000	0.057
Geographic Herfindahl Index	190	0.400	0.236	0.356	0.005	1.000
Number of States Operated	190	24.350	21.000	20.411	1.000	51.000
Product Line Herfindahl Index	190	0.326	0.230	0.267	0.074	1.000
Number of Product Line	190	14.662	15.000	8.569	1.000	32.000
Percent of Premiums Written in PP Line	149	0.258	0.196	0.199	0.001	0.750
Percent of Premiums Written in PL Line	113	0.172	0.115	0.147	0.002	0.674
Percent of Premiums Written in CP Line	156	0.292	0.227	0.234	0.008	1.000
Percent of Premiums Written in CL Line	168	0.302	0.226	0.290	0.002	1.000
Percent of Losses Incurred in PP Line	149	0.254	0.175	0.224	0.002	0.942
Percent of Losses Incurred in PL Line	113	0.178	0.104	0.170	0.001	0.798
Percent of Losses Incurred in CP Line	156	0.284	0.215	0.224	0.001	1.000
Percent of Losses Incurred in CL Line	168	0.306	0.237	0.320	0.001	1.000
Percent of Mutual Companies	190	0.406	0.000	0.493	0.000	1.000
Percent of Unaffiliated Companies	190	0.226	0.000	0.419	0.000	1.000
Percent of Independent Agent	190	0.690	1.000	0.464	0.000	1.000
Percent of Direct Writing	190	0.123	0.000	0.329	0.000	1.000
Percent of Brokerage	190	0.065	0.000	0.246	0.000	1.000
Percent of Mixed Distribution	190	0.084	0.000	0.278	0.000	1.000
Percent of New York Domicile	190	0.058	0.000	0.235	0.000	1.000
Percent Insurers with A++ or A+ Rating	190	0.221	0.000	0.416	0.000	1.000
Percent Insurers with A or A- Rating	190	0.468	0.000	0.501	0.000	1.000
Percent Insurers with B++ or B+ Rating	190	0.143	0.000	0.351	0.000	1.000
Percent Insurers with B or Below B	190	0.045	0.000	0.209	0.000	1.000

Table12. Economic Premium Ratio Regression for Personal Property Line, 1989-2004

Dependent Variable:	**Economic Premium Ratio**				
Fixed Effects	**X**	**Year**	**X**	**Year**	**Year+Firm**
Variable/Model Number	**1**	**2**	**3**	**4**	**5**
Intercept	0.8147 ***	0.8847 ***	0.6978 ***	0.7453 ***	1.0542 ***
	(0.0895)	(0.0910)	(0.0838)	(0.0854)	(0.3129)
Indicator for MA	-0.0463 **	-0.0567 **	-0.0476 **	-0.0563 **	-0.0683 *
	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0433)
Marginal Capital Allocation	0.0189 **	0.0109	0.0193 **	0.0145 *	0.0323 **
	(0.0077)	(0.0077)	(0.0076)	(0.0076)	(0.0132)
Cost Efficiency	-0.1079 ***	-0.1346 ***	-0.1214 ***	-0.1413 ***	-0.5656 ***
	(0.0312)	(0.0335)	(0.0311)	(0.0334)	(0.0509)
Market Share	-1.0906 *	-0.8666	-1.1881 *	-0.9901	1.5958
	(0.6134)	(0.6089)	(0.6069)	(0.6031)	(1.6419)
Geographic Herfindahl Index	0.0416 **	0.0380 **	0.0421 **	0.0391 **	0.0522 *
	(0.0176)	(0.0176)	(0.0176)	(0.0176)	(0.0329)
Product Line Herfindahl Index	0.1279 ***	0.1267 ***	0.1360 ***	0.1362 ***	0.1542 **
	(0.0329)	(0.0327)	(0.0328)	(0.0326)	(0.0591)
Natural log of Assets	0.0182 ***	0.0134 ***	0.0238 ***	0.0201 *	0.0360 *
	(0.0043)	(0.0044)	(0.0041)	(0.0041)	(0.0155)
Mutual	-0.1264 ***	-0.1258 ***	-0.1269 ***	-0.1265 ***	-0.0202
	(0.0117)	(0.0116)	(0.0116)	(0.0116)	(0.0382)
Unaffiliated Single Firms	0.0533 ***	0.0453 ***	0.0564 ***	0.0489 ***	0.0205 ***
	(0.0142)	(0.0141)	(0.0142)	(0.0141)	(0.0043)
Firm Licensed in New York	-0.0689 ***	-0.0716 ***	-0.0625 ***	-0.0667 ***	0.0192
	(0.0170)	(0.0169)	(0.0172)	(0.0171)	(0.0534)
A.M. Best Rating A or A-	-0.0193	-0.0262 **			
	(0.0122)	(0.0122)			
A.M. Best Rating B++ or B+	-0.0322 *	-0.0437 ***			
	(0.0166)	(0.0166)			
A.M. Best Rating B or lower	-0.0668 ***	-0.0798 ***			
	(0.0214)	(0.0215)			
Firm Insolvency Put Value			-8.8723 ***	-7.0252 **	-16.0084 **
			(2.8913)	(2.8878)	(3.3975)
Adjusted R-square	0.03	0.05	0.03	0.05	0.44
Observations	7259	7259	7259	7259	7259

