Fall 12-22-2009

Executive Incentives and Corporate Decisions: The Risk Management Channel

Jeremy O. Skog
University of Pennsylvania, skog@wharton.upenn.edu

Executive Incentives and Corporate Decisions: The Risk Management Channel

Abstract
This paper provides evidence that insurance executives respond to their compensation incentives by adjusting observable risk-management policy variables – the reinsurance purchase decision, type of business conducted, and firm leverage. Executive incentives are modeled by the executive sensitivity of wealth to stock price (Delta) and stock volatility (Vega). Firms respond to increased executive incentives to bear risk by purchasing less reinsurance, but also conducting less business in long-tailed lines – a change which rewards the executive through increased market volatility. The cost of altering executive incentives to effect firm policy is much less than a similar change in firm structural variables.

Degree Type
Dissertation

Degree Name
Doctor of Philosophy (PhD)

Graduate Group
Applied Economics

First Advisor
Greg Nini

Second Advisor
Scott Harrington

Third Advisor
John Core

Keywords
Executive Compensation, Corporate Governance, Risk Management, Insurance

Subject Categories
Finance | Finance and Financial Management | Insurance | Labor Economics

EXECUTIVE INCENTIVES AND CORPORATE DECISIONS:

THE RISK MANAGEMENT CHANNEL

Jeremy Skog

A DISSERTATION

In

Applied Economics

For the Graduate Group in Managerial Science and Applied Economics

Presented to the Faculties of the University of Pennsylvania

In

Partial Fulfillment of the Requirements for the

Degree of Doctor of Philosophy

2009

Supervisor of Dissertation:

Signature

Greg Nini, Assistant Professor, Insurance and Risk Management

Graduate Group Chairperson:

Signature

Eric Bradlow, Professor of Marketing, Statistics, and Education

Dissertation Committee:

John Core, Professor, Accounting

Scott Harrington, Professor, Insurance and Risk Management

Greg Nini, Assistant Professor, Insurance and Risk Management

Executive Incentives and Corporate Decisions: The Risk Management Channel

Acknowledgment

I appreciate comments from Greg Nini, Neil Doherty, John Core, Scott Harrington and Wayne Guay. Further comments and questions via email are welcome and appreciated. I appreciate support from the Huebner Foundation, which provided the fellowship making this paper possible.

ABSTRACT

EXECUTIVE INCENTIVES AND CORPORATE DECISIONS: THE RISK MANAGEMENT CHANNEL

Jeremy Skog

Greg Nini

This paper provides evidence that insurance executives respond to their compensation incentives by adjusting observable risk-management policy variables – the reinsurance purchase decision, type of business conducted, and firm leverage. Executive incentives are modeled by the executive sensitivity of wealth to stock price (Delta) and stock volatility (Vega). Firms respond to increased executive incentives to bear risk by purchasing less reinsurance, but also conducting less business in long-tailed lines – a change which rewards the executive through increased market volatility. The cost of altering executive incentives to effect firm policy is much less than a similar change in firm structural variables.

Table of Contents

List of Tables

List of Figures

1. Introduction

The risk management decision is of fundamental importance to any firm and must be addressed by boards of directors when deciding which managers to hire and how best to compensate them for their labor. To the extent that any policy decision made by the firm is determined by its managers, analyzing a company's risk-management policy without simultaneously analyzing the motivations of the management can give only partial insight into the reasons behind any decision. This study examines the effect of executive compensation incentives on the risk management decisions of insurance companies.

The managerial motivation literature can be divided into two major approaches. One approach attempts to model the decision made by the manager in a principal-agent framework where the goal of compensation design is to urge the manager to expend a high level of effort on the firm. I do not follow this technique as the anecdotal problem is not to get managers to expend a high level of effort, but for them to spend that effort on value-creating activities for the benefit of stockholders rather than on perquisites with private benefits which they alone enjoy. I focus on the second approach, examining the pay-for-performance sensitivity measurement. In these studies, the empirical goal is to identify the relationship between managerial decisions and the incentives contained in the structure of the manager's compensation package. These sensitivities provide a measure of how the manager's payoff varies with the rewards to shareholders and, consequently, of how closely the incentives of the managers are aligned with those of the firm's owners. I particularly investigate the observable decisions associated with a company's risk-management policies.

I examine managers' responses to their incentives using a data set composed of the largest publicly-traded insurance groups from 1992 to 2004, combining operating information from regulatory filings with publicly available information on the compensation of their executives. Because the handling and measurement of risk is the primary business of insurance companies, these firms should particularly focus on this part of their firm's decisions. By focusing on a single industry, I am also able to examine the firm's decisions at a close level and make use of decision variables specific to the industry. The use of the reinsurance variable and business-specific leverage measures is a significant improvement to the literature as it allows me to directly measure a company's risk-taking and exposure to bankruptcy risk in the company's main line of business as opposed to the more noisy proxies used in studies such as Coles, Daniel, and Naveen, (2006), Tufano (1996), Berger, Ofek and Yermack (1997), Rogers (2002), Anderson, Bates, Bizjak, and Lemmon (2000), Baghat and Welch (1995). Proxies have included leverage, corporate focus, research and development, and capital expenditure, and find mixed results. As the risk due to the insurance policies written by the firm cannot be easily hedged through derivatives contracts, reinsurance can provide a more complete measure of risk exposure. The decision of how many premiums to write relative to capital reserves is likely a substitute for this decision and I examine it as another risk decision made by the management. If managers respond to board-given incentives, then it is possible for the board of directors to induce shareholder-desired corporate policies through careful design of the compensation package. As incentives are mainly determined by board-adjustable option parameters such as the time-to-maturity of the options, it should be possible for companies to change their risk-profile over time in the interest of investors. In the end, these decisions may be a path through which boards may design executive compensation packages to increase shareholder value.

I find that, when accounting for relations between companies and structural policy decisions, the incentives given to the management have the ability to alter some aspects of the firm's risk-management decisions, although whether this actually increases the risk-profile of the firm is unclear. Depending on the measurement variable, results are mixed, indicating that rewarding managers for bearing risk, as measured through their reported compensation schemes, may actually encourage firms to conduct less business in risky lines, although they retain more of this business on their own books. Managerial incentives appear to play some role in determining firm decisions and the risk-management decision appears to be a potential path through which managerial incentives may affect firm performance, although the market's valuation of these decisions is weak.

The remainder of the paper is structured as follows: the next section reviews the existing literature of corporate risk-management and the role of executive compensation. Section three describes the sources of the data on insurance companies and the compensation of their managers. Sections four and five describe the empirical set-up and results. Section six focuses on various robustness tests. Section seven concludes.

2. Literature Review and Identification of Contributions

2.1 Reinsurance Literature

Executives are concerned with their firm's risk management because of the many benefits it provides to the various stakeholders in the firm. Shareholders gain value from reduced financing costs because of a lower discount rate due to larger and more stable cash-flows which reduce the chance of incurring bankruptcy costs (Stulz, 1996). Value is created through various channels including the level and type of projects chosen by managers, debt and tax costs, expected bankruptcy costs as well as lower transaction costs with other stakeholders and counterparties due to the increased likelihood of continuing the business relationship. Employees of the firm benefit from financial rewards and increased stability as they cannot diversify their employment risk as shareholders can with their financial risk.

Managers have several reasons, which are explained below (Stulz (1990), Stulz (1984), Mayers and Smith (1982)), to control the risk exposure of a firm and to adjust this exposure according to their personal preferences, which likely differ from those of shareholders. This differential creates agency costs from the shareholder's perspective and leads shareholders to take action to try and reduce these costs since managers, even while they may principally act in the shareholder's interest, are at the same time pursuing their own private goals.

Agency problems may result from several factors. First, managers likely have a higher proportion of their wealth invested in the firm, as well as relying on the firm's continued existence for their current and expected future income. Managers also depend on the firm for non-monetary rewards in a way that shareholders do not. Non-monetary aspects of compensation may include awards, reputation, and the potential for promotion. If corporate risk management increases shareholder value, then actions by executives to reduce risk will also be desired by shareholders. Since it is often impossible or illegal for executives to hedge their financial exposure to a firm, they may attempt to conduct this hedging at the corporate, rather than the individual, level.

Though shareholders and managers may both find risk management beneficial, conflict between management and shareholders may arise if they desire different levels of hedging. Because they are assumed to have risk-averse utility functions, the management may wish to hedge beyond the point where hedging increases firm value - managers are primarily interested in the value of hedging in preventing bankruptcy rather than benefits from value creation through tax savings, reduced underinvestment and asset substitution problems and more optimal risk sharing. This may lead managers to implement strategies which, while decreasing the risk of bankruptcy, actually lower the overall value of the firm. A firm might engage in diversification through conglomerate-building or enter into lines of business where the company cannot add value (Bartam, 2000), for example. Empirically, Coles, Daniel and Naveen (2003) show that firms whose managers are rewarded for bearing risk are more focused in their business activities.

Thus, the incentives given through contracts and compensation need to be carefully constructed to avoid incenting managers towards value-destroying activities while still rewarding value-creating ones. Most companies accomplish this linkage by tying employee compensation to stock price rather than accounting targets, which are often under some managerial control and may be easier to manipulate. Incentives, which include options, need to be carefully targeted as increasing rewards to risk can help to reduce managerial risk aversion but may also induce speculative behavior - while tying rewards directly to stock price may even decrease the manager's desire to bear risk.

Empirical studies such as Schrand and Unal (1998), Tufano (1996), Haushalter (1997), Gay and Nam (1998) have shown that executives who are paid with more option compensation tend to hedge less, lending credence to the behavior-altering abilities of incentives. Ross (2004) shows that there is no incentive schedule that can make all expected-utility-maximizing managers less risk averse so grants must be tailored by the corporate boards to individual circumstances. In addition, Ju, Leland and Senbet (2002) show that the effect of options may be indeterminate, inducing either too much or too little risk taking depending on the underlying utility function and investment technology. Lewellyn (2003) and Parrino, Poteshman, and Weisbach (2005) provide evidence that options, especially if they are in the money, could discourage risk taking. This is because in-the-money options lose the convexity of their payouts and offer a payout schedule more like that of restricted or pure stock. Stock has been shown in Stulz (1984) to exacerbate risk aversion because it reduces the manager's diversification of wealth.

Existing research has studied various financial and operating decisions from a corporate risk-management framework. In general there are few conclusive results. Financial strategy – measured by leverage, share repurchases, or derivative use – tends to be (weakly) related to managerial stock and options ownership. Operating decisions such as expanding into a new line of business or investing in research and development also appear to be related to managerial compensation.

Other studies have shown that managers respond to incentives by increasing firm risk and decreasing hedging activities. DeFusco, Johnson and Zorn (1990) demonstrate that firms which approve stock option plans for executives display an increase in stock return variance, and Guay (1999) shows that the standard deviation of returns are associated with contemporaneous vega, the sensitivity of executive wealth to a change in stock volatility. Demonstrating how incentives granted in one year may take time to be implemented and to have an effect on observable firm decisions, Rajgopal and Shevlin (2002) show that lagged vega is associated with increased oil exploration risk. Providing further evidence of the effect of incentives, Knopf, Nam and Thornton (2002) show that the use of derivatives is negatively associated with Vega and positively associated with delta. Examining other risk measures, Cohen, Hall and Viceira (2000) find that leverage and stock return volatility are both positively related to the elasticity of CEO wealth in stock return volatility.

This paper contributes to this literature by using a purer measure of risk-bearing and a comprehensive dataset of the insurance industry. By examining firms at the insurance group level, I can eliminate capital cost, internal risk shifting, tax, and other reasons why companies might appear to be purchasing reinsurance but are actually just shifting it within the firm. By limiting the data set to the insurance industry I examine firms which have advanced risk-management strategies and I am able to reduce the unobservable differences between firms. I am also able to examine and use industry-specific variables which should affect a firm's risk-bearing decision.

I also demonstrate that incentives appear to lead to changes in company policy, implying a role for compensation in directing corporate decisions. As most firm decisions are made by the management, it is therefore necessary to consider the incentives of the managerial team in any study of firm decision-making.

2.2 Hypotheses and Decision Variables

Based on the literature I make several hypotheses on the role of executive incentives in firm decisions. These hypotheses are given below and the empirical techniques used to test them are examined in section 4 of this paper.

2.2.1 Firm Decisions

If managers are responding to the increased rewards for risk by increasing the volatility of firm earnings then they should do so by altering the level of observable firm-risk variables.

Hypothesis 1) Ceteris paribus, managers with a higher level of vega should increase the level of risk in firm-decision variables.

To measure risk and determine if managers are attempting to make riskier decisions, I examine several observable variables which capture a variety of insurer decisions that affect the risk of their business.

2.2.2 Risk Management and Volatility

If these variables are to have an effect on the managerial incentives tied to stock performance, then it is necessary that riskier actions should increase the volatility of stock returns:

Hypothesis 2) Ceteris paribus, riskier choices in the firm decision variables should increase the volatility of stock returns for the insurance group.

This hypothesis provides the link between the actions that managers are taking when setting their firm policies and the rewards that they see from their incentive pay. This link is necessary if managers are translating their incentives into observable firm decisions through the risk management channel.

2.2.3 Reinsurance

This study examines the reinsurance purchase decisions made by insurance companies as one way in which they manage their risk-management decisions. The use of the reinsurance variable allows a direct measure of an insurance company's risk-bearing and exposure to bankruptcy risk in the company's main line of business, as opposed to the more noisy proxies used in other studies such as those mentioned in the section 1. Proxies have included leverage, corporate focus, research and development, and capital expenditure, and they find mixed results. The risk to the firm due to writing insurance policies cannot be easily hedged through derivatives contracts and therefore reinsurance can provide a more complete measure of this particular risk exposure. A higher level of vega should be associated with less reinsurance purchase and more risk retained by the firm.

2.2.4 Premium/Surplus Ratio

Concurrently with determining its reinsurance purchase a firm is determining what amount of insurance policies, and their associated expected risk as measured by premiums, it should write in relation to its surplus. Surplus is the reserve that insurance companies keep to protect them from larger-than-expected losses and hence the likelihood of ruin. A larger ratio makes bankruptcy more likely for the firm and is therefore a more risky decision. A higher ratio should therefore be associated with higher levels of vega.

2.2.5 Proportion of Business in Long-Tailed Lines

Certain lines of business expose the firm to more risk than others. These are known as schedule-P or long-tailed lines. I use the same definition as in Phillips, Cummins, and Allen (1996) and shown in Appendix 1. One way for firms to respond to risk-incentives would be to keep all other firm decision variables constant but simply conduct more business in riskier lines. I therefore compare the other firm decision variables with the amount of business conducted in these longer-liability lines. A higher proportion should be associated with higher levels of vega if firms are increasing risk in this way.

2.2.6 A.M. Best's Capital Adequacy Ratio

The A.M. Best Capital Adequacy Ratio measures a company's relative capital strength compared to industry composites as established by A.M. Best and is related to its premium surplus ratio. The specific calculation is adjusted surplus divided by net required capital. Adjusted surplus is calculated from reported surplus, which is then modified with adjustments related to loss reserves, assets, and off-balance-sheet liability exposures. The net required capital is calculated by separating investments into seven different risk categories. The capital is then determined as a sum of these, less a covariance adjustment which controls for the independence of risks across securities category. This ratio is important in determining the company's A.M. Best rating and is therefore another measure of the firm's leverage decision – one which is specific to insurance companies. A higher ratio means that the company has more surplus relative to the level deemed necessary according to its business. Therefore a lower ratio should be associated with higher levels of vega.

2.3 Additional Contributions to the Literature

The main contributions that this paper makes to the literature are further examining the role of incentives in firm risk decisions within a specific industry using previously unexamined measures of firm risk-bearing. By focusing on a specific industry I am able to include industry-specific control variables which are determinants of the company's risk-management decision as well as specific measures of risk-bearing. Because the business of the insurance industry is to manage risk they should have well-developed methods of handling risk policy and it should be a major focus of their management, thus the insurance industry seems ideal for this sort of study. I also examine whether companies are responding selectively – whether they simply take on riskier business while keeping the amount of business constant or whether managers make generally riskier or generally safer decisions. The variables used in this study cover most of the risk decisions available to insurance firms – types of premiums to write, amount to retain, and level of capital to back them up.

3. Data and Variable Creation

3.1 Data Gathering and Merging

Information on the insurance companies and groups is assembled from the yearly NAIC statements from 1993 through 2004, years which were chosen based on data availability. Data for the year 1992 was obtained from historical data in the 1993 statement and used for creating lagged values. This insurance data is merged with information on executives from Standard and Poor's Execucomp database and Compustat. CRSP data is also used for stock return information. The merging of these datasets restricts the type of companies which can be included in this study. These restrictions are explained below and comparisons are made between my specific dataset and the wider, unrestricted, market datasets.

The NAIC data files give information on the line-level business of insurers in terms of premiums written and business retained. From this it is possible to construct variables measuring a firm's exposure to policies and diversification, discussed below. It is also possible to determine the volatility and correlation of losses and investment earnings, which is expected to have an effect on risk decisions. Discrepancies in data definitions between years are resolved with the goal of producing variables which are as consistent as possible over the entire data range. This data was merged with the A.M. Best dataset which provides higher-level summary data on firms and served as a useful check on my variable calculations. Summary statistics for relevant variables appear in table 1.

3.1.1 Formation of Insurance Groups

Since an achievement of this study over prior literature is examining a more overarching ownership structure by studying insurance groups, rather than companies, a key part was properly tracking group ownership in the universe of insurance companies over time. Examining reinsurance at the insurance group level separates the actual off-loading of risk from internal risk-shifting and capital structure decisions. Examining risk-bearing at only the company level may yield spurious results because the risk transfer may be made for internal cost-of-capital or diversification reasons and may not actually represent the truly desired risk-management decision. CEO data from Execucomp is at the level of the insurer holding group so observable firm decisions should be measured at the same level as the incentives which inspire them. I created a proprietary merge-key to track group ownership of companies by year as they were merged, acquired and sold. The identifiers within the AM Best data were often erroneous when combined as panel-data as the raw data is isolated by year and did not accurately track ownership of companies over time.

For each insurance group, I created a list of NAIC company codes corresponding to firms which the group owned in each year and used this to fill in observations where companies might not be listed under the groups which owned them, including years for which group ownership data was missing. I created a record of group mergers with the acquiring group listed as owning all companies previously listed owned by the acquired group, unless they were specifically listed under another group's code and hence ownership. Furthermore, the code number assigned to groups varied over time in the original AM Best data. These codes were reconciled so that a group was listed under a single code for all of the years it exists in the dataset. If a company was owned by a particular group in year *t* and in year *t+2* it as assumed to be owned by the same group in year *t+1* unless specifically noted otherwise. The first year a company appears under group ownership in the dataset, it is assumed to be owned by that group for all previous years in the dataset. If the company had been independent, it would have been listed under its own group heading. By making these assumptions, I account for all missing data on group ownership.

There was not a pre-existing variable which identified firms in both the NAIC data and in the COMPUSTAT data. I therefore created a merge-key which was used to merge the two data sets. Companies were matched as seemed best appropriate on information such as stock ticker symbol, group name, chief executive name, and headquarters location. This key was then used to join the data sets. The final result is a set of panel data identified at the insurer group/year level. There are a total of 77 groups appearing in the data, although not each one appears in every year due to the changing nature of the insurance industry and company mergers and acquisitions. The names of groups appearing appear in Appendix 2.

Table 1: Summary Statistics

This table presents summary statistics of the variables used in this study, from years 1992-2004 in the ExecuComp database. The set of observations is those for which Risk Retained, Delta and Vega are available. Managerial variables are summarized for non-missing observations and missing variables are controlled for with the missing dummy variables. Total return to shareholders measures include dividends. Vega is the sensitivity of executive wealth to a .01 change in stock return variance and delta is the sensitivity to a 1% change in stock price. Fitted variables are calculated from the predicted values based upon a regression on managerial variables and structural variables. Team variables are calculated over the executives reported in the database. Firm size is calculated as the log of admitted assets for the insurance group reported to the NAIC. Risk Retained if the direct business of the firm less reinsurance ceded. Loss ratio is the sum of losses and loss adjustment expenses divided by premiums earned. Best's adequacy ratio is a risk-adjusted measure of surplus to necessary capital. The standard deviation of daily stock returns is obtained from CRSP data.

Rho is a measurement of the correlation between assets and losses, similar to the Myers-Read measure of insurance line risk used in capital allocation. The standard deviation of investment earnings, losses and premiums are calculated over the group's history in the data. Long-tailed lines are defined as in Phillips, Cummins and Allen (1996). Tax rate is determined from the reported taxes paid by the firm. The business herfindahl is calculated from reported direct business in each of the lines reported to the NAIC and the group concentration herfindahl is calculated by the total admitted assets of the group's constituent firms. All dollar values are calculated in 2004 constant dollars. Year dummies are provided to show how the availability of data changes over time, as the panel is not balanced.

variable	N	mean	sd	min	p25	p50	p75	max
Risk Measurement Variables								
Risk Retained (%)	305	81.305	19.837	7.471	79.897	88.736	93.206	100.000
Proportion of Business in Long-Tailed Lines (%)	305	61.443	32.145	0.000	52.371	68.243	76.049	117.443
Premium/Surplus Ratio (%)	300	321.500	514.342	0.000	63.350	168.249	319.330	2837.583
Best's Adequacy Ratio (%)	297	93.763	87.407	0.000	0.000	101.600	158.000	321.000
Change in Surplus ($ Million)	305	28.438	6017.854	-64581.490	-106.595	0.000	207.025	59599.250
Firm Performance Variables								
1-Year Return to Shareholders	297	15.158	32.690	-92.796	-2.688	13.582	34.054	167.826
Return On Assets	297	3.874	4.524	-8.851	1.655	2.855	4.784	37.191
Loss Ratio	272	1.982	8.408	-44.677	0.576	1.496	2.744	68.286
Growth in Premiums ($ BN)	231	632.833	11242.520	-54644.340	-46.110	1.989	1230.921	58.246
Ln(STD Stock Returns)	261	-4.018	0.363	-4.715	-4.284	-4.038	-3.792	-2.367
Executive Variables								
Age of CEO	179	53.960	5.847	39.738	49.757	53.749	58.003	67.705
Tenure As CEO	264	6.193	5.858	0.000	2.000	4.500	8.500	27.000
Tenure at Company	216	16.148	9.845	0.000	8.000	17.000	24.000	38.000
Missing: CEO Age	305	0.413	0.493					
Missing: CEO Tenure	305	0.134	0.342					
Missing: Tenure At Company	305	0.292	0.455					

variable	N	mean	sd	min	p25	p50	p75	max
DELTA ($1,000s)	305	1039.227	1963.498	10.716	113.256	274.651	825.946	10792.450
Lagged Delta ($1,000s)	203	1024.288	2040.341	10.716	106.229	259.091	793.426	10891.900
Lagged Delta t-2 ($1,000s)	159	945.458	2005.449	10.716	69.724	214.939	616.894	10792.450
VEGA ($1,000s)	305	114.174	163.411	0.659	13.702	47.764	137.989	923.330
Lagged Vega ($1,000s)	206	112.918	160.833	0.659	15.145	54.879	137.577	928.962
Lagged Vega t-2 ($1,000s)	162	93.156	138.076	0.659	10.644	41.499	114.471	734.469
Cash Compensation ($100,000)	305	12.952	8.455	2.053	7.500	10.024	15.900	49.622
Management Team Variables								
Team Delta ($1,000s)	318	2142.602	4193.72	22.46996	330.025	659.954	1825.328	28111.05
Team Vega ($1,000s)	318	257.193	379.853	3.566	37.897	116.930	292.771	2201.141
Team Cash Pay ($100,000s)	318	43.647	30.074	9.293	22.507	32.758	54.345	152.582
Firm Structure Variables								
Firm Size: Ln(Admitted Assets)	294	24.838	4.203	12.884	21.516	24.384	28.589	33.384
Proportion of Assets in Stocks and Bonds (%)	305	76.554	18.453	0.000	69.562	82.735	87.904	97.200
Rho	305	-0.004	0.012	-0.077	-0.003	-0.001	0.000	0.047
STD Investment Earnings	304	0.002	0.002	0.001	0.001	0.002	0.002	0.027
STD Losses	304	0.010	0.069	0.000	0.000	0.001	0.002	0.605
STD Premiums	304	1.792	11.029	0.000	0.145	0.255	0.643	96.937
Tax Rate	305	0.187	0.710	-7.497	0.104	0.209	0.292	4.402
Business Herfindahl	305	0.278	0.330	0.041	0.061	0.119	0.293	1.000
Number of States Licensed	305	37.472	20.089	0.000	22.000	50.000	52.000	55.000
AM Best Rating	305	19.397	25.331	0.000	0.000	11.000	13.000	72.000
Group Concentration Herfindahl	301	0.890	0.292	0.000	1.000	1.000	1.000	1.000
1992	305	0.046	0.210					
1993	305	0.069	0.254					
1994	305	0.062	0.242					
1995	305	0.075	0.264					
1996	305	0.075	0.264					
1997	305	0.085	0.280					
1998	305	0.102	0.303					
1999	305	0.095	0.294					
2000	305	0.072	0.259					
2001	305	0.092	0.289					
2002	305	0.085	0.280					
2003	305	0.069	0.254					
2004	305	0.072	0.259					

3.2 Comparison to Full Data Sets

To determine how the firms in my final dataset compare to the overall datasets in Execucomp and NAIC, I compare a few key variables to ensure consistency and note differences between my data and the wider market.

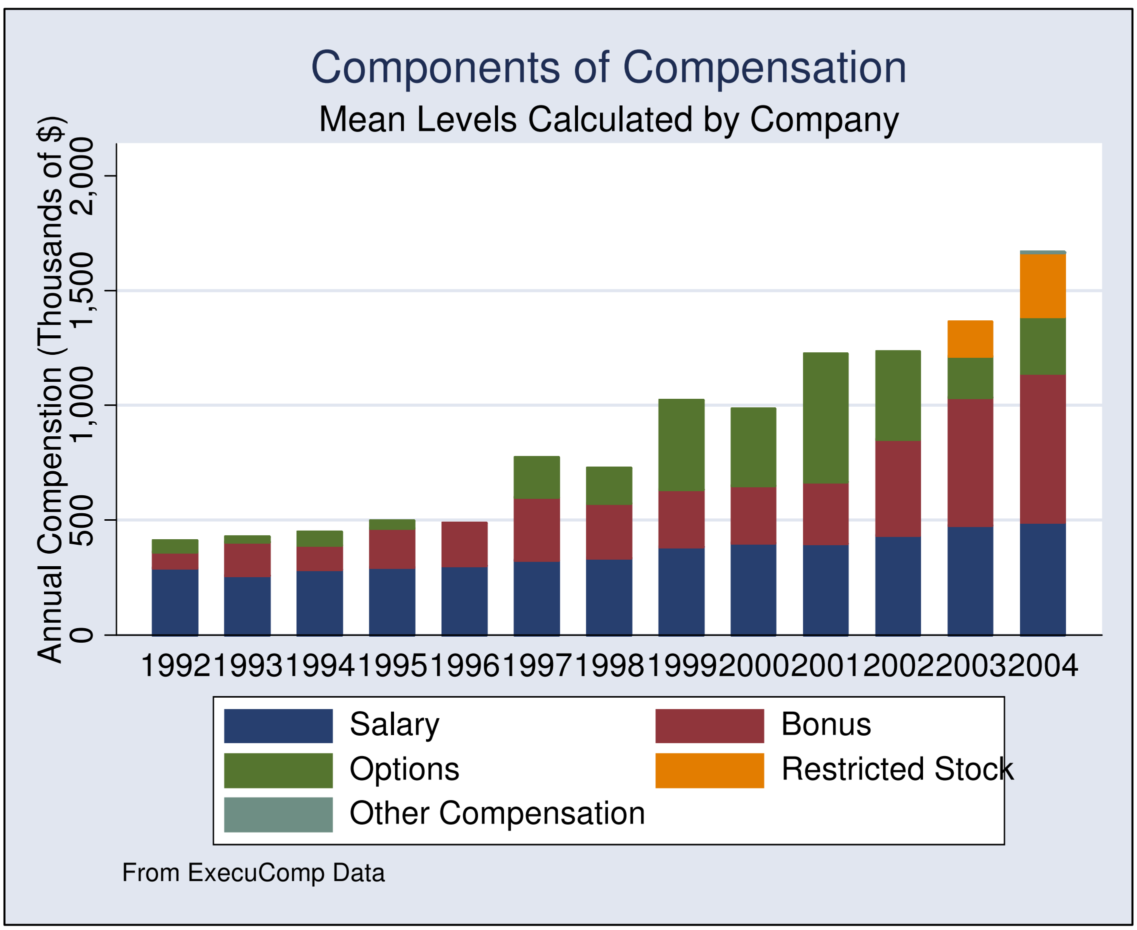
3.2.1 ExecuComp

The characteristics of the insurance industry executives included are broadly similar to those in the managerial market as a whole, although they exhibit the usual attributes associated with those who work in the financial world. Coles, Daniel and Naveen (2006) study the entire Execucomp database for all industries and present summary statistics which describe that database.

The executives within my data set have almost exactly the same age profile as those in the larger data set, although they have been at their jobs a somewhat shorter time. The differences are not statistically significant. Executives in the insurance industry appear to receive slightly more cash pay than those in the wider data set – an average of $1.3 million as opposed to $1.1 million in the overall data set. Median pay is higher as well at around $1 million as opposed to an industry-wide median of $800,000. Pay for the entire management team is higher as well, with an average of $4.3 million in the insurance industry compared to $2.5 million in all industries.

The most important difference between the insurance industry and others is its greater use of incentive compensation. This has grown over time as shown in figure 1, and composes almost half of an executive's take-home pay. The average calculated delta for executives in my data set is 1,039 as compared to an overall average of 600. This difference appears to be due mainly to a few executives who receive large options packages as the insurance industry median is 275, only slightly larger than the Execucomp median of 206. The situation is similar with vega. The insurance-CEO average is 114, compared with a total-industry average of 80. The respective medians are 48 in the insurance industry and 34 across all businesses. The standard deviations in my data set are larger as well. It appears that the executive market in the insurance industry pays more than average and makes more use of incentive pay. Further, there are several CEOs who have very generous pay packages which make large use of incentive pay.

Figure 1:



3.2.2 Insurance Company Data (A.M. Best and NAIC)

Due to the process of creating the data set, the included groups are not necessarily representative of the entire insurance industry. Because the NAIC data was merged with Execucomp data, only publicly traded companies are included. Execucomp includes data on top executives (usually the five highest-paid officers) from companies within the S&P 1,500, so an insurer must be a member of this set to be included. The S&P 1,500 is composed of companies in the S&P 500 large-cap, S&P 400 mid-cap, and S&P 600 small-cap indices. Because this index is dependent on firms still trading, not all information is available for every company in every year.

To determine how the insurer groups in my dataset compare with past literature on the subject, I reproduce the regressions from Garven and Lamm Tennant (2003) at both the company and the insurer group level and present the results in table 2. The form of the regressions run is given by the equation:

Equation 1:

$$R_i = \alpha + \beta_1 X_i + t + \mu_i$$

The control variables here, X, are purely the firm structure variables, and do not include managerial incentives or characteristics. *t* represents the year dummies and *u* is an error term. Since previous studies examined reinsurance purchase rather than risk retained, the expected signs must be flipped when comparing to previous studies. This has been done in the ‘predicted’ column of table 2 to make the signs equivalent, and to simplify comparisons with previous studies.

The company-level data provide a direct comparison between the data sets in each study while the group-level regressions allow extrapolation for further results presented in this paper. The similarities in the results between these regressions show that the capital-structure story of reinsurance purchase appears to hold at different ownership levels and that this data set is similar to those used in previous studies. Some differences would naturally exist because the data is constructed from different sources and over different time periods, with Garven and Lamm Tenant (2003) using the A.M. Best database and my using the raw NAIC data to construct the variables.

For the most part, the actions of my included firms appear to be similar to those results found in the prior study. The signs for significant variables are the same at both the corporation and group level, indicating that there is not too much bias in observed firm behavior due to the selection and aggregation into groups. The only times the signs of the coefficients differ is on the proportion of business on long tailed lines. At the company level the sign is negative, indicating more risky business is associated with more reinsurance purchase, while at the group level the coefficient is positive in sign. This could be due to reinsurance being used to shift risk within the insurer group, while at the group level insurers are making either generally riskier or generally safer risk decisions when choosing policy.

Table 2: Comparison of Regressions with Prior Literature

Comparison regressions with prior literature are presented below. Regressions conducted at the company level in columns 1,2 and 3 replicate the regressions from Table 2 in Garven and Lamm Tennant 2003, and include all companies in my data set. Coefficient directions from that study are given in the center column. The same regressions are replicated in columns 4,5 and 6 to show extrapolation from company level data to group level data. The major conclusions hold, confirming prior regressions and helping to validate the data set used in the rest of this study. The dependent variable is the proportion of risk-retained for each company or group. Standard errors are given in brackets. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	1 Proportion of Risk Retained	2 Proportion of Risk Retained	3 Proportion of Risk Retained	Garven & Lamm-Tenant Regression		4 Proportion of Risk Retained	5 Proportion of Risk Retained	6 Proportion of Risk Retained
Firm Size by Admitted Assets (ln($))	0.072 [0.004]***	0.058 [0.004]***	0.084 [0.004]***	+	Firm Size by Admitted Assets (ln($))	0.017 [0.005]***	0.014 [0.005]**	0.027 [0.006]***
Premium to Surplus Ratio by Direct Premiums Written	-0.016 [0.001]***	-0.017 [0.001]***	-0.015 [0.001]***	-	Premium to Surplus Ratio by Direct Premiums Written	-0.002 [0.002]	-0.003 [0.002]*	-0.002 [0.002]
Correlation between Investment Returns and Claims	-0.004 [0.002]	-0.005 [0.002]**		+	Group Correlation between Investment Returns and Claims	1.001 [0.626]	1.016 [0.635]	
Standard Deviation of Investment Returns (%)	0.014 [0.006]**	0.016 [0.006]***		-	Group Standard Deviation of Investment Returns (%)	4.101 [5.846]	3.495 [5.860]	
Standard Deviation of Claims Costs ($100 Mil)	0 [0.001]	-0.002 [0.001]*		-	Group Standard Deviation of Claims Costs ($100 Mil)	-0.087 [0.145]	-0.07 [0.145]	
Proportion of Direct Premiums Written in Long-Tailed Lines	-0.159 [0.019]***	-0.111 [0.019]***	-0.15 [0.018]***	-	Proportion of Direct Premiums Written in Long-Tailed Lines	0.181 [0.043]***	0.181 [0.043]***	0.158 [0.039]***
Average Tax Rate paid by the firm (%)	-0.012 [0.003]***	-0.014 [0.003]***	-0.012 [0.003]***	+	Average Tax Rate paid by the firm (%)	0.01 [0.008]	0.01 [0.008]	0.008 [0.008]
Herfindahl Index for Direct Premiums Written by line	0.19 [0.020]***	0.179 [0.020]***	0.187 [0.018]***	+	Herfindahl Index for Direct Premiums Written by line	0.218 [0.042]***	0.223 [0.042]***	0.19 [0.037]***

	1 Proportion of Risk Retained	2 Proportion of Risk Retained	3 Proportion of Risk Retained	Garven & Lamm-Tenant Regression		4 Proportion of Risk Retained	5 Proportion of Risk Retained	6 Proportion of Risk Retained
Company's herfindahl index for Direct Premiums Written By State		-0.083 [0.021]***		+	Group's herfindahl index for Direct Premiums Written By State		-0.172 [0.074]**	
Number of States Licensed	-0.003 [0.000]***		-0.003 [0.000]***	+	Number of States Licensed	0 [0.000]		0 [0.000]
Standard Deviation of Equity ($10 Mil)			-0.003 [0.001]***		Group Standard Deviation of Equity ($100 Mil)			-0.004 [0.003]*
1992	-0.557 [0.079]***	-0.355 [0.089]***	-0.737 [0.080]***		1992	0.304 [0.122]**	0.374 [0.126]***	0.165 [0.141]
1993	-0.582 [0.077]***	-0.387 [0.087]***	-0.769 [0.078]***		1993	0.327 [0.120]***	0.399 [0.125]***	0.185 [0.140]
1994	-0.546 [0.077]***	-0.369 [0.086]***	-0.732 [0.078]***		1994	0.319 [0.120]***	0.389 [0.124]***	0.166 [0.138]
1995	-0.557 [0.077]***	-0.382 [0.087]***	-0.745 [0.077]***		1995	0.38 [0.114]***	0.452 [0.119]***	0.207 [0.133]
1996	-1.051 [0.105]***	-0.761 [0.116]***	-1.326 [0.107]***		1996	0.244 [0.151]	0.343 [0.157]**	0.005 [0.177]
1997	-1.11 [0.106]***	-0.831 [0.118]***	-1.396 [0.109]***		1997	0.265 [0.153]*	0.359 [0.158]**	0.028 [0.178]
1998	-1.165 [0.105]***	-0.894 [0.116]***	-1.435 [0.106]***		1998	0.193 [0.151]	0.288 [0.156]*	-0.049 [0.177]
1999	-1.179 [0.105]***	-0.911 [0.117]***	-1.448 [0.106]***		1999	0.187 [0.152]	0.28 [0.157]*	-0.054 [0.178]
2000	-0.521 [0.072]***	0 [0.000]	-0.662 [0.071]***		2000	0.402 [0.108]***	0 [0.000]	0.268 [0.123]**
2001	-0.724 [0.080]***	-0.551 [0.089]***	-0.901 [0.079]***		2001	0.207 [0.120]*	0.281 [0.125]**	0.04 [0.137]
2002	-1.128 [0.107]***	-0.83 [0.119]***	-1.39 [0.108]***		2002	0.094 [0.156]	0.194 [0.161]	-0.16 [0.182]
2003	-1.235 [0.110]***	-0.954 [0.122]***	-1.499 [0.109]***		2003	0.117 [0.157]	0.215 [0.163]	-0.142 [0.182]
2004	-0.845 [0.084]***	-0.643 [0.094]***	-1.014 [0.081]***		2004	0.202 [0.125]	0.285 [0.131]**	0.015 [0.143]
Observations	1962	1892	1962		Observations	370	359	359
R-squared	0.86	0.86	0.86		R-squared	0.96	0.96	0.96

3.3 Chief Variables of Interest

I investigate two categories of variables which are of chief interest in this study. They are: those which measure the risk decisions of the firm and those which measure the incentives given to managers.