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table13. Economic Premium Ratio Regression for Personal Liability Line, 1989-2004

Dependent Variable:	**Economic Premium Ratio**				
Fixed Effects	**X**	**Year**	**X**	**Year**	**Year+Firm**
Variable/Model Number	**1**	**2**	**3**	**4**	**5**
Intercept	1.0583 ***	1.0660 ***	0.8542 ***	0.1814 ***	1.5988 ***
	(0.0952)	(0.0949)	(0.0875)	(0.0877)	(0.3282)
Indicator for MA	0.0269	-0.0099	0.0236	-0.0092	-0.0189 *
	(0.0236)	(0.0232)	(0.0235)	(0.0232)	(0.0347)
Marginal Capital Allocation	0.0178 *	0.0133	0.0078	0.0103	-0.0110
	(0.0100)	(0.0097)	(0.0100)	(0.0098)	(0.0161)
Cost Efficiency	0.0145	-0.0999 ***	-0.0044	-0.1077 ***	-0.3097 ***
	(0.0355)	(0.0383)	(0.0351)	(0.0381)	(0.0571)
Market Share	0.4112	0.7951	0.0089	0.3382	1.5158
	(0.5942)	(0.5810)	(0.5862)	(0.5752)	(2.0201)
Geographic Herfindahl Index	0.0603 ***	0.0662 ***	0.0652 ***	0.0703 ***	-0.0283
	(0.0191)	(0.0187)	(0.0190)	(0.0187)	(0.0384)
Product Line Herfindahl Index	0.1589 ***	0.1549 ***	0.1648 ***	0.1684 ***	0.2923 ***
	(0.0409)	(0.0401)	(0.0406)	(0.0398)	(0.0720)
Natural log of Assets	-0.0047	-0.0077 *	0.0066	0.0057	-0.0085
	(0.0046)	(0.0045)	(0.0043)	(0.0043)	(0.0165)
Mutual	0.0006	0.0057	-0.0022	0.0040	-0.0078
	(0.0121)	(0.0118)	(0.0120)	(0.0118)	(0.0472)
Unaffiliated Single Firms	0.0247 *	0.0236	0.0307 **	0.0307 **	0.0118 **
	(0.0149)	(0.0146)	(0.0148)	(0.0146)	(0.0047)
Firm Licensed in New York	-0.0316	-0.0375 *	-0.0118	-0.0218	-0.0784
	(0.0207)	(0.0202)	(0.0208)	(0.0204)	(0.0606)
A.M. Best Rating A or A-	0.0011	-0.0148			
	(0.0132)	(0.0130)			
A.M. Best Rating B++ or B+	-0.0465 **	-0.0698 ***			
	(0.0188)	(0.0185)			
A.M. Best Rating B or lower	-0.1015 ***	-0.1289 ***			
	(0.0227)	(0.0223)			
Firm Insolvency Put Value			-22.9823 ***	-19.1810 ***	-12.4967 *
			(3.0394)	(3.0199)	(3.6946)
Adjusted R-square	0.02	0.06	0.02	0.07	0.38
Observations	5176	5176	5176	5176	5176

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table14. Economic Premium Ratio Regression for Commercial Property Line, 1989-2004