The first category includes variables which represent the risk management decisions of the firm. These include the firm's reinsurance purchase decision – which measures how much of its premium risk it chooses to keep on its own books. Second, the proportion of business which is conducted in long-tailed lines, which measures how risky the insurance company's business is. There are also two variables which measure the firm's capital-structure decision by measuring its leverage. The first of these variables is the premium/surplus ratio, which measures how much business the company is conducting in relation to its loss reserves. Second is the A.M. Best Capital Adequacy ratio (described fully at: http://www.ambest.com/ratings/methodology/BCAR_UNDERSTANDING_PC_Insurers.pdf) which is a more specific ratio measuring how much capital the firm retains relative to the business it has underwritten, adjusted for the risk of each.

The variables which measure the incentives given to management include the two major sensitivity variables – the sensitivity of executive's wealth to a change in the stock price and the sensitivity in wealth to a change in stock price volatility. I also examine the overall level of cash and bonus pay as a proxy for how much the executive receives in total pay from the firm and how relatively risk-averse the executive is likely to be.

3.3.1 Firm Decision Variables

Reinsurance

I use the ratio of total business less reinsurance ceded plus reinsurance assumed over total business written plus reinsurance assumed as the measure of risk retained by the firm, similar to the method used in Garven and Lamm Tennant (2003) and Mayers and Smith (1990). Whereas the two previous studies use reinsurance premiums ceded to total business premiums as the measure of reinsurance demand, I am interested in the risk-taking activities of the firm and therefore use the measure of risk retained on the company's books. In each case, total business is defined as direct premiums written plus reinsurance assumed as reported in each year's NAIC statement. The variable is then winsorized at the 1st and 99th percentiles to reduce the effect of outliers. Groups retain about 81% of their portfolio on average and 89% at the median, although there is significant variation. The three firms which retained none of their business were removed from the data set as they were likely experiencing abnormal business conditions and not representative of standard insurance companies.

Premium-Surplus Ratio

Another decision which management can use to determine the firm's exposure to bankruptcy is the amount of premiums written relative to the surplus that the firm retains. This measure can be interpreted in a way similar to the leverage of the firm when considering debt policy. If the firm incurs too many losses on its business and cannot cover them by collected premiums and surplus, or by raising new capital, then it will enter a state of financial distress.

The premium to surplus ratio measures the level of capital surplus relative to premiums. It is specifically calculated by the amount of direct premiums written divided by surplus reported in the NAIC data. The variable was then winsorized at the 1st and 99th percentile. An insurance company must have an asset heavy balance sheet to pay out claims. Industry statutory surplus is the amount by which assets exceed liabilities. For instance: a ratio 0.95 -to 1 means that insurers are writing less than $1.00 worth of premium for every $1.00 of surplus. A ratio of 1.02-to-1 means insures are writing $1.02 for every $1.00 in surplus. The average ratio is 321% or a ratio of 3.21. This represents a leverage of $3 of premiums for every $1 of surplus and the mean is affected by a few highly levered firms. The median ratio is 1.68.

The bankruptcy costs that a high ratio exposes the firm to should lead a more levered company to purchase more reinsurance. Reinsurance can serve as a substitute for capital in this way. Powell and Sommer (2007) find evidence that higher leverage leads to greater reinsurance purchase. Mayers and Smith (1987) explain that the investment incentive hypothesis predicts that a more levered firm will purchase more reinsurance as this can help to alleviate the costs of debt and allow greater use of tax shields. Holding other risk policies constant, a higher vega should be associated with a higher premium surplus ratio - the theoretical explanations go in the same direction.

A.M. Best's Capital Adequacy Ratio

Best's Capital Adequacy Ratio is a percentage which measures a company's relative capital strength compared to its industry peer composite. A company's BCAR is an important component in determining its rating which is often used as a proxy for the risk of the firm. Capital adequacy ratios are calculated as the net required capital necessary to support components of underwriting, asset, and credit risks in relation to economic surplus. Required capital is based upon standard industry practice. The A.M.

Best dataset provides a calculated ratio for each insurance company, but not for groups. To create my measure I create a weighted average of the ratios for all the constituent members of the group using each company's assets as a weight. As before, this variable is winsorized at the 1st and 99th percentiles. This may yield a less naïve measurement of leverage than the simple premium/surplus ratio, as it takes into account the risks that the firm faces relative to the norm in the industry. I also check results using the provided minimum and maximum ratios for each company in an insurer group and find similar results.

Business in Long-Tailed Lines

An alternative for the firm to increasing the size of its business relative to its surplus or the amount that is retained is for it to simply write more risky business. I control for this possibility by examining the amount of business that a firm writes in more risky lines compared with the effects on the above three variables. If a firm is retaining more risk and also writing more risky business then both sets of equations should see a positive coefficient on vega. If the firm is simply writing more risky business, i.e. it is responding by increasing its risk level but not necessarily in value-adding ways then the coefficient on long-tailed lines would be positive while that on the other three measures would be insignificant.

Long-tailed lines are defined in Phillips, Cummins, and Allen (1996) and listed in Appendix 1. 61% of group business takes place in long lines and 86% of firms conduct at least some business in them. I check on the relative risk of long-tailed lines as well as property vs. liability lines in several ways. Table 3 shows several measures of the risk in every line – the standard deviation of gross losses, the contribution to the company's risk portfolio and the variance in the loss ratio. The rankings of the lines according to these measures gives an indication of the relative risk that they add to the firm. I also constructed the loss ratio for Schedule P versus non-Schedule P lines and property and liability lines separately. I examine the variance of the loss ratios to provide a measure of the relative predictability of losses in these lines, and hence, how much risk they create for the company. By testing the variances I am able to see if they are significantly different and if these definitions are actually suitable proxies for the risk a firm's business creates. To eliminate doubtful outliers the Schedule P loss ratios were winsorized at the 5% and 95% levels and the property/liability loss ratios were winsorized at the 1% and 9% levels. Once this had been done, I could not reject the null hypothesis that the variance in loss ratios for Schedule P lines is the same as it is for non-Schedule P lines. The variance of the loss ratios in property lines is significantly greater than the loss ratio variance in liability lines, which goes against expectations and theory. This is due to a few companies on the very upper end of the property-line loss ratio distribution. If the lines are winsorized at the 10% and 90% levels instead, then the variance of loss ratios for liability lines is higher than for property lines, although the difference is not significant in my sample. Still, I include the business conducted in long-tailed lines so that comparison may be drawn with theories and prior studies, as well as to control for the type of business which a firm conducts.

Table 3: Risk Measures of Lines of Business

This table displays the risk involved in the various lines in which in-sample firms conduct business. Three measures are presented, standard deviation of gross losses due to direct business and the contribution of a particular line to the risk of the overall portfolio of business of the firm, called rho. This measure takes into account the covariances of losses across lines to grant a more overarching risk measure. The final measure is the loss ratio which measures group losses over premiums written. Lines are further identified as Long-Tail as identified by Phillips, Cummins, and Allen (1998) or as lines consisting mainly of either Liability or Property business as identified by the National Association of Insurance Commissioners.

A: Standard Deviation of Gross Losses

Name	Long-Tailed	Liability	Property	Std. Dev.
Glass				209576.8
Burglary and Theft			1	1609627
Credit Accident and Health (Group and Individual)				2449020
Financial Guaranty				10600000
International	1			11100000
Credit				11500000
Fidelity				20600000
Boiler and Machinery	1			24900000
Aircraft (All Perils)	1			42500000
Farmowners Multiple Peril	1			46700000
Earthquake			1	48400000
Mortgage Guaranty				67300000
Ocean Marine	1			68000000
Surety				72200000
Products Liability (Claims Made)		1		91500000
Aggregate Other				92900000
Medical Malpractice (Occurrence)	1	1		122000000
Products Liability (Occurrence)	1	1		133000000
Fire			1	157000000
Medical Malpractice (Claims Made)		1		163000000
Other Accident and Health				171000000
Inland Marine			1	207000000
Allied Lines			1	237000000
Group Accident and Health				415000000
Other Liability (Claims Made)		1		562000000
Other Liability (Occurrence)	1	1		610000000
Commercial Multiple Peril	1			697000000
Homeowners Multiple Peril	1			715000000
Auto Physical Damage			1	1170000000
Workers Compensation	1	1		1290000000
Commercial Auto Liability	1	1		2240000000
Private Passenger Auto Liability	1	1		2420000000

B: Contribution to Company Portfolio Risk (Rho)

Name	Long-Tailed	Liability	Property	Mean Group Rho
Aggregate Other				-4.15E-09
Financial Guaranty				-1.70E-09
Mortgage Guaranty				-6.64E-10
Private Passenger Auto Liability	1	1		-6.09E-10
Other Liability (Occurrence)	1	1		-2.92E-10
Auto Physical Damage			1	-2.63E-10
Medical Malpractice (Occurrence)	1	1		-1.29E-10
Boiler and Machinery	1			-1.03E-10
Fire			1	-7.77E-11
Commercial Multiple Peril	1			-6.84E-11
Inland Marine			1	-6.72E-11
Allied Lines			1	-6.11E-11
Workers Compensation	1	1		-5.04E-11
Other Liability (Claims Made)		1		-3.43E-11
Medical Malpractice (Claims Made)		1		-3.40E-11
Homeowners Multiple Peril	1			-1.88E-11
Surety				-1.48E-11
Group Accident and Health				-1.34E-11
Fidelity				-1.79E-12
Other Accident and Health				-8.13E-13
Farmowners Multiple Peril	1			-1.50E-14
International	1			-3.46E-15
Credit Accident and Health (Group and Individual)				-2.90E-22
Glass				1.19E-16
Burglary and Theft			1	3.91E-14
Credit				1.95E-13
Earthquake			1	9.22E-13
Aircraft (All Perils)	1			5.59E-12
Products Liability (Claims Made)		1		6.18E-12
Ocean Marine	1			1.31E-11
Products Liability (Occurrence)	1	1		7.05E-11
Commercial Auto Liability	1	1		1.43E-10

C: Loss Ratio

Name	Long-Tailed	Liability	Property	Std. Dev.
Mortgage Guaranty				0
International	1			0
Group Accident and Health				0.226386
Glass				1.421629
Other Accident and Health				3.316184
Credit				4.788437
Aggregate Other				15.23695
Financial Guaranty				36.73861
Boiler and Machinery	1			65.02786
Fidelity				116.4936
Aircraft (All Perils)	1			143.6758
Products Liability (Claims Made)		1		216.2264
Farmown+M43ers Multiple Peril	1			321.6956
Inland Marine			1	663.9639
Commercial Multiple Peril	1			700.6706
Homeowners Multiple Peril	1			810.1761
Medical Malpractice (Claims Made)		1		985.5577
Medical Malpractice (Occurrence)	1	1		1021.736
Burglary and Theft			1	1254.016
Products Liability (Occurrence)	1	1		1454.292
Earthquake			1	2141.237
Other Liability (Claims Made)		1		2181.231
Fire			1	2884.879
Commercial Auto Liability	1	1		8189.964
Other Liability (Occurrence)	1	1		10591.45
Ocean Marine	1			12856.05
Allied Lines			1	16705.06
Surety				21584.27
Auto Physical Damage			1	42710.19
Workers Compensation	1	1		93845.41
Private Passenger Auto Liability	1	1		297881.3
Credit Accident and Health (Group and Individual)				N/A

3.3.2 Executive Incentive Variables

Information on executive pay and characteristics were taken from the Execucomp database provided by COMPUSTAT. Executives in the insurance industry were identified by the SIC code of their company, limited to 6300-6500. They were then matched to companies in the NAIC data using the created merge-key described earlier. The incentives given to CEOs through stock and options are represented by two variables, measuring the change in an executive's wealth to changes in company share price. Using available information and the estimation technique determined by Core and Guay (2002), the executive wealth sensitivity variables were created. Option values are calculated using the Black-Scholes option pricing formula and compare closely with those provided by COMPUSTAT. The estimation technique used is able to determine fairly accurate values for sensitivities even when all of the option information is not directly observable and compensates for the sometimes-limited information available through COMPUSTAT. To control for responsibilities being distributed throughout the upper-level management, these sensitivities were also calculated for the entire upper-level management team at each company.

Delta

Delta is the sensitivity of CEO wealth to a one percent change in stock price and represents the alignment between the incentives of managers and those of stockholders (Coles, Daniel and Naveen, 2006). Figure 2 shows how this measure has increased over time as the use of options in executive compensation has become more popular. A larger delta increases the rewards from an increase in stock price as the managers now share in the stockholder's payoff – restricted stock increases delta linearly - so the executive should work more effectively and direct his effort more productively. Because his payout parallels that of equity-holders a manager should be relatively less concerned with bankruptcy risk and should desire to increase the company's risk-taking. John and John (1993) show that a high delta may increase the management's motivations to shift risk to policy-holders. However, an increase in delta also increases and executive's expected wealth to a point further out on the manager's utility curve. This leads the manager to be exposed to more risk and as their shareholdings are relatively undiversified compared to most equity holders, therefore they may also pass over some risky, but positive NPV, projects as demonstrated in Holmstrom (1979), Holmstrom and Milgrom (1987), Murphy (1999), Smith and Stulz (1985), and Guay (1999). Thus, delta may exacerbate the underinvestment problem if insurers focus on safer but less-profitable lines. Mayers and Smith (1990) report finding that insurance companies with a less diverse ownership structure demand more reinsurance. This implies that companies with management whose wealth is more tied to the performance of the firm could lead their firm to purchase more reinsurance, to the extent that the risk-aversion argument holds in both cases.

An executive's delta was created according to the estimation technique described in Core and Guay (2002). This estimation allows the use of standard Execucomp data, while achieving a very high reliability when compared to other means of determining executive wealth and sensitivities. Compared with all companies in the Compustat database reported in Coles, Daniel, and Naveen (2006), the average delta of insurance industry executives is higher, at 1,039 for a chief executive, as opposed to the previously-reported value of 600 for a CEO. The median value is 274, compared with a previous median of 172. This is a comparison that should be expected as financial companies often make higher use of options compensation than firms in other industries. My figure indicates that a 1% increase in stock price would increase the wealth of an average chief executive by $1 million I examine the within-firm variance of delta to ensure that the data set has enough heterogeneity. I run a fixed-effect regression on delta with firm and year dummy variables. The within-firm standard deviation of the residuals is then calculated and found to be about $730,000. This is less than half of the overall value of $2 million, but it is evidence that companies are varying their executive incentives over the years examined in this study.

The CEO's incentives are calculated at the end of each fiscal year based upon stock and option holdings as reported by Execucomp. The number of shares held by each executive is given by the Execucomp variable *shrown* according to the formula: max(0,*shrown*). Each share has a delta of one. The delta of an option is given by the Black-Scholes formula:

$$delta = \frac{\partial \Pi}{\partial S} = e^{-\delta T} \frac{S}{100} N\left(\frac{\ln\left(\frac{S}{K}\right) + T\left(R_f - \delta + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{T}} \right)$$

δ is the continuously compounded expected dividend yield as given by *bs_yield*/100 based upon the company's average dividend yield over the past three years. If missing, the previous value is used.

σ is the expected volatility of stock returns calculated over 60 months in decimal units and reported in the variable *bs_volat*. Again, if missing the previous value is used.

R_f is the continuously compounded risk-free rate, available from

http://mi.compustat.com.docs-mi.help/blk_schol.htm

S is the stock price at the end of the fiscal year, given by *prccf*.

K is the strike price of the option, given by *expric*.

T is the time to maturity of the option determined from the Execucomp variable *exdate* and the current year. Assumptions for missing data are explained below:

N(*) is the cumulative standard normal distribution.

Option holdings fall into one of three categories: new grants in each year, existing grants from prior years which cannot be exercised, and existing grants which can be exercised. Dividend yield, volatility, risk-free rate and end-of-year stock price are available for all option categories. Strike price and time-to maturity are available for new option grants. If the company made an options grant in the most recent fiscal year, then the time-to-maturity of unexercisable options is set to one year less than the most recent options grant and the time-to-maturity for exercisable options is four years less than the most recent options grant. Because K and T are not always available for existing options, I make certain assumptions based on the Core and Guay methodology. If there was no recent options grant then unexercisable options are assumed to have a time-to-maturity of nine years and exercisable options are assumed to have a time-to-maturity of six years. The minimum time-to-maturity is recoded to be three years for unexercisable options and one year for exercisable options as lesser values are likely to be miscoded.

CEOs may receive multiple grants in each year. I first calculate the delta of each grant, multiply it by the number of options in each grant (*numsecur*), and then sum all of the grants given to an executive in a specific year. This yields a variable (*numnewop*) which is my calculation of the total number of new options granted in each year. Execucomp provides a variable (*soptgrnt*) which gives the number of options granted in each year but the values provided are not always the same as those obtained when summing across all grants for an executive. Using the 'bottom-up' approach is more internally consistent with the rest of the estimation of grant value and therefore it is the one which I employ.

The intrinsic value of new options granted in a year is calculated as:

$$\text{ivnew} = \max(0, (\text{prccf - expric})) * \text{numsecur} = \max(0, \text{S - K}) * \text{numsecur}$$

The intrinsic values of exercisable and unexercisable options are calculated in a similar manner. First, I need to determine an estimate of the average strike price, since this information is not directly available from Execucomp. For unexercisable options, the average strike price is assumed to be:

$$prccf - \frac{inmonun - ivnew}{uexnumun - numnewop}$$

Inmonun is the intrinsic value of the unexercisable options held at the end of the year, some of which are from new option grants, as reported to Execucomp. *Uexnumun* is the reported number of such options.

Although most option grants are unexercisable, there are some circumstances where *numnewop* > *uexnumum* – the number of newly granted options exceeds the intrinsic year-end value of the unexercisable options. In this case, wealth is calculated assuming that some of the options are exercisable. The strike price for exercisable options is calculated as:

$$K_{new} = \frac{inmonex}{uexnumex - (numnewop - uexnumun)}$$

where the *(numnewop-uexnumun)* represents the portion of exercisable options due to new grants. *Inmonex* is the reported intrinsic value of exercisable options held at year end and *uexnumex* is the number of these options.