Dependent Variable:	**Economic Premium Ratio**				
Fixed Effects	**X**	**Year**	**X**	**Year**	**Year+Firm**
Variable/Model Number	**1**	**2**	**3**	**4**	**5**
Intercept	1.9049 ***	2.0597 ***	1.5545 ***	1.6829 ***	1.1364 ***
	(0.1151)	(0.1168)	(0.1084)	(0.1101)	(0.4092)
Indicator for MA	0.0198	0.0027	0.0160	0.0032	0.0186
	(0.0300)	(0.0299)	(0.0300)	(0.0299)	(0.0299)
Marginal Capital Allocation	0.0169 *	0.0120	0.0183 *	0.0176 *	0.0036
	(0.0120)	(0.0103)	(0.0101)	(0.0101)	(0.0168)
Cost Efficiency	-0.1475	-0.1454 ***	-0.1887 ***	-0.1723 ***	-0.4041 ***
	(0.0427)	(0.0456)	(0.0430)	(0.0458)	(0.0704)
Market Share	0.0718	0.3877	-0.6662	-0.4183	1.3656
	(0.8295)	(0.8236)	(0.8226)	(0.8179)	(2.7520)
Geographic Herfindahl Index	0.0976 ***	0.0911 ***	0.1001 ***	0.0953 ***	0.1014 **
	(0.0223)	(0.0222)	(0.0223)	(0.0222)	(0.0410)
Product Line Herfindahl Index	0.0827 ***	0.0852 ***	0.1001 ***	0.1072 ***	0.0175
	(0.0318)	(0.0316)	(0.0317)	(0.0316)	(0.0614)
Natural log of Assets	-0.0283 ***	-0.0344 ***	-0.0095 *	-0.0138 **	0.0132
	(0.0056)	(0.0057)	(0.0054)	(0.0054)	(0.0198)
Mutual	-0.0468 ***	-0.0507 ***	-0.0459 ***	-0.0499 ***	0.0453
	(0.0153)	(0.0152)	(0.0153)	(0.0152)	(0.0511)
Unaffiliated Single Firms	0.0192	0.0060	0.0324 *	0.0206	0.0047
	(0.0178)	(0.0177)	(0.0178)	(0.0177)	(0.0039)
Firm Licensed in New York	-0.0804 ***	-0.0752 ***	-0.0709 ***	-0.0667 ***	-0.0626
	(0.0220)	(0.0218)	(0.0221)	(0.0220)	(0.0664)
A.M. Best Rating A or A-	0.0038	-0.0056			
	(0.0156)	(0.0157)			
A.M. Best Rating B++ or B+	-0.0654 ***	-0.0822 ***			
	(0.0215)	(0.0217)			
A.M. Best Rating B or lower	-0.2277 ***	-0.2378 ***			
	(0.0320)	(0.0320)			
Firm Insolvency Put Value			-28.9689 ***	-27.5552 ***	-24.2742 ***
			(3.9977)	(3.9857)	(4.7061)
Adjusted R-square	0.04	0.06	0.04	0.05	0.45
Observations	7786	7786	7786	7786	7786

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table15. Economic Premium Ratio Regression for Commercial Liability Line, 1989-2004

Dependent Variable:	**Economic Premium Ratio**				
Fixed Effects	**X**	**Year**	**X**	**Year**	**Year+Firm**
Variable/Model Number	**1**	**2**	**3**	**4**	**5**
Intercept	2.0288 ***	2.1671 ***	1.7325 ***	1.8355 ***	1.1499 ***
	(0.1009)	(0.1029)	(0.0974)	(0.0997)	(0.3776)
Indicator for MA	0.0425	0.0157	0.0385	0.0145	-0.0043
	(0.0290)	(0.0289)	(0.0289)	(0.0289)	(0.0306)
Marginal Capital Allocation	0.0491 ***	0.0338 ***	0.0419 ***	0.0337 ***	0.0557 ***
	(0.0095)	(0.0098)	(0.0096)	(0.0098)	(0.0161)
Cost Efficiency	0.2103	0.1480	0.1856	0.1419 *	0.0642
	(0.0406)	(0.0441)	(0.0405)	(0.0441)	(0.0673)
Market Share	0.6247	0.9785	-0.1534	0.2668	0.5246
	(0.8061)	(0.8004)	(0.7992)	(0.7958)	(3.0781)
Geographic Herfindahl Index	0.1239 ***	0.1172 ***	0.1256 ***	0.1187 ***	0.0581
	(0.0205)	(0.0204)	(0.0205)	(0.0204)	(0.0428)
Product Line Herfindahl Index	-0.1259	-0.1660 *	-0.0867	-0.1171 *	-0.0693
	(0.0233)	(0.0237)	(0.0235)	(0.0239)	(0.0555)
Natural log of Assets	-0.0496 ***	-0.0558 ***	-0.0339 ***	-0.0387 ***	-0.0012
	(0.0050)	(0.0050)	(0.0049)	(0.0046)	(0.0194)
Mutual	0.0270 **	0.0283 **	0.0282 **	0.0301 **	-0.0144
	(0.0137)	(0.0137)	(0.0137)	(0.0137)	(0.0443)
Unaffiliated Single Firms	0.0367 **	0.0256	0.0522 ***	0.0423 **	0.0267 ***
	(0.0164)	(0.0163)	(0.0164)	(0.0164)	(0.0036)
Firm Licensed in New York	-0.1570 ***	-0.1540 ***	-0.1480 ***	-0.1466 ***	-0.0591
	(0.0209)	(0.0208)	(0.0210)	(0.0208)	(0.0659)
A.M. Best Rating A or A-	0.0128	-0.0081			
	(0.0145)	(0.0146)			
A.M. Best Rating B++ or B+	-0.0682 ***	-0.1016 ***			
	(0.0196)	(0.0198)			
A.M. Best Rating B or lower	-0.1488 ***	-0.1777 ***			
	(0.0286)	(0.0286)			
Firm Insolvency Put Value			-13.5920 ***	-12.4990 ***	-16.5255 ***
			(1.6802)	(1.6833)	(2.2637)
Adjusted R-square	0.06	0.08	0.07	0.08	0.41
Observations	7314	7314	7314	7314	7314

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table16. Cost and Revenue Efficiency Regression
-One Way and Two Way Fixed Effect Model

Dependent Variable (Type of Efficiency):	**Cost**		**Revenue**	
Variable/Model(Fixed Effects)	**Year**	**Year+Firm**	**Year**	**Year+Firm**
Intercept	-0.3749***	0.0229	-0.0863***	0.0761
	(0.0195)	(0.0625)	(0.0206)	(0.0700)
Indicator for MA	-0.0201***	-0.0023	-0.0227***	-0.0134**
	(0.0068)	(0.0056)	(0.0072)	(0.0063)
Size				
Natural log of assets	0.027***	0.0191***	0.0133***	0.0256***
	(0.0009)	(0.0028)	(0.0009)	(0.0031)
Business Mix				
% of Losses Incurred in PP Line	0.2848***	0.2727***	-0.0275***	-0.0956***
	(0.0061)	(0.0148)	0.0069	(0.0166)
% of Losses Incurred in PL Line	0.2543***	0.1886***	-0.0505***	-0.0533***
	(0.0073)	(0.0138)	(0.0075)	(0.0155)
% of Losses Incurred in CL Line	-0.0037	-0.0420***	0.0037	-0.0177
	(0.0047)	(0.0110)	(0.0050)	(0.0123)
Geographic Herfindahl Index	0.0442***	0.0140**	0.0280***	0.0287***
	(0.0041)	(0.0063)	(0.0043)	(0.0070)
Product Line Herfindahl Index	0.0204***	0.0003	0.0070	-0.0311
	(0.0053)	(0.0079)	(0.0056)	(0.0089)
Capitalization				
Net Premium Written/Surplus	0.0235***	0.0338***	0.0769***	0.0632***
	(0.0018)	(0.0023)	(0.0020)	(0.0026)
(Cash+Invested Assets)/Liability	-0.0334***	-0.0295***	-0.0037	-0.0205***
	(0.0033)	(0.0036)	(0.0035)	(0.0040)
Distributions Systems				
Direct Marketing	0.0686***	0.0034	0.0074**	0.0167**
	(0.0035)	(0.0065)	(0.0037)	(0.0073)
Brokerage	0.0142**	0.0094	0.0216	0.0004
	(0.0058)	(0.0135)	(0.0061)	(0.0151)
Mixed Distribution	0.0075	-0.0134	-0.0296	0.0247***
	(0.0057)	(0.0083)	(0.0061)	(0.0093)
Organization Form				
Mutual	0.0107***	0.0035	0.0125	0.0015
	(0.0031)	(0.0075)	(0.0033)	(0.0084)
Unaffiliated Single Firms	0.0166***	0.0178***	0.0074**	0.0148**
	(0.0033)	(0.0069)	(0.0035)	(0.0072)
Regulation				
Firm Licensed in New York	-0.0138**	-0.0220*	-0.0125**	0.0170
	(0.0046)	(0.0122)	(0.0049)	(0.0137)
Adjusted R-square	0.51	0.80	0.38	0.72
F-Statistic for fixed effect	148.61	11.78	226.06	13.17
Observations	10643	10643	10643	10643