There are several specific cases for exercisable options which are dealt with particularly. To handle outliers the maximum value of an option is recoded to be the year-end value of the stock price – an option cannot be worth more than the underlying asset. There are also a number of cases where the number of newly granted options exceeds the number of total options at year end, i.e. *numnewop* > *uexnumun* + *uexnumex*. In these cases I assume that the options held at year end are entirely new grants and there were no previously granted options. There are also some cases where some of the newly granted options appear to be exercisable options with intrinsic value. These are identified when *ivnew* > *inmonun* and *numnewop* > *uexnumun*. For these values, the strike price of the exercisable options is calculated as

$$K_{new} = prccf - \frac{inmonex - (ivnew - inmonun)}{uexnumex - (numnewop - uexnumun)}$$

Given these estimates of the strike prices and maturities of the outstanding option portfolios, it is possible to calculate the delta for total new grants, unexercisable options held and exercisable options held. These are then combined with the shares owned by the executive to give the formula for total delta:

$$Delta = \begin{bmatrix} 1 \times shrown + delta\_new + \max(0, uexnumun - numnewop) \times delta\_unex \\ + \max(0, (unexnumex - \max(0, numnewop - uexnumun))) \times delta\_exer \end{bmatrix}$$

Where the deltas are calculated according to the formula given above.

Vega

Vega is the sensitivity of CEO wealth to a change in the volatility of the underlying stock, specifically to a .01 change in the annualized stock return volatility. Vega increases the convexity of the rewards to executives, and this convexity creates incentives for executives to take on more risk. The level of vega is generally determined by several structural factors, some of which are easily manipulable by the granting boards and others not. These include the time-to-maturity of the option, the dividend yield, the historic volatility of the company, the ratio of the current stock price to strike price, and the risk-free rate. The first-order effects are expected to be due to stock price relative to the exercise price and time to maturity.

Capital structure theories of reinsurance purchase, as shown in Garven and Lamm Tennant (2003), predict that a higher vega should lead to less reinsurance purchased and more risk retained by the firm. Although Guay (1999) notes that the net effect of vega depends on the power of the payoff convexity to overcome the concavity of the managerial utility function, the convexity appears to override the concavity of the utility function in all empirical studies.

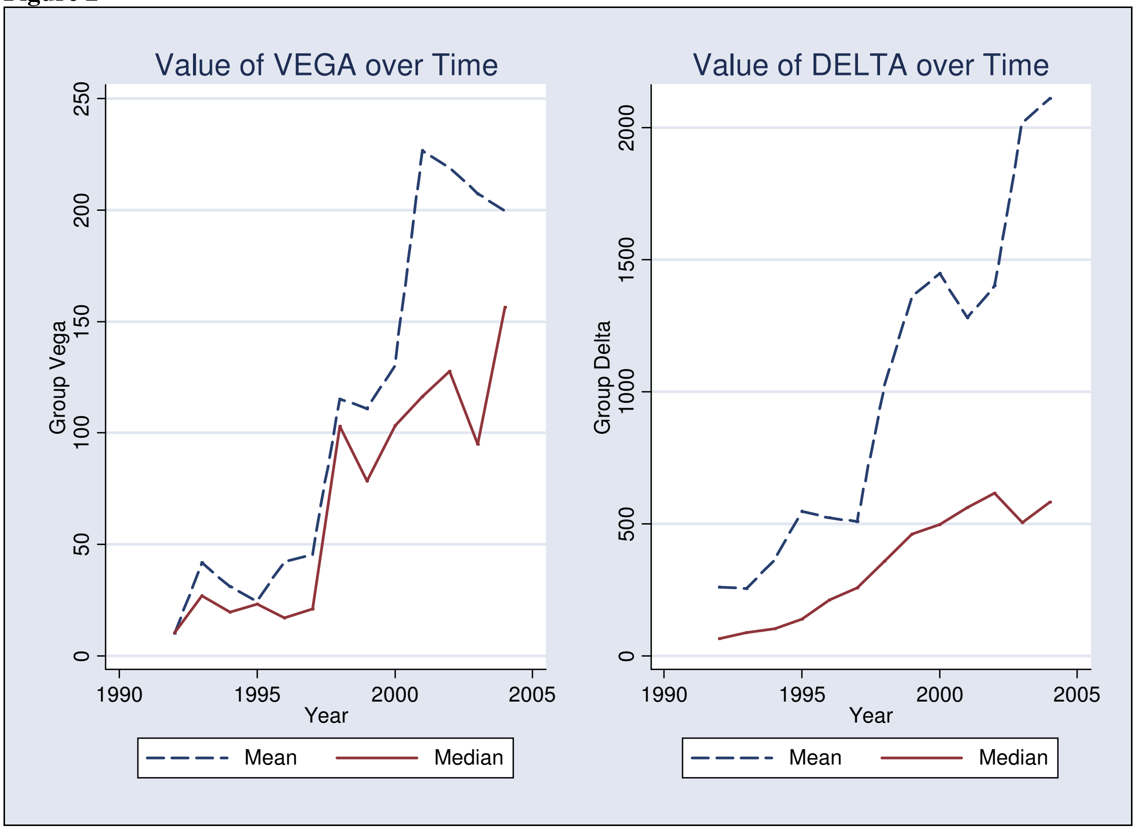
This has been shown empirically as Guay (1999) mentions “stock return volatility is positively related to the convexity provided to managers, suggesting convex incentive schemes influence investing and finance decisions.” Cohen, Hall and Viceira (2000), and Guay (1999) have shown a positive association between vega and stock return volatility and leverage using vega on the right-hand-side. When vega is the dependent variable there exists a positive correlation between vega and firm size, investment opportunities, and research and development expenditure (Guay, 1999).

Like delta, vega is estimated using the method described in Core and Guay (2002) and the same assumptions described above in the creation of delta are used for numbers of options, strike price and time to maturity. Guay (1999) shows that option vega is many times higher than stock vega, allowing for the assumption that the vega of restricted stock is zero. The calculated vegas are summed across each of the categories of new grants, exercisable and unexercisable options to create the total vega. Vega for each is calculated according to the formula:

$$vega = \frac{\partial \Pi}{\partial \sigma} = 0.01 \cdot e^{-\delta T} S\sqrt{T} n\left(\frac{\ln\left(\frac{S}{K}\right) + T\left(R_f - \delta + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{T}} \right)$$

Again, compared with Coles, Daniel, and Naveen (2006) who reported a mean value of 80 and median of 46, the numbers are slightly higher. The average vega for an insurance CEO is 114, with a median value of 48. As with delta, a t-test confirms that CEOs have vegas which are significantly higher than other managers at a company. The fact that the means are so much higher than the medians shows that a few CEOs have contracts with significantly more incentive pay than the industry average and there is a long right tail in the pay distribution. Vega has increased over time, as shown in figure 2. As with delta, I examine the within-firm variance in vega by examining the residuals after a fixed effect regression controlled with firm and year dummies. The within-firm standard deviation of the residuals is found to be about $97,000, about half of the value before controlling for fixed effects. While firms obviously differ in their use of executive incentives, firms have enough heterogeneity over time to provide meaningful results on the effect of a policy change.

Figure 2



3.4 Other Insurance Company Variables

The control variables used in the regressions can be broadly separated into three categories: those related to structural reasons for managing risk, those related to the executive's personal reasons for managing risk, and those which help address the issue of endogeneity in the equations. The structural variables are measures of the size of the firm, firm performance, risk-management skill, the riskiness of insurance claim losses, the riskiness of investment returns, the riskiness of revenue, the riskiness of insurance reserves, the average tax rate paid by the firm, the diversification of group business by line and geography, the diversification of the group's ownership, the standard deviation of stock returns, and the A.M. Best rating of the group. The managerial control variables are the level of cash compensation, the age of the executive, and the tenure at current company and as Chief Executive Officer. These are expected to be positively associated with reinsurance purchase. In the final group of control variables, which are sometimes included in panel regressions, are the predicted values of delta and vega given the other observables of the firm as well as the residuals. Twice-lagged values (*t-2*) are also included in some specifications to control for prior firm policy.

The size of the firm is likely to affect both the demand for reinsurance and the amount of compensation paid to the manager. Consistent with prior literature, firm size is defined as the logarithm of admitted assets and is positively related to risk retained, as shown in table 2. The size of the firm likely affects reinsurance demand through expected bankruptcy costs and tax burden, investment incentives, real-service efficiencies and economies of scale, since larger firms likely need to purchase proportionally less reinsurance to take advantage of a greater risk pool and may also experience some economies of scale in hedging (Fok, Carroll and Chiou (1997), Powell and Sommer (2007)). Additionally, expected bankruptcy costs are less than proportional to firm size, (Fok, Carroll and Chiu (1997), Warner (1977) Altman (1984)) so larger firms will have less probability of bankruptcy and gain less from reducing the effects of bankruptcy, giving them less reason to hedge. Mayers and Smith (1990), Powell and Sommer (2007) and Garven and Lamm Tennant (2003) find evidence of this effect.

Most insurance companies do not break even or make the majority of their profits on the premiums they charge, demonstrated by an average combined ratio of above 100 in the data. Companies rely on investment earnings for profitability, taking advantage of both their investment skill and the time-lag between premium payments and loss payments. Companies should retain more risk if their investment earnings are correlated with their losses and therefore provide a natural hedge. Rho is calculated from the losses by line and return by investment category for each observed year and line for a group, weighted by the proportion of investments and premiums. Rho is a measure of the overall risk of the portfolio of business that a company conducts, similar to that computed for assigning surplus in Myers and Read (2001). This measure accounts for the variances and covariances between the liability lines and assets of the firm. Rho is not strongly related to firm-observable results, although it is related to the incentives given to executives.

The primary risk to an insurer is from claims due to losses and their variance may be very different depending on line and type of business written. The volatility of losses is calculated from a group's observed loss history. I find that the riskiness of each company's business has an insignificant effect on its demand for reinsurance.

Earnings risk is calculated from the variance in investment and premium earnings. A low volatility in investment earnings reduces the risk that a company will have to cover losses out of its surplus and a company should attempt to offset high volatility by purchasing more reinsurance. Alternately, if the higher deviation of investment returns reflects a preference of the management for more risky activities, the risky investment decisions could imply less reinsurance. The net effect is theoretically uncertain, and I find that historical volatility in a group's reported investment earning is related to more risk retention at the company, but not group, level. I use these variances in the comparison regressions where I attempt to see how similar my data set is to other studies in the field. In my own regressions I use the portion of a company's investments in stock and bonds as a measure of their investment risk as this information is available in all years of the study. This measure is obtained from the A.M. Best database.

The other portion of earnings volatility comes from the direct business written by a company. A large change in premium volatility could represent a company that is rapidly changing, either growing or shrinking in size or one that is entering a new line of business. While the loss volatility can measure that danger that a company is exposed to an unexpected loss, the historical premium volatility measures the steadiness of a group's business model and can be compared to a group's 'tenure' in a given industry. Fok, Carroll and Chiou (1997) note that firm's with more volatile operating income are more likely to hedge in order to reduce their business risk. I find mixed results, occasionally showing an insignificant relation between risk retained and premium volatility and occasionally a positive and significant one. These three volatility variables are constant over years for included firms, due to the method of their construction, so the variables are excluded from the fixed-effects regressions.

The average tax rate that a firm pays may provide incentives to purchase reinsurance because decreasing the proportion of assets in taxable investments provides valuable tax shields, but also increases the probability of insolvency as the firm becomes more levered. Simultaneously, since tax-favored assets likely yield lower returns than taxable ones, the firm lowers its potential investment returns and it therefore faces greater risk of paying out of its reserves. Because of these two effects, a firm should retain more risk if it pays a higher tax rate and purchase more reinsurance as its proportion of tax-favored assets increases. A firm's average tax rate is calculated from the average tax paid on investments and a higher tax rate is associated with more risk retained. Tax rates may vary greatly due to accounting carry-backs and carry-forwards, hence the wide variance observed in the data set.

By diversifying across several lines of business a company can help to protect itself from large, idiosyncratic shocks and avoid bankruptcy costs. The business concentration of an insurance company is measured by its herfindahl index across its lines of business which measures the exposure to a given line. The net effect of business concentration is ambiguous as there are several ways in which concentration can affect reinsurance demand. Real-service efficiencies have a direct effect as the less concentrated an insurer's business is, the more valuable the rating function of the reinsurer will be (Mayers and Smith, 1990). Diversification may act as a substitute for reinsurance, leading to less demand. However, a company could specialize in a low-volatility line of business which would decrease its demand for reinsurance or choose less risky insureds within those lines (Powell and Sommer, 2007). I do not find any evidence that companies target their risk-retention on specific lines of business. The herfindahl index is calculated by the direct premiums written in each line for a group and is found to be positively associated with risk retention, implying that the diversification effect is more pronounced than the possibility of specializing in low-volatility lines.

Group concentration measures to what extent an insurance group is split between different companies. A group with many large companies would be quite diverse while a company which has only one large lead company and a few smaller subsidiaries would be less diverse. The diversity of a group is likely to play a role in reinsurance demand because of the diversification effect that limited liability grants to insurance companies, which may limit bankruptcy costs. If a subsidiary suffers excessive losses, the lead company has the valuable option to declare bankruptcy, shielding the rest of the insurance group from the shock. This is desirable as owning a portfolio of options is worth more to an investor than owning an option on a portfolio. The group concentration Herfindahl is constructed by aggregating the direct premiums written for each company within an insurance group. I do not find a significant relationship between group diversification and reinsurance purchase.

Diversification effects also affect risk management through geographic diversification. The most basic measurement technique is simply to use the number of states in which a firm is licensed to sell insurance. This is the technique used in Mayers and Smith (1990) and Garven and Lamm Tennant (2003). The valid regions for business include the 50 states, the District of Columbia and four territories. The maximum number of geographic regions is 55.

Mayers and Smith (1990) identify three ways in which geographic concentration can affect demand for reinsurance. 1) By increasing the volatility of taxable income, the tax savings through reinsurance are increased. 2) The volatility of the value of the firm is increased and so the expected bankruptcy costs and investment incentives for reinsurance are increased. 3) The value of real services provided by the insurer is increased with specialization and therefore the demand for reinsurance should decline. The net effect is therefore ambiguous, as the tax, bankruptcy, and investment incentives effects imply increased demand while the real-service efficiencies argument implies less demand.

A more-diversified firm is also less likely to be exposed to catastrophic losses (Powell and Sommer, 2007), because this effect is likely to be more important in some lines than others this is unlikely to be a major causal variable for most insurance companies. A larger firm is more likely to be licensed in more states so this variable captures the effect of a large firm which is located within only one state versus a large firm which is spread over many states. I find little actual effect for geographic diversification among insurance groups. The states-licensed variable is negative and significant when examining at the company-level but not at the group level. The geographic herfindahl index, which measures diversification of premiums written by state is significantly negative for both companies and groups.

The A.M. Best rating describes the default probability for an insurance firm. This default risk affects reinsurance demand through the bankruptcy cost and investment incentive channels. Both channels imply that a riskier firm should purchase more reinsurance, although I find no significant effect. For groups, the A.M. Best rating of the largest corporation in the group in a given year is used.

To account for supply effects in the insurance market within a given year and market performance, yearly dummy variables are included. This study covers both periods of hard and soft-markets in the insurance industry. There are many years with significant negative effects, controlling, for example for the pricing shocks on reinsurance after the terrorist attacks in 2001. It is particularly necessary to account for year-by-year differences because of the long time series used in this study. The base year (t=1) is 1992.

Firm performance is measured by the total return to shareholders, obtained from COMPUSTAT. As in Coles, Daniel, and Naveen (2006) it is included as a control variable to capture the general quality of a company's business and the environment it is operating in. This measure of firm performance is included because it is the one which is most directly affected by equity compensation of managers. If equity compensation does bring the interests of management in line with those of shareholders, then the focus of management should be on increasing this return, the one which would benefit the managers-as-owners the most. These returns vary from -73% to +121% in the short-term 1-year data. A drawback to this measure is that it is affected by noise and general market trends – and thus may not give an entirely clear picture of the actions of management. Demsetz and Lehn (1985) note that monitoring of managers is more difficult in markets with more variance or returns and more noise. The more noise there is, the greater the cost of obtaining information on managerial performance and the less information which is available. Also, if managers are behaving optimally, then there is relatively more noise to information on managerial performance – the random effects of the market have a greater effect if managers have already maximized firm value as much as they are able to through their decisions.

I use growth in premiums as a control to measure the business environment of the firm and its need for proper risk management. A firm can grow quickly by taking on more business but may also find it more difficult to assess the risk. Generally, a new account will have more unknowns than a long-established one and the company may not yet have expertise in pricing idiosyncratic properties. Thus a large growth in premiums may generate demand for safer risk-decisions. If firms are drawing in more customers because they are viewed as able to better assess risk and offer a fairer price or because they are better managed than their competitors then a growth in premiums represents a gain in firm value. However, if an increase in premiums is due to the firm taking on customers which they otherwise would not have - worse market risks – then an increase in premiums may not represent an increase in firm value. The growth in premiums is calculated as the change in direct premiums written as reported to the NAIC by each company. Total premiums written for each year are calculated by summing across all of the companies owned by each insurance group.

The loss ratio measures how risky an insurer's book of business is. It is calculated by dividing losses and loss adjustments expenses by premiums earned. This control variable gives a broad measure as to how good of a job a company does at assessing risk and charging proper premiums. The loss ratio shows what percentage of payouts are being settled with recipients. The lower the loss ratio the better – a firm with a low loss ratio appears to be good at assessing its business risk and may be ale to make riskier decisions when concerning bankruptcy risk. Higher loss ratios may indicate that an insurance company may need better risk management policies to guard against future possible insurance payouts. A high ratio may also occur because of an idiosyncratic shock which results in an abnormally high number of claims. If this is an industry-wide effect however, then the use of year dummies should control for this potential source of error.

3.5 Executive Demographic Variables

The chief executive at each company was determined mainly by the Execucomp CEO flag which I corrected according to the date on when an executive became CEO. If a company switched CEOs midyear both executives were flagged as being the CEO for that year. If no executive was listed for a company, then the highest-paid executive was identified as the CEO. In 23 cases two executives were listed as CEO for a given company in the same year. In these cases the one who held the office at the end of the year was retained as his policies were more likely to be in place at the end of the year – when the variables were recorded. This allows the panel to be identified by firms in a given year, rather than by executives.

I examined the employment horizon of each executive by using the age of the executive. Employment horizon may particularly play a role as the executive nears retirement and wants to secure any promised retirement package. As this date draws closer, the executive will likely be willing to retain less risk to ensure he maintains his position and the company remains in business. Tufano (1996) notes that in this context managerial age may serve as a proxy for risk aversion, although he does not find significant results.