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table17. Decomposition of Cost Efficiency Regression -One Way and Two Way Fixed Effect Model

Dependent Variable:	Pure Technical		Scale		Allocative	
Variable/Model	**Model1**	**Model2**	**Model1**	**Model2**	**Model1**	**Model2**
Intercept	-0.8897***	-0.3161***	1.4170***	1.5201***	0.0444***	0.4076***
	(0.0305)	(0.0944)	(0.0212)	(0.0749)	(0.0224)	(0.0809)
Indicator for MA	-0.0213**	-0.0080	-0.0114*	0.0048	0.0072	0.0036
	(0.0106)	(0.0085)	(0.0074)	(0.0068)	(0.0078)	(0.0073)
Size						
Natural log of assets	0.0639***	0.0515***	-0.0320**	-0.0319*	0.0141***	0.0201***
	(0.0014)	(0.0042)	(0.0010)	(0.0033)	(0.0010)	(0.0036)
Business Mix						
% of Losses Incurred in PP Line	0.2629***	0.2311***	0.0759***	0.0516***	0.1911***	0.1875***
	(0.0103)	(0.0224)	(0.0071)	(0.0177)	(0.0075)	(0.0192)
% of Losses Incurred in PL Line	0.1900***	0.1916***	0.0536***	0.0244	0.1891***	0.1275***
	(0.0111)	(0.0208)	(0.0077)	(0.0165)	(0.0081)	(0.0179)
% of Losses Incurred in CL Line	0.0176**	-0.0207	-0.0332***	-0.0698***	0.0431***	0.0227
	(0.0073)	(0.0166)	(0.0051)	(0.0132)	(0.0054)	(0.0142)
Geographic Herfindahl Index	0.0278***	0.0178*	0.0195***	0.0263***	0.0417***	0.0280***
	(0.0064)	(0.0095)	(0.0045)	(0.0075)	(0.0047)	(0.0081)
Product Line Herfindahl Index	0.0383***	0.0325***	0.0051	0.0217	-0.0545*	-0.0423
	(0.0082)	(0.0120)	(0.0057)	(0.0095)	(0.0060)	(0.0103)
Capitalization						
Net Premium Written/Surplus	0.0534***	0.0846***	0.0064**	0.0144**	-0.0236**	-0.0287*
	(0.0029)	(0.0035)	(0.0020)	(0.0028)	(0.0021)	(0.0030)
(Cash+Invested Assets)/Liability	0.0111	-0.0260***	-0.0469***	-0.0255***	-0.0438***	-0.0192***
	(0.0051)	(0.0055)	(0.0036)	(0.0043)	(0.0038)	(0.0047)
Distributions Systems						
Direct Marketing	0.0995***	0.0085	0.0095**	0.0159**	-0.0109**	-0.0053
	(0.0055)	(0.0099)	(0.0038)	(0.0078)	(0.0040)	(0.0084)
Brokerage	0.0285***	0.0236	0.0157**	0.0257	-0.0430	-0.0286
	(0.0090)	(0.0204)	(0.0063)	(0.0162)	(0.0066)	(0.0175)
Mixed Distribution	-0.0100	-0.0373***	0.0226***	0.0271***	-0.0084	-0.0273**
	(0.0090)	(0.0126)	(0.0062)	(0.0099)	(0.0066)	(0.0108)
Organization Form						
Mutual	0.0496***	0.0082	0.0086**	-0.0120	0.0621***	0.0053
	(0.0048)	(0.0114)	(0.0034)	(0.0090)	(0.0035)	(0.0097)
Unaffiliated Single Firms	0.0351***	0.0311***	0.0146***	0.0148**	-0.0175***	-0.0124*
	(0.0052)	(0.0110)	(0.0036)	(0.0066)	(0.0038)	(0.0070)
Regulation						
Firm Licensed in New York	-0.0120*	-0.0122	-0.0011	0.0009	0.0047	-0.0218
	(0.0072)	(0.0185)	(0.0050)	(0.0147)	(0.0053)	(0.0158)
Adjusted R-square	0.38	0.76	0.24	0.62	0.33	0.66
F-Statistic for fixed effect	70.85	11.26	114.44	6.48	183.45	6.43
Observations	10643	10643	10643	10643	10643	10643

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively. Model1 indicates one-way (year) fixed effect and model2 represents two-way (year and firm) fixed effects.

Table18. Performance (ROA) Regression-One Way Fixed Effect and IV Model

Dependent Variable:	Return On Assets		
Variable/Model	Year Fixed	Year Fixed	IV
Intercept	-0.0884***	-0.0848***	-0.0936***
	(0.0125)	(0.0123)	(0.0117)
Indicator for MA	-0.0153***	-0.0152***	-0.0120***
	(0.0042)	(0.0042)	(0.0040)
Natural log of Assets	0.0059***	0.0050***	0.0049***
	(0.0005)	(0.0005)	(0.0005)
Equity Capital/Total Assets	0.0857***	0.0827***	0.1049***
	(0.0037)	(0.0036)	(0.0035)
% of Premium Written in PP Line	-0.0084*	-0.0037	-0.0052
	(0.0043)	(0.0041)	(0.0039)
% of Premium Written in PL Line	-0.0061	-0.0088*	-0.0067
	(0.0046)	(0.0045)	(0.0043)
% of Premium Written in CP Line	0.0166***	0.0198***	0.0146***
	(0.0032)	(0.0030)	(0.0028)
Geographic Herfindahl Index	0.0018	0.0010	-0.0031
	(0.0025)	(0.0025)	(0.0024)
Product Line Herfindahl Index	0.0177***	0.0150***	0.0159***
	(0.0033)	(0.0032)	(0.0031)
Direct Marketing	0.0105***	0.0081***	0.0085***
	(0.0022)	(0.0022)	(0.0021)
Brokerage	-0.0043	-0.0051	0.0016
	(0.0036)	(0.0036)	(0.0034)
Mixed Distribution	-0.0025	-0.0035	0.0034
	(0.0036)	(0.0035)	(0.0034)
Mutual	-0.0127***	-0.0141***	-0.0130***
	(0.0019)	(0.0019)	(0.0018)
Unaffiliated Single Firms	0.0059***	0.0052**	0.0089***
	(0.0021)	(0.0021)	(0.0020)
Firm Licensed in New York	-0.0094***	-0.0100***	-0.0061**
	(0.0029)	(0.0029)	(0.0027)
Revenue efficiency			0.1713***
			(0.0051)
Standard Deviation of Returns over past 5 years		-0.0211**	-0.0248**
		(0.0101)	(0.0096)
Firm Portfolio Risk	-0.1077***		
	(0.0288)		
Adjusted R-square	0.10	0.11	0.19
F-Statistic for fixed effect	41.64	45.01	82.13
Observations	10643	10643	10643

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table19. Performance (ROE) Regression-One Way Fixed Effect and IV Model

Dependent Variable:	Return On Equity		
Variable/Model	**Year Fixed**	**Year Fixed**	**IV**
Intercept	-0.1587***	-0.1023***	-0.1184***
	(0.0313)	(0.0311)	(0.0298)
Indicator for MA	-0.0363***	-0.0349***	-0.0272***
	(0.0106)	(0.0105)	(0.0101)
Natural log of Assets	0.0155***	0.0121***	0.0118***
	(0.0014)	(0.0013)	(0.0013)
Equity Capital/Total Assets	0.0193	-0.0049	0.0456***
	(0.0092)	(0.0093)	(0.0090)
% of Premium Written in PP Line	-0.0197*	-0.0132	-0.0173*
	(0.0107)	(0.0102)	(0.0098)
% of Premium Written in PL Line	-0.0116	-0.0177	-0.0128
	(0.0114)	(0.0113)	(0.0108)
% of Premium Written in CP Line	0.0281***	0.0308***	0.0178**
	(0.0081)	(0.0075)	(0.0071)
Geographic Herfindahl Index	0.0056	0.0066	-0.0030
	(0.0064)	(0.0064)	(0.0061)
Product Line Herfindahl Index	0.0582***	0.0536***	0.0557***
	(0.0082)	(0.0081)	(0.0078)
Direct Marketing	0.0245***	0.0182***	0.0187***
	(0.0055)	(0.0055)	(0.0052)
Brokerage	-0.0017	-0.0048	0.0114
	(0.0090)	(0.0089)	(0.0085)
Mixed Distribution	-0.0162*	-0.0159*	0.0009
	(0.0090)	(0.0089)	(0.0085)
Mutual	-0.0168***	-0.0239***	-0.0217***
	(0.0048)	(0.0048)	(0.0045)
Unaffiliated Single Firms	0.0206***	0.0195***	0.0286***
	(0.0054)	(0.0054)	(0.0051)
Indicator for Firm Licensed in New York	-0.0233***	-0.0249***	-0.0155**
	(0.0073)	(0.0072)	(0.0069)
Revenue efficiency			0.4083***
			(0.0129)
Standard Deviation of Returns over past 5 years		-0.1337***	-0.1489***
		(0.0131)	(0.0126)
Firm Portfolio Risk	-0.2932***		
	(0.0719)		
Adjusted R-square	0.05	0.06	0.14
F-Statistic for fixed effect	18.42	23.26	55.67
Observations	10643	10643	10643