The length of time which an executive has served as CEO may play an important role for several reasons. If the executive is more familiar with the business then he may be able to better the firm's productivity. However if tenure is a proxy for managerial power over the board of directors then the executive may direct his power towards activities that enrich him personally but do not create firm value. Fok, Carroll, and Chiou (1997) find a negative relationship between managerial entrenchment and corporate hedging, implying that firms where managers are more entrenched are more likely to bear risk, which they explain as evidence of perk consumption: entrenched managers are still not acting in shareholder's interests by not hedging. Chakraborty, Sheikh, and Subramanian (2007) provide evidence that managers who face high termination risk are more likely to make low-volatility investments than those who do not face such risk of losing their jobs. This implies that entrenched managers would make more risky investments than those who are less entrenched. I constructed this variable using the year in which the executive joined the company subtracted from the observation year in the data set.

The length of time a CEO has spent at his company may be another measure of how entrenched he his and how well he performs at the business, separate from his role as CEO. This is strictly a measure of an executive's length of association with a company and may be longer, in some cases much longer, than the tenure as CEO. A manager who is well entrenched is more likely to desire to maintain his position and purchases more reinsurance. Tufano (1996) notes that a manager with less tenure may be more likely to engage in risk management practices and finds evidence of this result. However, since reinsurance is well-known in the insurance industry, this sort of effect is less prevalent here. It may also be a measure of how well he knows the business of the company and therefore the size of the real-service efficiencies the company is able to provide, which would lead to less reinsurance purchase. These effects go in opposite directions so the net effect of tenure needs to be determined empirically.

I created missing dummies to control for missing observations without reducing the sample size. These dummy variables allow observations to be included in the analysis while still recognizing that they are different from observations for which we have complete information. The missing dummy is coded as one if the observation was missing and zero otherwise. After the dummy is created the initial observation is recoded as zero and included in the regression. This has the effect of counting the observation as the mean value of the variable and leaves an OLS regression unbiased. Missing dummy variables were created for age, tenure as CEO, tenure at company, stock returns, loss ratio, proportion of risky investments, and growth in premiums.

4. Empirical Setup

This section covers the empirical methodology used in this study. First, I describe the panel least-squares and instrumental variable regressions used to investigate the relationship between executive incentives and risk-management decisions, along with the regressions to create predicted variables. Then I identify the systems of simultaneous equations used for investigating the possibility that many of the variables are co-determined. Section six explains robustness checks, along with their results.

4.1 Incentives and Risk Management

4.1.1 Panel Regressions

I am ultimately interested in determining the effect that delta and vega have on the risk decision variables. With the panel data I have, the most general empirical specification is the fixed-effects regression:

Equation 2

$$R_{i,t} = \beta_1 \upsilon_{i,t-1} + \beta_3 \delta_{i,t-1} + Y_t + \eta_i + \varepsilon_{i,t}$$

which simply examines the effect on the risk decision, observed at the end of year *t* of the managerial incentives in effect at the beginning of year *t*. An individual insurer group is denoted by *i*. This fixed effects regressions also controls for unobservable firm effects which are constant over time – such as preferences of ingrained habits on risk policy or a history of conducting certain business – and potentially correlated with other independent variables in the regression. This regression is presented in column 1 of tables 6-9. It is then expanded by adding the control variables discussed in section 3, which yields equation 3, displayed in column 2 of those same tables:

Equation 3:

$$R_{i,t} = \beta_1 X_{i,t} + \beta_2 \upsilon_{i,t-1} + \beta_3 \delta_{i,t-1} + \beta_4 C_{i,t} + Y_t + \eta_i + \varepsilon_{i,t}$$

I run this equation for each of the risk-decision variables, represented by *R*: risk-retained, proportion of business in schedule P lines, the Premium/Surplus ratio and the A.M. Best Capital Adequacy ratio. *X* represents the control variables determined by prior literature to affect reinsurance purchase and described in section 3. The structural controls are the size of the firm, the premium-surplus ratio, the correlation between investment returns and claims, the average tax rate paid by the firm, the diversification of group business by line and geography, the diversification of the group's ownership, growth in premiums, loss ratio, proportion of assets in stocks and bonds, shareholder return and the A.M. Best rating of the group. Managerial control variables include the age of the executive, as well as his tenure as a chief executive and at a particular company, as well as missing dummies to control for missing variables. The executive's incentives are given by δ (delta) and υ (vega), whereas the cash value of a compensation package is represented by *C*, which I use to help control for managerial risk aversion. *Y* are the year dummies for each year in the study, except the first year, 1992. η represents fixed effects for a specific company, and ε is a idiosyncratic error for each individual at each time.

I assume that target values for the risk-decision are set by the executive and adjusted throughout the year, according to market conditions, so I include contemporaneous values of the control variables. Cash compensation is assumed to be guaranteed, so the contemporaneous value is used. Because incentive variables are calculated using year-end figures, the current year incentives known to the chief executive are those which exist at the and of the previous year. Thus, lagged values of incentive variables are used in the equations. The contemporaneous relationship between the risk-decision and incentive variables is investigated using a system of simultaneous equations, described below.

By using fixed-effects regressions on panel data, I am able to control for firm and executive specific idiosyncrasies that may be persistent over time. Employing the fixed-effect regressions has a similar effect to de-meaning the data to account for unobserved variables which are constant over time, but vary between firms – the error structure which best describes unobserved variables due to risk policy preferences or a history of conducting particular business. It is likely that some executives internally prefer more risk than others for reasons that are not directly observable. Similarly, some firms may have a culture of bearing more risk than others. The fixed-effects specifications accounts for the fact that these preferences may be correlated with observed variables. Industry-wide effects that occur in only a single year are controlled for using the year dummies, allowing me to concentrate on individual observation fixed-effects.

The fixed-effect regressions are then expanded as:

Equation 4:

$$R_{i,t} = \beta_1 X_{i,t} + \beta_2 C_{i,t} + \beta_3 \hat{\upsilon}_{i,t-1} + \beta_4 \hat{\delta}_{i,t-1} + Y_t + \eta_i + \varepsilon_{i,t}$$

and

Equation 5

$$R_{i,t} = \beta_1 X_{i,t} + \beta_2 C_{i,t} + \beta_3 \hat{\upsilon}_{i,t-1} + \beta_4 \hat{\delta}_{i,t-1} + \beta_5 \hat{\upsilon}_{i,t-1,resid} + \beta_6 \hat{\delta}_{i,t-1,resid} + Y_t + \eta_i + \varepsilon_{i,t}$$

which incorporate the predicted lagged values of delta and vega as well as the residuals in equation 5, denoted by hats: ^.

Here, several additional variables are included in an attempt to control for a firm's natural or desired level of vega and deviations form it. This allows me to examine if variation in incentives from past policy and structural preference, represented by $\hat{\upsilon}$ and $\hat{\delta}$, or the predicted values of vega and delta affect risk bearing. Deviations from this value are given by the residuals in the equations, which capture the effect of the portion of incentives which are orthogonal to all of the other control variables. Thus, it is possible to investigate how much of the risk decision is due to what would be natural for the firm and how much is due to variations in the incentives given to management. The predicted values are determined by the regressions:

Equation 6:

$$\widehat{\upsilon}_{i,t} = \beta_1 X_{i,t} + Y_t + \widehat{\upsilon}_{i,t,resid}$$

and

Equation 7:

$$\widehat{\delta}_{i,t} = \beta_1 X_{i,t} + Y_t + \widehat{\delta}_{i,t,resid}$$

where *X* represents the current managerial and structural control variables as explained before. The control variables are contemporaneous with the vales of delta and vega, one year before the control variables used in equation 4, which are contemporaneous with the risk decision. *Y* is a control variable for all of the years appearing in the study. These expressions yield what the industry-standard value of delta or vega would be, given the particular observable details of a firm, and results are presented in table 4. By controlling for this, I can compensate for whether expected values of incentives have effects on risk decisions. In addition, in equation 5, the coefficients on residual delta and vega can determine if providing greater or fewer incentives has the effect of being able to induce behavior by differing from the 'expected' incentives.

I also examine the role of managerial power on risk decisions in some of the specifications. Managers who are more entrenched in their firm are likely better able to dictate the terms of their contract to extract more compensation from a willing board and should also be positioned to make safer risk-decisions to protect their position. To test this I predict how much an executive should be paid given the structure of an insurance firm and the demographics of the executive. The difference between this predicted value and the actual level of pay could be considered a proxy of the power of the manager. This relationship is estimated using the following equation:

Equation 8

$$Pay_i = \alpha + \beta_1 X_i + \varepsilon_i$$

Pay is measured using Compustat's *TDC1* variable which measures the pay granted to the executive by the board. *X* is the entire set of firm structural and managerial characteristic variables described previously. The residual, *PayResid,* is then calculated using the predicted coefficients. This regression is also presented in table 4, described in section 5.

4.1.2 Instrumental Variable Regressions

I attempt to resolve the problem of potential endogeneity due to simultaneous determination of the risk and compensation structure choices by conducting several instrumental variable regressions with a form similar to that of the panel regressions. Four different specifications are presented below. The first, in column 5 of tables 6-9, includes only the incentives with the twice-lagged value of vega used to instrument the lagged value of vega. Next, control variables are added. The third specification uses the twice-lagged predicted value of vega to instrument lagged vega. It is possible that the incentive variables at the beginning of a year are correlated with the idiosyncratic error in the risk-decision regression for that year. However, it is less likely that the incentives from two years ago are associated with this error, making the twice-lagged variables a potential instrument. There is consistency in incentive variables over time. The correlation coefficient between vega at *t* and *t-1* is 0.84, while that for delta is 0.96. I also use the *t-2* predicted values as an instrument in column 7 to attempt to capture the effects of firm policies and make the instrumental variable regressions as directly comparable to the least-squares fixed-effect panel regressions as possible. All instrumental regressions are run taking into account panel fixed effects. Because these instrumental variable regressions control for potential endogeneity better than the panel regressions and these best fit the likely story of managerial incentives, the results in column 6, using twice-lagged values of vega and control variables are the preferred results in this paper. The correlation matrix among all main variables in this study is given in appendix 3.

4.1.3 Simultaneous Equations

It is likely that the level of risk that the firm bears, or the level that is preferred by boards of directors, is determined at the same time as the pay package offered to the CEO. If directors are using incentives to attempt to alter risk policy in a systematic way then delta and vega should be related to the risk decisions. If they are unrelated then this could mean that boards are no looking at current policy when setting compensation or that compensation is already set optimally. I examine this situation for the risk-retention decision using the system of equations displayed in equation nine with results given in table 9.

Equation 9

$$R_{it} = \alpha_1 + \beta_1 \upsilon_{i,t} + \beta_2 \delta_{i,t} + \beta_3 Payresid_{i,t} + \beta_4 C_{i,t} + \beta_5 CEO_{i,t} + \beta_6 trs_{i,t} + \beta_7 GPW_{i,t} + \beta_8 tax_{i,t}$$
$$\beta_9 numS_{i,t} + \beta_{10} Hown_{i,t} + \beta_{11} Yrs + \varepsilon_{i,t,R}$$
$$\upsilon_{i,t} = \alpha_2 + \lambda_1 R_{i,t} + \lambda_2 \delta_{i,t} + \lambda_3 \upsilon_{i,t-1} + \lambda_4 C_{i,t} + \lambda_5 firmrisk + \lambda_6 CEO_{i,t} + \lambda_7 X_{i,t} + \lambda_8 schedP_{i,t}$$
$$+ \lambda_9 Yrs + \varepsilon_{i,t,\upsilon}$$
$$\delta_{i,t} = \alpha_3 + \gamma_1 R_{i,t} + \gamma_2 \upsilon_{i,t} + \gamma_3 \delta_{i,t-1} + \gamma_4 firmrisk + \gamma_5 CEO_{i,t} + \gamma_6 X_{i,t} + \gamma_7 schedP_{i,t}$$
$$+ \gamma_8 Yrs + \varepsilon_{i,t,\delta}$$

here, contemporaneous variables are used, in accordance with the assumptions of simultaneous equations. The measures of risk decisions are included in the incentive equations. Previously used variables are as described before. *payresid* is the residual of predicted pay level. *trs* is the total return to shareholders. *firmrisk* is the standard deviation of stock returns, which measures the 'noise' of the market that the firm is operating in and the potential usefulness of incentive pay. *GPW* is the growth in premiums written, *schedP* is the proportion of firm business which takes place in long-tailed lines. Variables are included according to prior simultaneous equations literature which examines incentives and the risk-management decision. Schedule P, or long-tailed lines are included as part of the identification restrictions for the incentive equations, because this is another choice through which incentives could affect firm risk decisions – I examine the co-determination of business in long-tailed lines and incentives variables next.

A similar set of equations is estimated for the amount of business in schedule P lines described in equation 10.

Equation 10

$$schedP_{i,t} = \alpha_1 + \beta_1 \upsilon_{i,t} + \beta_2 \delta_{i,t} + \beta_3 Payresid_{i,t} + \beta_4 C_{i,t} + \beta_5 CEO_{i,t} + \beta_6 trs_{i,t} + \beta_7 GPW_{i,t}$$
$$+ \beta_8 tax_{i,t} + \beta_9 numS_{i,t} + \beta_{10} Hown_{i,t} + \beta_{11} Yrs + \varepsilon_{i,t}$$
$$\upsilon_{i,t} = \alpha_2 + \lambda_1 schedP_{i,t} + \lambda_2 \delta_{i,t} + \lambda_3 \upsilon_{i,t-1} + \lambda_4 C_{i,t} + \lambda_5 firmrisk + \lambda_6 CEO_{i,t} + \lambda_7 X_{i,t} + \lambda_8 R_{i,t}$$
$$+ \lambda_9 Yrs + \varepsilon_{i,t}$$
$$\delta_{i,t} = \alpha_3 + \gamma_1 schedP_{i,t} + \gamma_2 \upsilon_{i,t} + \gamma_3 \delta_{i,t-1} + \gamma_4 firmrisk + \gamma_5 CEO_{i,t} + \gamma_6 X_{i,t} + \gamma_7 R_{i,t} + \gamma_8 Yrs + \varepsilon_{i,t}$$

Each of the control variables is defined as above, but here the risk-retention decision is included to help identify the incentive equations, along with lagged incentive values, because this is an alternate decision that could be made by managers to increase or reduce risk.

Next, each measure of leverage: the Premium/Surplus ratio and Best's Capital Adequacy Ratio, is estimated using a similar system, described in equation 11.

Equation 11

$$Lev_{i,t} = \alpha_1 + \beta_1 \upsilon_{i,t} + \beta_2 \delta_{i,t} + \beta_3 Payresid_{i,t} + \beta_4 C_{i,t} + \beta_5 CEO_{i,t} + \beta_6 trs_{i,t} + \beta_7 GPW_{i,t} + \beta_8 tax_{i,t}$$
$$\beta_9 numS_{i,t} + \beta_{10} Hown_{i,t} + \beta_{11} R_{i,t} + \beta_{12} Yrs + \varepsilon_{i,t}$$
$$\upsilon_{i,t} = \alpha_2 + \lambda_1 schedP_{i,t} + \lambda_2 \delta_{i,t} + \lambda_3 \upsilon_{i,t-1} + \lambda_4 C_{i,t} + \lambda_5 firmrisk + \lambda_6 CEO_{i,t} + \lambda_7 X_{i,t} + \lambda_8 R_{i,t}$$
$$+ \lambda_9 Yrs + \varepsilon_{i,t}$$
$$\delta_{i,t} = \alpha_3 + \gamma_1 schedP_{i,t} + \gamma_2 \upsilon_{i,t} + \gamma_3 \delta_{i,t-1} + \gamma_4 firmrisk + \gamma_5 CEO_{i,t} + \gamma_6 X_{i,t} + \gamma_7 R_{i,t} + \gamma_8 Yrs + \varepsilon_{i,t}$$

This system is much the same as the two before, however the leverage decision is now assumed to be made while incentives are set, taking into account the firm's business and risk-retention decision, in a manner similar to Coles, Daniel and Naveen (2006).

4.2 Relationship with Stock Return Variance

For executives to consider incentives when determining firm decisions, it is necessary that those decisions should have an effect on the stock variance – the underlying measure upon which the incentives are based. To see if the risk decision variables are actually related to the risk of the firm which affects vega, I regress each measure upon the variance of stock returns on the market. To compensate for the fact that each variable may take some time to take effect, I include both contemporaneous and lagged values of each of the risk variables in the right-hand-side of the equations, along with the standard variables which should affect the risk of firm returns.

Equation 12

$$\ln sdrets_i = RR_{i,t} + RR_{i,t-1} + RR_{i,t-2} + X_i + Y_t + a + e_i$$

In these standard OLS regressions, *X*, is the observable set of control variables which is included to compensate for other factors which investors may take into account when determining firm value and the benefit of firm decisions. *Y* is the set of year dummies which account for returns in any specific year, while *e* is the idiosyncratic error and *a* is a constant term. This equation is estimated both with and without the twice-lagged term and results are given in table 14.

5. Empirical Results

5.1 Creation of Predicted Variables

For the panel and instrumental variable regressions, predicted values of managerial pay, risk retention, delta, and vega were created as described in section 4. The results are presented in Table 4. Several of the control variables were found to be important in determining the level of these variables.

The residual of managerial pay is used as a proxy measure for the manager's clout within the firm's management structure. As is consistent with the literature, larger firms pay more and managers who have been CEO longer receive more pay. After his has been controlled for, older executives receive less pay than expected. Several of the year dummy variables are significant – there do appear to be broad effects in the market for executive talent over time. This regression broadly confirms the usual results from the managerial pay literature.

Delta is related to the length of time an executive has worked – how long they have had to build up a portfolio of options and stock. Both length of tenure as CEO and tenure at the company are positive and significant as CEOs are usually awarded more options per year than other managers. All of the firm variables are insignificant. In contrast, some of the firm-structure variables do seem to be important when determining the executive's vega. The tenure variables are still significant, and tenure at company has a negative effect. Executives at larger firms also have higher sensitivities of wealth to stock variance. Executives at firms with concentrated business have higher sensitivities while those at firms whose business is uncorrelated with losses – those which do not have as much of a natural hedge – have lower sensitivies. Executives at better-rated firms also have higher sensitivities to firm stock-price variance.

As shown in the comparison regressions discussed in section 4, many of the structural variables have an effect on a group's risk retention. Older CEOs tend to take riskier actions while those who have been a CEO for longer, and are presumably more entrenched, take less risky actions. As expected, larger firms bear more risk. Finally, groups with worse AM Best ratings are also those who bear more risk, suggesting that the company penalizes firms for excessive risk-bearing.

Table 4: First-Stage Regressions for Fitted Variables

First-Stage cross-sectional regressions are presented which are used to create the fitted variables - managerial pay, Delta, Vega, and risk retained by the firm. All control variables are presented, including missing and time dummy variables. Missing variables are included to help retain observations and observations which are missing are recoded as zero. The loss ratio is the ratio of loss expenses to premiums earned. Managerial Pay is measured in $1,000s. Delta in the sensitivity of CEO wealth ($1,000s) to a 1% change in stock price. Vega is the sensitivity of CEO wealth ($1,000s) to a .01 change in the volatility of stock price. The risk retained by the firm is the premiums written less reinsurance ceded divided by premiums written. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Variables are current-year values.