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.

Table20. Combined Ratio Regression-One Way Fixed Effect Model

Dependent Variable:	Combined Ratio			
Variable/Lines of Business	**PP**	**PL**	**CP**	**CL**
Intercept	1.1706***	1.2226***	1.0152***	0.8240***
	(0.0480)	(0.0601)	(0.0457)	(0.0587)
Indicator for MA	0.0492***	0.0093	-0.0021	0.0362*
	(0.0148)	(0.0184)	(0.0150)	(0.0195)
Natural log of Assets	-0.0167***	-0.0114***	-0.0012	0.0128***
	(0.0022)	(0.0028)	(0.0021)	(0.0027)
Equity Capital/Total Assets	0.0093*	-0.0844***	-0.0560***	-0.0467**
	(0.0138)	(0.0180)	(0.0131)	(0.0185)
Geographic Herfindahl Index	-0.0274***	-0.0657***	-0.0693***	-0.0376***
	(0.0106)	(0.0136)	(0.0099)	(0.0129)
Product Line Herfindahl Index	-0.0827***	-0.0397	-0.0348***	-0.1641***
	(0.0174)	(0.0256)	(0.0129)	(0.0150)
Direct Marketing	-0.0205**	0.02314*	-0.0172*	-0.0303***
	(0.0095)	(0.0118)	(0.0088)	(0.0111)
Brokerage	0.0138	0.0105	-0.0093	-0.0052
	(0.0145)	(0.0185)	(0.0137)	(0.0170)
Mixed Distribution	-0.0660***	0.0111	0.0010	0.0145
	(0.0166)	(0.0231)	(0.0148)	(0.0168)
Mutual	0.1003***	0.0232**	0.0060	-0.0036
	(0.0069)	(0.0092)	(0.0070)	(0.0090)
Unaffiliated Single Firms	-0.0357***	-0.0555***	-0.0463***	-0.0515***
	(0.0087)	(0.0111)	(0.0083)	(0.0110)
Firm Licensed in New York	0.0181*	0.0573***	-0.0105	0.0911***
	(0.0103)	(0.0148)	(0.0104)	(0.0149)
Adjusted R-square	0.08	0.05	0.05	0.08
F-Statistic for fixed effect	25.24	9.62	13.72	25.28
Observations	7259	5176	7786	7314

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively. PP represents personal property line, PL personal liability line, CP commercial property line, and CL commercial liability line.

Table21. Expense Ratio Regression-One Way Fixed Effect Model

Dependent Variable:	**Expense Ratio**			
Variable/Lines of Business	**PP**	**PL**	**CP**	**CL**
Intercept	0.6121***	0.5561***	0.9522***	0.7736***
	(0.0252)	(0.0242)	(0.0275)	(0.0281)
Indicator for MA	0.0274***	0.0085	-0.0110	0.0166*
	(0.0078)	(0.0074)	(0.0090)	(0.0093)
Natural log of Assets	-0.0196***	-0.0175***	-0.0271***	-0.0190***
	(0.0011)	(0.0011)	(0.0012)	(0.0013)
Equity Capital/Total Assets	0.0528***	-0.0330***	0.0207***	0.0273***
	(0.0072)	(0.0072)	(0.0078)	(0.0089)
Geographic Herfindahl Index	-0.0278***	-0.0078	-0.0605***	-0.0315***
	(0.0055)	(0.0054)	(0.0060)	(0.0061)
Product Line Herfindahl Index	-0.0511***	-0.0228**	0.0172*	-0.1575***
	(0.0091)	(0.0103)	(0.0077)	(0.0071)
Direct Marketing	-0.0419***	-0.0219***	-0.0642***	-0.0607***
	(0.0050)	(0.0047)	(0.0052)	(0.0053)
Brokerage	-0.0082	0.0089	-0.0624***	-0.0079
	(0.0076)	(0.0074)	(0.0082)	(0.0081)
Mixed Distribution	-0.0687***	-0.0150	-0.0188**	-0.0182**
	(0.0087)	(0.0092)	(0.0089)	(0.0080)
Mutual	0.0515***	0.0012	-0.0301***	0.0376***
	(0.0036)	(0.0037)	(0.0042)	(0.0043)
Unaffiliated Single Firms	-0.0254***	-0.0300***	-0.0308***	-0.0170***
	(0.0045)	(0.0045)	(0.0050)	(0.0052)
Firm Licensed in New York	0.0198***	0.0019	-0.0382***	0.0251***
	(0.0054)	(0.0059)	(0.0062)	(0.0071)
Adjusted R-square	0.15	0.23	0.13	0.18
F-Statistic for fixed effect	49.78	59.80	44.80	60.02
Observations	7259	5176	7786	7314

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively. PP represents personal property line, PL personal liability line, CP commercial property line, and CL commercial liability line.

Table22. Risk-Adjusted Performance Regression-One Way Fixed Effect and IV Model

Dependent Variable:	**Risk-Adjusted ROA**		**Risk-Adjusted ROE**	
Variable/Model	**Fixed Effect**	**IV**	**Fixed Effect**	**IV**
Intercept	-2.7869***	-2.9044***	-1.7294*	-1.8406**
	(0.3393)	(0.3364)	(0.8862)	(0.8857)
Indicator for MA	-0.4430***	-0.4071***	-0.4559*	-0.4218*
	(0.1171)	(0.1161)	(0.3058)	(0.3056)
Natural log of Assets	0.1962***	0.1951***	0.1877***	0.1866***
	(0.0153)	(0.0152)	(0.0401)	(0.0400)
Equity Capital/Total Assets	0.9913***	1.2646***	0.5820**	0.8415***
	(0.1015)	(0.1025)	(0.2651)	(0.2698)
% of Premium Written in PP Line	0.2341**	0.2184*	0.2020	0.1870
	(0.1133)	(0.1123)	(0.2960)	(0.2957)
% of Premium Written in PL Line	0.0484	0.0867	0.8926***	0.9289***
	(0.1250)	(0.1239)	(0.3265)	(0.3262)
% of Premium Written in CP Line	0.5875***	0.5311***	0.8107***	0.7571***
	(0.0826)	(0.0820)	(0.2158)	(0.2159)
Geographic Herfindahl Index	0.2825***	0.3350***	0.5284***	0.5782***
	(0.0709)	(0.0704)	(0.1852)	(0.1853)
Product Line Herfindahl Index	0.7735***	0.7960***	1.1055***	1.1270***
	(0.0903)	(0.0895)	(0.2359)	(0.2356)
Direct Marketing	0.0604	0.0762	-0.0593	-0.0442
	(0.0606)	(0.0601)	(0.1584)	(0.1583)
Brokerage	0.1144	0.1966**	-0.0413	0.0367
	(0.0990)	(0.0983)	(0.2587)	(0.2589)
Mixed Distribution	-0.3367***	-0.2493**	-0.4389*	-0.3559
	(0.0988)	(0.0981)	(0.2581)	(0.2584)
Mutual	-0.0564	-0.0409	0.0874	0.1021
	(0.0529)	(0.0524)	(0.1382)	(0.1381)
Unaffiliated Single Firms	0.0339***	0.3835***	0.1896	0.2316
	(0.0598)	(0.0593)	(0.1562)	(0.1562)
Firm Licensed in New York	-0.1259	-0.0803	-0.1827	-0.1394
	(0.0800)	(0.0793)	(0.2089)	(0.2089)
Revenue efficiency		2.0749***		1.9698***
		(0.1481)		(0.3900)
Adjusted R-square	0.06	0.07	0.02	0.03
F-Statistic for fixed effect	21.94	28.13	5.60	6.28
Observations	10643	10643	10643	10643

Notes: Standard errors are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent level, respectively.