	1 Managerial Pay	2 Delta	3 Vega	4 Risk Retianed
Age of CEO	-105.639	14.168	-1.482	0.007
	[31.440]***	[23.479]	[1.945]	[0.002]***
Tenure as CEO	64.778	94.535	6.516	-0.004
	[22.046]***	[16.842]***	[1.394]***	[0.002]***
Tenure at Company	-22.692	24.757	-2.956	0.001
	[18.523]	[12.451]**	[1.027]***	[0.001]
Missing: Age of CEO	-6351.054	-87.656	-132.873	0.413
	[1,717.178]***	[1,259.299]	[104.398]	[0.112]***
Missing: Tenure as CEO	-913.667	1132.141	-11.675	-0.057
	[490.235]*	[357.355]***	[29.696]	[0.031]*
Missing: Tenure at Company	-1342.095	943.069	-118.452	0.005
	[445.679]***	[308.422]***	[25.627]***	[0.030]
Firm Size (ln of admitted assets)	373.75	-28.909	18.371	0.014
	[87.655]***	[62.194]	[5.166]***	[0.006]**
Correlation between Investmnent Returns and Claims Costs	-13018.809	-3993.781	-729.213	-0.163
	[6,910.243]*	[5,248.333]	[437.045]*	[0.605]
Tax Rate	71.656	35.221	1.331	0.009
	[65.286]	[41.575]	[3.464]	[0.008]
Group Herfindahl Index for Direct Premiums Written by line	690.009	-188.291	53.191	0.024
	[527.227]	[370.976]	[30.745]*	[0.036]
Number of States Licensed	-3.95	8.476	0.65	-0.001
	[7.735]	[5.393]	[0.446]	[0.001]
A.M. Best Rating of Group	-5.506	-6.897	-0.881	0.001
	[8.164]	[5.670]	[0.465]*	[0.001]**
Concentration of Group Ownership Herfindahl	196.897	-89.143	-18.745	0.013
	[499.480]	[347.732]	[28.827]	[0.034]
Growth in Direct Premiums Written ($ Trillion)	8.827	3.909	1.04	0.001
	[14.623]	[9.712]	[0.807]	[0.001]
Loss Ratio	13.559	-16.292	0.718	0
	[17.405]	[12.092]	[1.006]	[0.001]
1-Year Return to Shareholdesr	-406.311	157.533	-12.485	0.033
	[466.037]	[393.641]	[32.288]	[0.031]
Percentage of Assets Invested in Stocks and Bonds	-14.116	12.803	-0.074	0.001
	[12.212]	[8.936]	[0.744]	[0.001]
Missing: Loss Ratio	1027.478	89.873	124.249	0.019

	1 Managerial Pay	2 Delta	3 Vega	4 Risk Retianed
	[513.689]**	[338.588]	[27.852]***	[0.040]
Missing: 1-Year Return to Sharedholers	525.959	-221.952	-30.498	-0.052
	[792.996]	[637.090]	[53.041]	[0.048]
Missing: Growth in Direct Premiums Written	705.517	517.373	26.857	-0.008
	[334.877]**	[234.222]**	[19.477]	[0.023]
Missing: Group Assets	-956.87	2705.431	-27.885	-0.037
	[1,549.778]	[1,030.096]***	[85.784]	[0.104]
1992	349.597	-2219.936	-236.85	0.149
	[2,773.375]	[2,102.304]	[174.266]	[0.184]
1993	471.922	-1699.6	-238.723	0.136
	[722.830]	[2,060.179]	[170.842]	[0.180]
1994	405.853	-1754.03	-230.226	0.169
	[761.352]	[2,068.132]	[171.536]	[0.180]
1995	744.398	-1621.171	-238.8	0.123
	[710.880]	[2,088.680]	[173.032]	[0.181]
1996	-1775.223	-1263.567	-328.369	-0.026
	[970.447]*	[2,408.427]	[199.605]	[0.214]
1997	-821.159	-1377.393	-319.21	-0.011
	[1,006.980]	[2,431.803]	[201.333]	[0.216]
1998	-294.637	-1190.463	-264.415	-0.06
	[984.497]	[2,400.051]	[198.974]	[0.214]
1999	-266.861	-781.775	-280.695	-0.048
	[1,068.161]	[2,430.266]	[201.328]	[0.216]
2000	3035.885	-558.361	-149.038	0.09
	[977.686]***	[2,104.916]	[174.660]	[0.183]
2001	4081.112	-1051.688	-44.209	-0.057
	[834.742]***	[2,169.033]	[179.682]	[0.189]
2002	1027.021	-667.419	-169.254	-0.178
	[1,166.276]	[2,495.677]	[206.886]	[0.223]
2003	1489.157	-400.054	-175.255	-0.162
	[1,148.536]	[2,532.429]	[209.774]	[0.224]
2004	4503.245	-476.556	-70.38	-0.082
	[872.516]***	[2,227.293]	[184.463]	[0.196]
Observations	458	386	390	368
R-squared	0.37	0.44	0.61	0.97

5.2 Panel and IV Regressions

Panel and instrumental variable regressions are the preferred specifications in this paper and are presented in tables 6-9, all of which share the same basic structure. Table 5 provides summary results from the preferred regressions in this study. Delta is found to be associated with less-risky decisions while the results from vega are mixed. The only result significant at the 10% level is that a higher vega is associated with less business in long-tailed lines. The regression results are explained in the particular subsections below. In each table, least-squares panel regressions are shown in section A (Columns 1-4) and the instrumental variable regressions are shown in section B (Columns 5-7). The equation in column 1 only the incentive variables are regressed on the risk decision variable. Column 2 adds control variables to examine the relative importance of managerial incentives. Column 3 uses predicted values of delta and vega to analyze the general effect of expected firm policy and correct for endogeneity. Column 4 includes residuals for delta and vega to determine the effect of the part of the sensitivity which is orthogonal to its predictor control variables – deviations from expected policy. The instrumental variables follow similar specifications using twice-lagged values of the sensitivity variables as instruments for the once-lagged variables included in the normal specification. Column 6 performs this same regression with control variables. Columns 7 uses the twice-lagged predicted values as an instrument.

Table 5: Summary IV Results

Risk Measure	Delta	Vega
Risk Retained	0.14	8.402
Proportion of Business in Long-Tailed Lines	-1.357	**-24.303***
Premium/Surplus Ratio	-19.535	153.145
Best's Capital Adequacy Ratio	-5.277	-74.703

* indicates significane at the 10% level. Risk measure and incentives are described in section 4.

5.2.1 Risk Retained

The fixed-effects regressions on risk retained reveal a role for executive incentives in determining risk policy. The sign on delta is negative and insignificant in the first four specifications. However, the delta residuals are significant, indicating that an increase in delta from expected values is correlated with more risk-bearing. Vega is positive and significant in column one, as expected. When control variables are included, the coefficient is still positive, but no longer significant. The coefficient on predicted Vega is positive and significant in both of the specifications, although residuals appear to have no effect. These results indicate that increasing an executive's wealth sensitivity to volatility at the beginning of a year does in fact encourage companies to purchase less reinsurance throughout the ensuing business year.

When considering other control variables, cash compensation is negative, but insignificant. Older CEOs, a natural hedge, and firm business concentration all are associated with more risk retention in the incentives and control equation. In the predicted and residuals equation groups which are more concentrated retain more risk. Again, these firms appear to be taking on more risky policies, rather than using reinsurance as a way to reduce risk.

The instrumental variable regressions show that the incentives have the proper sign, although they are not significant. Further, delta is positive when lagged predicted values are used as instruments rather than actual values. Firm structure variables appear to be more significant in these regressions. Cash compensation is positively associated with risk retention, which is unexpected. As in the panel regressions older CEOs keep on more risk. More natural hedging, provided by a higher correlation of claims and losses, leads to more risk retention, as expected. More concentrated firms appear to retain more risk, which indicates general risk-bearing preferences.

Table 6: Panel Regressions on Risk Retained

Least squares and instrumental variable panel regressions of the firm's reinsurance purchase decision, defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		(A) Least-Squares				(B) Instrumental Variable		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-0.305	-0.325			-0.122	0.14	5.322
		[0.626]	[0.961]			[0.668]	[1.059]	[4.024]
$Vega_{t-1}$ (.01/$1000000)	(+)	12.527	14.28			9.609	8.402	139.531
		[7.477]*	[9.068]			[11.912]	[14.420]	[90.282]
Predicted $Delta_{t-2}$	(+/-)			-0.002	-0.002			
				[0.002]	[0.002]			
Predicted $Vega_{t-2}$	(+)			0.041	0.064			
				[0.021]*	[0.026]**			
Delta $Residual_{t-2}$	(+/-)				0.016			
					[0.009]*			
Vega $Residual_{t-2}$	(+)				0			
					[0.001]			
Salary and Bonus $Compensation_t$ ($100,000)	(-)		0.267	-0.102	0.023		0.417	0.45
			[0.233]	[0.159]	[0.197]		[0.226]*	[0.437]
Age of CEO_t			0.15	-0.377	0.036		0.159	-0.052
			[0.084]*	[0.401]	[0.497]		[0.085]*	[0.201]
Tenure as CEO_t			0.022	0.324	-0.265		-0.137	-1.47
			[0.396]	[0.267]	[0.440]		[0.567]	[1.292]
Tenure at $Company_t$			0.098	0.059	0.219		0.257	1.541
			[0.221]	[0.154]	[0.187]		[0.259]	[0.994]
Firm $Size_t$ (ln of admitted assets)	(+)		-0.796	0.898	-2.114		-1.892	-1.544
			[2.522]	[1.335]	[2.556]		[2.560]	[4.817]

		(A) Least-Squares				(B) Instrumental Variable		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
Correlation between Investment Returns and Claims Costs$_t$	(+)		204.291	40.65	94.449		391.708	-56.563
			[92.848]**	[63.893]	[80.289]		[86.629]***	[299.758]
Tax Rate$_t$			1.103	-0.187	4.78		2.169	2.807
			[1.851]	[3.025]	[4.392]		[1.859]	[5.796]
Herfindahl Index for Direct Premiums Written by Line$_t$			25.876	5.866	8.428		57.558	12.4
			[9.669]***	[7.816]	[9.063]		[8.650]***	[23.619]
Number of States Licensed$_t$	(-)		0.007	-0.088	-0.077		0.024	0.017
			[0.084]	[0.072]	[0.096]		[0.090]	[0.184]
A.M. Best Rating of Group$_t$			-0.011	0.01	0.006		-0.224	0.158
			[0.080]	[0.064]	[0.093]		[0.097]**	[0.216]
Concentration of Group Ownership Herfindahl$_t$	(+)		-1.736	1.121	10.725		1.372	-21.991
			[5.770]	[4.215]	[6.001]*		[6.382]	[18.929]
Growth in Direct Premiums Written$_t$ ($ Trillion)			0.037	0.114	0.062		0.034	0.05
			[0.089]	[0.081]	[0.097]		[0.084]	[0.164]
Loss Ratio$_t$			0.063	-0.159	-0.041		0.063	0.184
			[0.130]	[0.154]	[0.190]		[0.142]	[0.389]
1 Yr Return to Shareholders$_t$			5.983	1.028	1.633		-3.62	-1.125
			[3.984]	[2.983]	[4.161]		[3.874]	[7.297]
Percentage of Assets Invested in Stocks and Bonds			0.142	0.107	0.236		0.236	-0.004
			[0.170]	[0.116]	[0.181]		[0.186]	[0.366]
Observations		223	215	234	177	146	142	167
Number of A.M. Best Group Number		54	54	51	45	36	36	43
R-squared		0.22	0.36	0.44	0.5			

5.2.2 Proportion of Business in Long-Tailed Lines

There is evidence that executives are responding to incentives on the decision of how much business to conduct in risky lines, although their actions are the opposite of what would be expected. Incentives are insignificant in columns 1 and 2. When predicted values are used then delta is positive, indicating that executives are taking on business that they might otherwise have passed by, but predicted vega is negative and significant and remains so when residuals are included. This result implies that executives are actually taking on less risky business when they are given incentives to take on risk – a counterintuitive result. This same result occurs in columns 6 and 7 of the instrumental variable regressions. While delta has a negative effect in the instrumental variable regressions using predicted variables.

Again, several of the firm and structural variables are significant. Lower correlations between investment returns and claims costs are associated with more long-tailed line business – these Schedule P lines do seem to add more risk to the company's profile and do not provide a natural hedge. Firms which are more diversified in their business conduct less business in long-tailed lines, as we would expect. These risky lines seem to be the business of some specialty firms as other results suggest. Instrumental variables suggest that companies which are more concentrated in their group ownership conduct more of this risky business, which is what would be expected if these lines are the specialty of a few companies. Instrumental variable results, as well as those from panel regressions using predicted values indicate that companies which are less geographically diversified also conduct more business in these risky lines. CEOs who have been in their position longer appear to conduct more business in these risky lines.

Older CEOs do as well, only the regression using predicted and residual values gives the opposite result. The only significant results for tenure at a particular company come from using predicted values and indicate that executives who have longer tenure appear to conduct less business in these lines. CEOs who are brought in from outside may be more willing to expand into this business or may have specialized skills or preferences which leads them to pursue these lines.

Table 7: Panel Regressions on Proportion of Business in Long-Tailed Lines

Least squares and instrumental variable panel regressions of the firm's decision of amount of business conducted in long-tailed lines at the end of year t. Long-tailed lines are as defined in Phillips, Cummins, and Allen (1996) and are listed in Appendix 1. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		Least-Squares				Instrumental Variable		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-0.761	-0.625			-0.704	-1.357	-2.071
		[0.739]	[0.785]			[0.865]	[0.905]	[0.965]**
$Vega_{t-1}$ (.01/$1000000)	(+)	-6.205	-7.728			-8.742	-24.303	-47.429
		[7.707]	[7.843]			[12.739]	[12.860]*	[26.453]*
Predicted $Delta_{t-2}$	(+/-)			0.003	0.003			
				[0.002]*	[0.002]			
Predicted $Vega_{t-2}$	(+)			-0.068	-0.057			
				[0.020]***	[0.022]**			
Delta $Residual_{t-2}$	(+/-)				-0.011			
					[0.008]			
Vega $Residual_{t-2}$	(+)				0.001			
					[0.001]			
Salary and Bonus $Compensation_t$ ($100,000)	(-)		0.007	0.116	0.141		-0.078	0.078
			[0.176]	[0.144]	[0.157]		[0.203]	[0.250]
Age of CEO_t			0.123	-0.507	-0.876		0.108	0.179
			[0.079]	[0.402]	[0.446]*		[0.091]	[0.087]**
Tenure as CEO_t			0.633	0.252	1.04		0.928	1.018
			[0.383]*	[0.281]	[0.388]***		[0.615]	[0.456]**
Tenure at $Company_t$			-0.022	-0.294	-0.386		-0.16	-0.302
			[0.169]	[0.150]*	[0.159]**		[0.209]	[0.222]
Firm $Size_t$ (ln of admitted assets)	(+)		1.892	-0.23	2.551		1.534	-0.022
			[2.281]	[1.300]	[1.931]		[3.124]	[2.355]

	Predicted Direction of Effect	Least-Squares				Instrumental Variable		
		1	2	3	4	5	6	7
		Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
Correlation between Investment Returns and Claims Costs$_t$	(+)		-470.48	-383.818	-409.288		-509.364	-375.359
			[84.970]***	[67.494]***	[77.937]***		[91.565]***	[98.092]***
Tax Rate$_t$			-0.115	0.744	-0.105		-0.273	-3.752
			[0.308]	[2.919]	[3.691]		[0.310]	[3.202]
Herfindahl Index for Direct Premiums Written by Line$_t$			-63.833	-54.739	-61.349		-73.158	-52.07
			[7.658]***	[7.099]***	[7.664]***		[8.644]***	[9.175]***
Number of States Licensed$_t$	(+)		-0.045	-0.138	-0.061		-0.142	-0.179
			[0.069]	[0.068]**	[0.079]		[0.089]	[0.080]**
A.M. Best Rating of Group$_t$			0.182	0.008	0.116		-0.025	-0.065
			[0.079]**	[0.070]	[0.089]		[0.115]	[0.100]
Concentration of Group Ownership Herfindahl$_t$	(+)		1.834	5.82	-0.653		15.857	20.141
			[4.821]	[4.434]	[5.504]		[7.314]**	[7.816]***
Growth in Direct Premiums Written$_t$ ($ Trillion)			0.025	0.103	0.094		0.07	0.084
			[0.070]	[0.070]	[0.073]		[0.079]	[0.075]
Loss Ratio$_t$			-0.095	0.065	0.062		0.051	-0.035
			[0.123]	[0.117]	[0.118]		[0.171]	[0.174]
1 Yr Return to Shareholders$_t$			-3.461	-1.693	-0.339		2.189	-3.878
			[3.885]	[3.134]	[3.869]		[4.535]	[4.299]
Percentage of Assets Invested in Stocks and Bonds			0.293	0.245	0.308		0.21	0.341
			[0.165]*	[0.125]*	[0.176]*		[0.216]	[0.184]*
Observations		278	267	287	225	185	178	208
Number of A.M. Best Group Number		59	59	56	51	42	41	48
R-squared		0.46	0.65	0.56	0.63			

5.2.3 Leverage: Premium/Surplus Ratio

Executives do not appear to be responding to incentives when determining leverage, at least as measured by the premium/surplus ratio. Both the delta and vega coefficients are negative, though insignificant, in the panel regression. The predicted values of vega are both positive, but again, insignificant. The residual of delta has a negative effect on leverage and is significant at the 10% level. The coefficient values for the instrumental variable regressions go in the expected direction, but these values are not statistically significant.

Some of the structural control variables do appear to be positively related to the leverage of the firm. The loss ratio is uniformly positive and significant – firms which take on more business appear to experience greater losses relative to the premiums they earn. It is possible that this is because they are taking on riskier business that they might otherwise pass over, rather than recruiting new business with the same risk profile. The number of states in which a firm does business is also uniformly related to more premiums for a given level of surplus. Perhaps state-level subsidiaries provide bankruptcy protection which offsets the affect of increased leverage for the group as a whole. When considering incentive and control variables firms which are more specialized in their business are also more leveraged – considering that firms which are more specialized also retain more risk then it is possible that these firms are making riskier decisions when they specialize in a particular line of business. I investigate whether firms are specializing in particularly risky lines of business in 5.2.2 and also in the robustness checks section of this paper. A higher tax rate is associated with less leverage as is more investment in risky assets. This is evidnce that firms who write more premiums seem to be less concerned with potential tax shields and perhaps are using these extra premiums to attempt to earn higher yields on their invested assets.

Table 8: Panel Regressions on Premium/Surplus Ratio

Least squares and instrumental variable panel regressions of the firm's premium/surplus decision, defined as total net premiums written to insurer-reported surplus at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 4. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		Least-Squares				Instrumental Variable		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-25.41	-32.041			-34.777	-19.535	-21.161
		[24.018]	[27.855]			[31.378]	[38.051]	[34.112]
$Vega_{t-1}$ (.01/$1000000)	(+)	-25.115	-308.633			415.209	153.145	501.321
		[239.346]	[270.574]			[458.198]	[540.568]	[898.600]
Predicted $Delta_{t-2}$	(+/-)			-0.03	-0.054			
				[0.057]	[0.078]			
Predicted $Vega_{t-2}$	(+)			0.748	1.418			
				[0.721]	[0.902]			
Delta $Residual_{t-2}$	(+/-)				-0.043			
					[0.026]*			
Vega $Residual_{t-2}$	(+)				-0.027			
					[0.321]			
Salary and Bonus $Compensation_t$ ($100,000)	(-)		4.251	4.089	2.428		5.117	-1.06
			[6.090]	[5.000]	[6.163]		[8.529]	[8.796]
Age of CEO_t			-1.573	-2.251	6.054		-2.014	-1.398
			[2.717]	[13.970]	[17.537]		[3.834]	[3.078]
Tenure as CEO_t			4.788	-2.833	-12.418		6.268	2.501
			[13.200]	[9.767]	[15.193]		[25.919]	[16.071]
Tenure at $Company_t$			-4.614	1.329	-0.366		-1.847	-1.585
			[5.815]	[5.207]	[6.243]		[8.769]	[7.786]
Firm $Size_t$ (ln of admitted assets)	(+)		111.586	38.87	24.896		111.022	131.378
			[78.869]	[45.224]	[75.629]		[131.408]	[84.175]

	Predicted Direction of Effect	Least-Squares				Instrumental Variable		
		1	2	3	4	5	6	7
		Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
Correlation between Investment Returns and Claims Costs$_t$	(+)		1968.29	662.133	1195.495		2472.061	-1267.074
			[2,930.422]	[2,342.667]	[3,053.820]		[3,850.094]	[3,483.451]
Tax Rate$_t$			-0.217	-206.258	-31.638		1.356	-274.088
			[10.624]	[102.357]**	[147.372]		[13.018]	[115.785]**
Herfindahl Index for Direct Premiums Written by Line$_t$			421.134	213.411	214.267		609.446	207.677
			[264.131]	[246.591]	[300.472]		[363.358]*	[328.784]
Number of States Licensed$_t$	(+)		4.317	3.483	5.378		6.239	4.68
			[2.384]*	[2.350]	[3.100]*		[3.764]*	[2.874]
A.M. Best Rating of Group$_t$			-1.561	2.306	1.884		0.83	2.031
			[2.726]	[2.432]	[3.502]		[4.850]	[3.571]
Concentration of Group Ownership Herfindahl$_t$	(+)		144.646	26.544	-17.51		-142.818	-130.381
			[166.555]	[153.882]	[215.571]		[307.471]	[275.469]
Growth in Direct Premiums Written$_t$ ($ Trillion)			-0.337	-1.538	-1.795		0.166	-1.386
			[2.410]	[2.445]	[2.881]		[3.317]	[2.706]
Loss Ratio$_t$			10.641	13.323	14.566		24.298	31.167
			[4.242]**	[4.072]***	[4.642]***		[7.297]***	[6.228]***
1 Yr Return to Shareholders$_t$			-61.438	-13.726	7.549		44.862	96.846
			[136.966]	[109.484]	[152.506]		[193.223]	[155.563]
Percentage of Assets Invested in Stocks and Bonds			-12.97	-11.267	-17.198		-17.574	-19.359
			[5.695]**	[4.338]**	[6.932]**		[9.101]*	[6.620]***
Observations		276	265	286	224	185	177	207
Number of A.M. Best Group Number		60	59	56	51	42	41	48
R-squared		0.09	0.22	0.27	0.36			

5.2.4 Leverage: Best's Capital Adequacy Ratio

Another leverage decision faced by the firm is that of setting policies to determine Best's Capital Adequacy Ratio. There is little evidence that incentive variables play a role in this decision, as none of the incentive variables are significant. Furthermore, in all of the regressions except for the incentives-only fixed effects regression, vega has a negative coefficient. These signs are the same for delta. The residual for delta is positive and significant at the 5% level, the only significant incentive result. Best's Capital Adequacy Ratio does not seem to be a major target of managers.

Only a few structural variables are significant. As is expected, firms with a better AM best rating have a better, higher ratio. Interestingly, firms with more concentrated ownership also have a better adequacy ratio. Firms with more investments in stocks and bonds have higher ratios.

Table 9: Panel Regressions on A.M. Best's Capital Adequacy Ratio

Least squares and instrumental variable panel regressions of the firm's leverage decision based upon Best's Capital Adequacy Ratio, defined as risk-adjusted surplus to net required capital at the end of year t. The full calculation for risk adjustment and required capital is available from A.M. Best and takes into account standard insurance industry practice. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively.
Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	1.33	-3.329			-1.039	-5.277	-5.747
		[2.752]	[2.782]			[3.267]	[3.742]	[3.872]
$Vega_{t-1}$ (.01/$1000000)	(-)	44.24	-16.833			-17.951	-74.703	-139.31
		[28.688]	[27.794]			[48.027]	[53.158]	[101.995]
Predicted $Delta_{t-2}$	(+/-)			-0.001	0.007			
				[0.007]	[0.009]			
Predicted $Vega_{t-2}$	(-)			-0.04	-0.08			
				[0.091]	[0.105]			
Delta $Residual_{t-2}$	(+/-)				0.006			
					[0.003]**			
Vega $Residual_{t-2}$	(-)				-0.017			
					[0.037]			
Salary and Bonus $Compensation_t$ ($100,000)	(+)		-0.379	-0.109	-0.164		-0.965	-0.181
			[0.625]	[0.630]	[0.717]		[0.839]	[0.998]
Age of CEO_t			0.208	-0.856	-2.459		0.189	0.338
			[0.279]	[1.760]	[2.041]		[0.377]	[0.349]
Tenure as CEO_t			-0.73	-0.247	0.096		-1.836	0.411
			[1.356]	[1.230]	[1.769]		[2.549]	[1.824]
Tenure at $Company_t$			-0.489	-0.428	-0.548		-0.451	-0.916
			[0.597]	[0.656]	[0.727]		[0.862]	[0.884]
Firm $Size_t$ (ln of admitted assets)	(-)		-13.426	-7.667	-8.028		-21.007	-12.662
			[8.081]*	[8.204]	[8.804]		[12.922]	[9.554]

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
Correlation between Investment Returns and Claims Costs$_t$	(-)		-114.005	-288.941	-148.15		40.763	-27.96
			[301.051]	[295.336]	[355.487]		[378.607]	[395.386]
Tax Rate$_t$			-0.834	-1.115	5.83		-1.458	-0.443
			[1.092]	[12.867]	[17.155]		[1.280]	[13.142]
Herfindahl Index for Direct Premiums Written by Line$_t$			9.558	-43.622	-50.456		-2.842	4.328
			[27.136]	[31.095]	[34.977]		[35.732]	[37.318]
Number of States Licensed$_t$	(-)		-0.015	-0.269	-0.505		-0.357	-0.203
			[0.245]	[0.297]	[0.361]		[0.370]	[0.326]
A.M. Best Rating of Group$_t$			-1.313	-0.922	-1.049		-1.386	-1.258
			[0.280]***	[0.308]***	[0.408]**		[0.477]***	[0.405]***
Concentration of Group Ownership Herfindahl$_t$	(-)		56.164	43.023	58.813		127.761	118.779
			[17.084]***	[19.363]**	[25.094]**		[30.236]***	[31.267]***
Growth in Direct Premiums Written$_t$ ($ Trillion)			-0.106	-0.308	-0.111		-0.06	-0.141
			[0.248]	[0.308]	[0.335]		[0.326]	[0.307]
Loss Ratio$_t$			-0.361	-0.372	-0.69		-0.008	0.031
			[0.435]	[0.516]	[0.540]		[0.718]	[0.707]
1 Yr Return to Shareholders$_t$			-11.818	9.951	8.025		-29.01	-24.834
			[13.982]	[13.875]	[17.753]		[19.001]	[17.657]
Percentage of Assets Invested in Stocks and Bonds			2.474	1.648	1.675		2.365	3.468
			[0.583]***	[0.546]***	[0.807]**		[0.895]***	[0.751]***
Observations		274	266	285	224	182	177	207
Number of A.M. Best Group Number		60	59	56	51	42	41	48
R-squared		0.42	0.65	0.39	0.45			

5.3 Simultaneous Equation Regressions

The relationship between incentives and firm decisions was also investigated in a simultaneous-equations framework to test the possibility that the contemporaneous levels of delta and vega were made at the same time as the firm's risk decision. Because grants of options are made throughout the year and firms continually adjust their business decisions, treating these variables as uncorrelated and static may not capture their true structure. Simultaneous equations adjust the error structure of the regressions to account for this possible co-determination. I first examine the firm's reinsurance purchase decision and its business in risky lines. Then, taking these decisions into account, I examine the firm's leverage decision. The results are presented in tables 10-13. Each table has a similar structure, adjusted for the specifications of each regression. The endogenous variable three-stage-least-squares regressions are presented in columns 1-3. The first-stage regressions are presented in columns 4-6 so that the determinants of each of the endogenous variables can be seen.

5.3.1 Risk Retained

In the simultaneous equations, incentives do not appear to play a large role in determining a company's risk retention – delta is negative and significant at the 10% level but vega is insignificant. Both of the incentive variables are strongly correlated with their past values. Firms which pay more in cash also appear to pay compensation with higher levels of vega, perhaps in an effort to combat the risk-aversion effects of higher cash payments. Higher cash pay is associated with less risk retention, indicating that this could be the case. If boards are setting the optimal level of risk and managers are responding, then it could be the case that the variables offset each other to produce result shareholders desire. Older CEOs tend to make riskier decisions, although those who have been in their jobs longer do not. They do, however, have higher sensitivity to stock price changes, likely from a build-up of options in their wealth portfolio. Larger firms retain more risk, as do those who pay more taxes. Firms which undertake riskier investments also retain more risk – indicating that risk decisions may be made across-the-board. Many of the structural variables are significant in the first-stage regressions. Notably firms which display a larger growth in premiums have higher vega in their pay packages and firms which do more business in long-tailed lines also retain more risk – perhaps firms are taking on or retaining more risky business than they would otherwise. This does not seem to be associated with loss ratio – that may play less of a role in the decision of how much to reinsure than in what to reinsure or how much leverage to bear.

Table 10: Simultaneous Equations (3SLS): Risk Retained

Simultaneous regressions of the firm's reinsurance decision, delta and vega are reported, along with first-stage regression results. Identification of systems is indicated by the included variables. The reinsurance purchase decision is defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars.

Standard errors are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1	2	3	4	5	6
	Risk Retained	Vega	Delta	Risk Retained	Delta	Vega
Risk Retained$_t$ (%)		0.297	0.55			
		[1.664]	[4.883]			
Delta$_t$ ($/1000)	-0.001	0.01				
	[0.001]*	[0.004]**				
Vega$_t$ (.01/$1000)	-0.021		0.37			
	[0.023]		[0.319]			
Delta$_{t-1}$			0.983	-0.001	0.981	0.009
			[0.021]***	[0.001]*	[0.022]***	[0.004]**
Vega$_{t-1}$		0.698		0.01	-0.827	0.412
		[0.060]***		[0.011]	[0.384]**	[0.066]***
Fitted Pay Residual$_t$	7.466			1.481	238.221	108.991
	[4.066]*			[2.439]	[86.218]***	[14.842]***
Salary and Bonus Compensation$_t$ ($100,000)	-1.205	4.582		-0.843	-9.506	-4.381
	[0.278]***	[1.695]***		[0.267]***	[9.449]	[1.627]***
Age of CEO$_t$	0.619	-0.357	-13.172	0.851	-18.299	-2.903
	[0.276]**	[2.384]	[10.786]	[0.301]***	[10.655]*	[1.834]
Tenure as CEO$_t$	-0.377	1.805	15.001	-0.517	18.932	2.874
	[0.246]	[1.841]	[8.896]*	[0.259]**	[9.156]**	[1.576]*
Tenure at Current Company$_t$	0.154	-1.72	-6.317	0.161	-7.283	-0.732
	[0.155]	[1.067]	[5.379]	[0.168]	[5.947]	[1.024]
Return to Shareholders$_t$ (%)	4.945			8.69	-200.621	-15.441
	[5.356]			[5.990]	[211.771]	[36.456]

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1	2	3	4	5	6
	Risk Retained	Vega	Delta	Risk Retained	Delta	Vega
Percentage of Assets Invested in Stocks and Bonds	0.241	-0.075		0.307	1.714	-0.657
	[0.101]**	[0.959]		[0.112]***	[3.955]	[0.681]
Log Standard Deviation of Returns$_t$		-23.226	-121.768	10.099	-167.482	-31.216
		[39.131]	[177.065]	[5.729]*	[202.527]	[34.865]
Loss Ratio$_t$	-0.099	-0.748	0.281	-0.051	-1.416	-1.038
	[0.149]	[0.991]	[4.967]	[0.158]	[5.595]	[0.963]
Growth in Direct Premiums Written$_t$ ($ Trillion)	0.034			-0.036	3.136	1.387
	[0.109]			[0.118]	[4.182]	[0.720]*
Proportion of Business in Long-Tailed Lines$_t$ (%)		0.048	0.557	0.153	-0.405	-0.057
		[0.568]	[2.768]	[0.081]*	[2.851]	[0.491]
Firm Size$_t$ (ln of admitted assets)	2.722	3.725	21.038	1.856	31.154	16.91
	[1.161]**	[6.690]	[31.704]	[1.101]*	[38.939]	[6.703]**
Correlation between Investment Returns and Claims Costs$_t$	-51.918	203.805	-13315.9	119.578	-13505.04	-400.899
	[118.506]	[896.808]	[1,458.823]***	[138.454]	[1,894.743]**	[842.621]
Tax Rate$_t$	4.734			5.244	34.62	-10.335
	[1.507]***			[1.613]***	[57.022]	[9.816]
Herfindahl Index for Direct Premiums Written by Line$_t$	-3.551	52.439	39.021	8.534	-78.716	-4.071
	[5.731]	[58.403]	[294.722]	[8.849]	[312.841]	[53.855]
Number of States Licensed$_t$	-0.031			-0.032	2.441	-0.385
	[0.076]			[0.083]	[2.939]	[0.506]
AM Best Rating of Group$_t$	0.06	-0.203	-2.223	0.04	-2.553	0.064
	[0.073]	[0.508]	[2.550]	[0.079]	[2.799]	[0.482]
Concentration of Group Ownership Herfindahl$_t$	-3.013			-3.091	-44.424	-3.714
	[4.641]			[5.153]	[182.182]	[31.362]
Constant	-26.965	-221.895	-335.852	-3.837	-421.834	-130.399
	[32.047]	[232.606]	[1,084.614]	[38.634]	[1,365.834]	[235.126]
Observations	170	170	170	170	170	170
R-squared				0.56	0.95	0.8

5.3.2 Business in Long-Tailed Lines

The simultaneous equation regressions show that the contemporaneous incentives given to executives do not appear to have much effect on the amount of business in conducted in long-tailed lines. Here, firms which are less concentrated in their business conduct more business in these lines. These lines of business are also associated with less correlation with investment and natural hedging and greater variance of losses – the lines to appear to be more risky but the two effects might cancel each other out.

Table 11: Simultaneous Equations (3SLS): Business in Long-Tailed Lines

Simultaneous regressions of the proportion of business in long-tailed lines, delta and vega are reported, along with first-stage regression results. Identification of systems is indicated by the included variables. The reinsurance purchase decision is defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars.
Standard errors are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1	2	3	4	5	6
	Schedule P	Vega	Delta	Schedule P	Delta	Vega
Proportion of Business in Long-Tailed Lines$_t$ (%)		-7.329	38.815			
		[4.863]	[20.931]*			
Delta$_t$ ($/1000)	-0.001	0.003				
	[0.001]	[0.006]				
Vega$_t$ (.01/$1000)	-0.031		1.394			
	[0.022]		[0.466]***			
Delta$_{t-1}$			0.996	-0.001	0.975	0.008
			[0.025]***	[0.001]	[0.022]***	[0.004]**
Vega$_{t-1}$		0.531		-0.009	-0.776	0.421
		[0.082]***		[0.011]	[0.380]**	[0.065]***
Fitted Pay Residual$_t$	-3.521			-1.058	245.93	110.353
	[3.518]			[2.570]	[85.231]***	[14.659]***
Salary and Bonus Compensation$_t$ ($100,000)	0.347	3.116		-0.029	-14.172	-5.215
	[0.251]	[1.449]**		[0.292]	[9.672]	[1.663]***
Age of CEO$_t$	0.323	2.64	-21.803	0.403	-13.427	-2.026
	[0.310]	[2.863]	[14.009]	[0.325]	[10.771]	[1.852]
Tenure as CEO$_t$	-0.33	-1.738	27.539	-0.462	15.879	2.322
	[0.277]	[3.112]	[14.462]*	[0.274]*	[9.082]*	[1.562]
Tenure at Current Company$_t$	-0.03	-0.918	-8.312	0.089	-6.355	-0.564
	[0.176]	[1.338]	[6.581]	[0.178]	[5.889]	[1.013]
Return to Shareholders$_t$ (%)	-2.94			-0.14	-152.735	-6.886
	[4.422]			[6.358]	[210.818]	[36.259]

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1 Schedule P	2 Vega	3 Delta	4 Schedule P	5 Delta	6 Vega
Percentage of Assets Invested in Stocks and Bonds	0.075	0.746		0.099	3.449	-0.346
	[0.105]	[0.888]		[0.121]	[4.004]	[0.689]
Log Standard Deviation of Returns$_t$		48.899	-595.728	23.205	-101.574	-19.084
		[118.033]	[495.217]	[5.766]***	[191.209]	[32.886]
Loss Ratio$_t$	-0.109	-1.391	3.727	-0.059	-1.721	-1.094
	[0.166]	[1.206]	[6.144]	[0.167]	[5.526]	[0.950]
Growth in Direct Premiums Written$_t$ ($ Trillion)	-0.061			0.079	2.97	1.358
	[0.099]			[0.124]	[4.127]	[0.710]*
Risk Retained$_t$ (%)	-0.314	-6.848	0.123	0.17	-5.443	-0.97
	[0.867]	[4.122]*	[0.089]	[0.089]*	[2.966]*	[0.510]*
Firm Size$_t$ (ln of admitted assets)	0.582	11.993	-12.47	0.457	41.594	18.783
	[1.195]	[7.706]	[39.045]	[1.171]	[38.846]	[6.681]***
Correlation between Investment Returns and Claims Costs$_t$	-643.672	-4483.794	10051.52	-562.262	-13,092.07	-335.686
	[134.798]***	[2,890.192]	[12,264.302]	[137.978]***	[4,575.292]***	[786.903]
Tax Rate$_t$	1.034			-1.339	62.966	-5.29
	[1.377]			[1.760]	[58.367]	[10.038]
Herfindahl Index for Direct Premiums Written by Line$_t$	-71.381	-507.295	2898.143	-77.063	-65.455	-2.878
	[6.547]***	[378.487]	[1,606.213]*	[6.593]***	[218.608]	[37.598]
Number of States Licensed$_t$	0.051			0.032	2.28	-0.413
	[0.064]			[0.088]	[2.904]	[0.499]
AM Best Rating of Group$_t$	0.047	0.329	-4.163	0.049	-2.311	0.108
	[0.082]	[0.629]	[3.156]	[0.083]	[2.764]	[0.475]
Concentration of Group Ownership Herfindahl$_t$	-0.131			3.194	-60.077	-6.462
	[4.071]			[5.428]	[179.974]	[30.954]
Constant				101.712	-398.358	-124.651
				[39.737]**	[1,317.670]	[226.626]
Observations	170	170	170	170	170	170
R-squared				0.75	0.96	0.81

5.3.3 Leverage: Premium/Surplus Ratio

Premium/Surplus ratio is not significantly related to an executive's incentives. Executives who are paid more than expected take on more leverage although executives which are paid more in general take on less leverage – the executives who exceed their expected pay could be being compensated for the high risk of their particular companies or might have special skills in working at highly levered companies. As expected, the coefficient on vega is positive, although not significant. It does not appear that executives are affecting the firm risk through leverage in the way that they are with reinsurance. The two are negatively correlated, so reinsurance is a substitute for leverage although the relationship is not significant. Also, companies with more assets in stocks and bonds are taking on less leverage through writing more premiums relative to surplus. Older executives appear to make less risky decisions. The other structural variables are not related to the leverage decision in a meaningful way.

Table 12: Simultaneous Equations (3SLS): Premium/Surplus Ratio

Simultaneous regressions of the leverage decision as measured by the premium/surplus ratio, delta and vega are reported, along with first-stage regression results. Identification of systems is indicated by the included variables. The reinsurance purchase decision is defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars.

Standard errors are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1 Premium/ Surplus Ratio	2 Vega	3 Delta	4 Premium/ Surplus Ratio	5 Delta	6 Vega
Premium/Surplus Ratio$_t$ (%)		-0.295	1.426			
		[0.792]	[3.179]			
Delta$_t$ ($/1000)	-0.028	0.016				
	[0.023]	[0.007]**				
Vega$_t$ (.01/$1000)	0.292		1.238			
	[0.696]		[0.429]***			
Delta$_{t-1}$			0.947	0	0.97	0.007
			[0.026]***	[0.000]	[0.024]***	[0.004]*
Vega$_{t-1}$		0.488		0.001	-0.789	0.421
		[0.095]***		[0.004]	[0.385]**	[0.066]***
Fitted Pay Residual$_t$	208.179			0.931	252.778	111.235
	[110.155]*			[0.907]	[86.711]***	[14.919]***
Salary and Bonus Compensation$_t$ ($100,000)	-15.762	3.101		-0.006	-14.715	-5.29
	[7.790]**	[1.784]*		[0.103]	[9.809]	[1.688]***
Age of CEO$_t$	-18.327	4.36	-19.354	-0.175	-14.573	-2.229
	[10.039]*	[3.350]	[12.559]	[0.116]	[11.085]	[1.907]
Tenure as CEO$_t$	3.817	0.291	12.112	0.056	16.979	2.418
	[8.759]	[2.635]	[9.970]	[0.098]	[9.393]*	[1.616]
Tenure at Current Company$_t$	-5.664	0.929	-10.911	-0.087	-6.226	-0.54
	[5.493]	[1.917]	[6.930]	[0.062]	[5.961]	[1.026]
Return to Shareholders$_t$ (%)	-28.948			-2.381	-143.376	-4.648
	[133.577]			[2.241]	[214.191]	[36.852]

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1 Premium/ Surplus Ratio	2 Vega	3 Delta	4 Premium/ Surplus Ratio	5 Delta	6 Vega
Percentage of Assets Invested in Stocks and Bonds	-8.51	2.482		-0.082	3.296	-0.336
	[3.360]**	[1.288]*		[0.043]*	[4.082]	[0.702]
Log Standard Deviation of Returns$_t$		-15.618	-48.11	-1.588	-124.493	-21.825
		[38.979]	[178.435]	[2.151]	[205.600]	[35.374]
Loss Ratio$_t$	1.495	-1.373	2.066	0.005	-1.08	-0.999
	[5.320]	[1.558]	[5.958]	[0.059]	[5.678]	[0.977]
Growth in Direct Premiums Written$_t$ ($ Trillion)	1.749			-0.042	3.046	1.342
	[2.608]			[0.044]	[4.188]	[0.720]*
Proportion of Business in Long-Tailed Linest (%)		0.293	-0.752	0.058	0.516	0.106
		[0.106]***	[0.339]**	[0.030]*	[2.885]	[0.496]
Risk Retained$_t$ (%)	-2.163	-0.013	-5.937	-0.021	-5.515	-0.996
	[2.756]	[0.880]	[3.262]*	[0.032]	[3.038]*	[0.523]*
Firm Size$_t$ (ln of admitted assets)	19.511	7.896	0.802	0.221	39.722	18.353
	[39.406]	[9.467]	[36.058]	[0.413]	[39.461]	[6.789]***
Correlation between Investment Returns and Claims Costs$_t$	3530.95	-1412.081	-8244.037	66.018	-12753.24	-271.379
	[4,232.111]	[1,524.145]	[5,529.414]	[51.246]	[4,897.626]*	[842.641]
Tax Rate$_t$	-44.349			-0.877	63.543	-5.187
	[41.020]			[0.618]	[59.058]	[10.161]
Herfindahl Index for Direct Premiums Written by Line$_t$	-92.022	18.329	48.915	4.714	-23.765	5.109
	[205.727]	[89.177]	[330.001]	[3.279]	[313.339]	[53.910]
Number of States Licensed$_t$	-1.838			-0.029	2.255	-0.403
	[1.862]			[0.031]	[2.941]	[0.506]
AM Best Rating of Group$_t$	-2.001	0.671	-3.935	-0.028	-2.369	0.097
	[2.596]	[0.839]	[3.157]	[0.029]	[2.795]	[0.481]
Concentration of Group Ownership Herfindahl$_t$	21.183			1.011	-72.603	-9.092
	[104.836]			[1.921]	[183.633]	[31.594]
Constant	2270.275	0	0			
	[1,095.748]*	[0.000]	[0.000]			
Observations	168	168	168			
R-squared						

5.3.4 Leverage: Best's Capital Adequacy Ratio

Incentives do have some effect on the capital adequacy ratio, but as with the panel direction they go in the opposite direction as theory predicts. A higher Vega appears to increase the capital adequacy ratio of firms, so firms where executives have more incentive to take risk are actually holding more risk-adjusted capital relative to their business, a counterintuitive result. This may imply that either managers are not responding to their incentives or that tying their wealth more closely to firm performance actually discourages risky actions. Of course, because Best's Adequacy ratio is dependent on the particular business of firms, it could be that manager s are making less risky decisions but are focusing more on risk-management policy and this increased focus results in a higher ratio, while not showing up in the more naïve measurement of leverage that the premium/surplus ratio represents. Firms where managers have more control have a lower adequacy ratio, although managers should use their power to make safer decisions. At the same time firms which pay more cash compensation have a higher ratio, as well as higher sensitivity of wealth to variance. Companies which retain more risk have a higher ratio. Most of the results for this simultaneous equation system go in the opposite direction of what should be expected – managers who should be making riskier decisions also appear to be taking on less leverage compared with their risk profile and peers.

Table 13: Simultaneous Equations (3SLS): A.M. Best Capital Adequacy Ratio

Simultaneous regressions of the leverage decision as measured by Best's Capital Adequacy ratio, delta and vega are reported, along with first-stage regression results. Identification of systems is indicated by the included variables. The reinsurance purchase decision is defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars.

Standard errors are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1 Best's Capital Adequacy Ratio	2 Vega	3 Delta	4 Best's Capital Adequacy Ratio	5 Delta	6 Vega
Capital Adequacy Ratio$_t$ (%)		-3.476	0.784			
		[1.525]**	[1.906]			
Delta$_t$ ($/1000)	0.002	0.02				
	[0.002]	[0.009]**				
Vega$_t$ (.01/$1000)	0.162		0.341			
	[0.071]**		[0.317]			
Delta$_{t-1}$			0.975	0.004	0.975	0.008
			[0.022]***	[0.002]*	[0.022]***	[0.004]**
Vega$_{t-1}$		0.729		0.036	-0.773	0.422
		[0.099]***		[0.037]	[0.384]**	[0.066]***
Fitted Pay Residual$_t$	-43.006			-8.358	247.231	110.833
	[11.607]***			[8.357]	[86.028]***	[14.784]***
Salary and Bonus Compensation$_t$ ($100,000)	3.879	7.2		1.436	-14.258	-5.257
	[0.842]***	[2.508]***		[0.948]	[9.757]	[1.677]***
Age of CEO$_t$	0.375	-1.238	-8.653	0.055	-13.852	-2.177
	[0.938]	[3.246]	[9.972]	[1.068]	[10.995]	[1.890]
Tenure as CEO$_t$	-0.268	2.021	11.544	0.167	16.049	2.35
	[0.810]	[2.732]	[8.436]	[0.898]	[9.246]*	[1.589]
Tenure at Current Company$_t$	0.529	0.902	-6.37	0.658	-6.34	-0.548
	[0.513]	[2.105]	[5.602]	[0.577]	[5.944]	[1.022]
Return to Shareholders$_t$ (%)	4.311			20.442	-148.625	-5.029
	[14.151]			[20.742]	[213.511]	[36.692]

	Simultaneous Equations (3SLS)			First-Stage Regressions		
	1	2	3	4	5	6
	Best's Capital Adequacy Ratio	Vega	Delta	Best's Capital Adequacy Ratio	Delta	Vega
Percentage of Assets Invested in Stocks and Bonds	1.775	5.908		1.749	3.476	-0.323
	[0.340]***	[2.864]**		[0.395]***	[4.062]	[0.698]
Log Standard Deviation of Returns$_t$		-12.435	-125.432	24.176	-110.826	-20.834
		[54.744]	[176.756]	[19.807]	[203.889]	[35.039]
Loss Ratio$_t$	-0.022	-1.682	-0.352	-0.18	-1.578	-1.035
	[0.493]	[1.705]	[4.964]	[0.545]	[5.606]	[0.963]
Growth in Direct Premiums Written$_t$ ($ Trillion)	-0.473			0.113	2.891	1.331
	[0.256]*			[0.405]	[4.170]	[0.717]*
Proportion of Business in Long-Tailed Linest (%)		0.166	0.797	0	0.456	0.102
		[0.584]	[2.638]	[0.279]	[2.876]	[0.494]
Risk Retained$_t$ (%)	0.31	-0.502	-3.985	0.068	-5.543	-0.998
	[0.261]	[0.876]	[2.533]	[0.294]	[3.031]*	[0.521]*
Firm Size$_t$ (ln of admitted assets)	-11.703	-16.217	31.964	-5.212	40.698	18.423
	[3.663]***	[13.952]	[29.777]	[3.821]	[39.335]	[6.760]***
Correlation between Investment Returns and Claims Costs$_t$	-67.977	-291.985	-12423.03	-150.853	-12832.35	-277.118
	[397.106]	[1,421.925]	[1,337.619]***	[474.497]	[1,884.323]**	[839.382]
Tax Rate$_t$	1.101			-3.053	63.498	-5.19
	[3.632]			[5.724]	[58.918]	[10.125]
Herfindahl Index for Direct Premiums Written by Line$_t$	-41.128	-126.626	106.763	-51.98	-31.118	4.575
	[19.219]**	[115.566]	[292.204]	[30.345]*	[312.366]	[53.681]
Number of States Licensed$_t$	0.126			-0.135	2.303	-0.399
	[0.179]			[0.285]	[2.933]	[0.504]
AM Best Rating of Group$_t$	-2.273	-7.786	-0.106	-2.227	-2.342	0.099
	[0.242]***	[3.467]**	[4.779]	[0.271]***	[2.788]	[0.479]
Concentration of Group Ownership Herfindahl$_t$	9.288			24.263	-65.459	-8.574
	[13.422]			[17.761]	[182.825]	[31.419]
Constant	0	0	-763.678	206.561	228.607	-37.339
	[0.000]	[0.000]	[1,198.158]	[108.259]*	[1,114.388]	[191.510]
Observations	169	169	169	169	169	169
R-squared				0.72	0.96	0.81

5.4 Firm Decision Effects on Stock-Return Volatility

For compensation incentives to be effective at altering executive behavior it is necessary that the managerial decision variables have an effect on the market measurements to which the incentives are tied – stock price and volatility. I regress several lagged values of each risk measure on the log of the standard deviation of daily stock returns and present the results in table 12. The lagged and twice-lagged values of business in long-tailed lines are the only variables significantly associated with risk policy and they do appear to increase the variance of stock returns – these lines are actually more risky when it comes to the market's judgment of firm performance. Because the measure is the log of a value between zero and one, the negative sign is actually associated with greater volatility of stock returns. Most of the lagged values have this sign, except for risk retained in the once-lagged specification, although the results are not significant at the ten-percent level. Stock variance is also associated with the standard deviation of premiums, and the rating of the group, with better rated groups exhibiting less variance. The returns to shareholders are also associated with stock variance and those stocks with greater returns exhibit greater variance during a one-year period.

Executives with a higher Vega seemed to do relatively less business in risky lines – they react in the opposite way expected for the one measurement that the market appears to be considering when variance of returns are determined. This puzzle is resolved somewhat in the robustness checks in section 6.1 where I find that firms increase their business in long-tailed lines faster than other premiums. The difference could be due to lagged reporting requirements and is an area for future research.

According to these results the firm risk variables which markets pay attention to are the risk retained, the proportion of business in long-tailed lines and Best's Capital Adequacy Ratio. The panel regression results show that executive's incentives affect risk retention and the proportion of business in long-tailed lines. The panel regressions found that executives who had higher sensitivities to stock price volatility were actually doing less business in long-tailed lines, which seemed counterintuitive but these results indicate that firms which do less business in these lines have more stock return volatility – at least in the short term. Thus, executives appear to be behaving rationally in their lines-of-business-business decision and increasing their stock volatility - and hence reward - by doing so. This is evidence that executives are responding to their incentives. The risk retained measure, however, goes in the opposite direction. Although executives with higher sensitivity to stock price volatility retain more risk in their firm, these companies appear to have lower stock price volatility overall. This effect becomes insignificant when other control variables are included in the regression, so it is likely another variable which affects both risk retained and stock price volatility that drives this result.

Table 14: Relation Between Risk Measures and Stock Return Volatility

This table presents the regressions of the risk measures upon the natural log of stock return volatility, as obtained from CRSP. Returns are less than one in SD so logs are negative, so Two specifications are presented for each risk measure. Risk measures are given in column headings. The first includes contemporaneous and lagged values. The second adds twice-lagged values. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	1	2	3	4	5	6
	SD of Stock Returns *(Risk Retained)*	SD of Stock Returns *(Risk Retained)*	SD of Stock Returns *(Risk Retained)*	SD of Stock Returns *(Premium / Surplus Ratio)*	SD of Stock Returns *(Premium / Surplus Ratio)*	SD of Stock Returns *(Premium / Surplus Ratio)*
Risk Measure$_t$	-2.985	-0.779	-0.99	-0.016	-0.066	-0.007
	[1.007]***	[1.848]	[2.290]	[0.037]	[0.042]	[0.058]
Risk Measure$_{t-1}$		1.117	0.964		-0.039	-0.048
		[1.880]	[2.699]		[0.043]	[0.048]
Risk Measure$_{t-2}$			0.863			-0.076
			[2.567]			[0.061]
Firm Sizet (ln of admitted assets)		1.407	1.769		2.795	1.625
		[6.006]	[7.023]		[5.046]	[5.839]
Correlation between Investment Returns and Claims Costs$_t$		-216.85	40.72		481.314	616.74
		[1,430.886]	[1,523.783]		[1,374.682]	[1,473.937]
Tax Rate$_t$		-31.036	-28.735		-7.824	-5.968
		[29.832]	[36.941]		[7.383]	[7.786]
Herfindahl Index for Direct Premiums Written by Line$_t$		0.86	77.879		13.633	49.478
		[96.909]	[115.580]		[82.796]	[97.589]
Number of States Licensed$_t$		-0.157	-1.294		0.207	1.011
		[1.220]	[1.480]		[1.001]	[1.198]
AM Best Rating of Group$_t$		4.774	4.107		5.051	4.194
		[1.239]***	[1.520]***		[1.085]***	[1.283]***
Concentration of Group Ownership Herfindahl$_t$		50.681	90.325		54.05	22.467
		[84.563]	[113.826]		[66.123]	[79.612]
Growth in Direct Premiums Written$_t$ ($ Trillion)		-0.118	0.093		0.021	0.025
		[2.060]	[2.504]		[1.634]	[1.826]
Loss Ratio$_t$		1.045	6.334		-0.014	2.036
		[3.019]	[3.711]*		[2.387]	[3.173]
1-Year Return to Shareholders$_t$		-197.785	-263.268		-227.857	-237.604
		[68.731]***	[82.931]***		[60.247]***	[71.625]***
Percentage of Assets Invested in Stocks and Bonds		-8.477	-8.386		-10.18	-10.071
		[2.096]***	[2.916]***		[1.883]***	[2.579]***
Constant	-3,801.25	-3,555.48	-3,617.64	-4,053.44	-3,433.89	-3,403.36
	[83.987]***	[230.370]***	[305.897]***	[21.370]***	[194.962]***	[254.815]***
Observations	325	223	170	423	303	239
R-squared	0.03	0.24	0.25	0	0.25	0.22

	7	8	9	10	11	12
	SD of Stock Returns *(Business in Long-Tailed Lines)*	SD of Stock Returns *(Business in Long-Tailed Lines)*	SD of Stock Returns *(Business in Long-Tailed Lines)*	SD of Stock Returns *(Best's Capital Adequacy Ratio)*	SD of Stock Returns *(Best's Capital Adequacy Ratio)*	SD of Stock Returns *(Best's Capital Adequacy Ratio)*
Risk Measure$_t$	-1.679	0.536	2.502	0.104	0.804	0.253
	[0.596]***	[1.079]	[1.297]*	[0.208]	[0.358]**	[0.441]
Risk Measure$_{t-1}$		-1.811	0.294		-0.335	-0.162
		[0.936]*	[1.187]		[0.349]	[0.440]
Risk Measure$_{t-2}$			-3.257			0.178
			[1.045]***			[0.398]
Firm Size$_t$ (ln of admitted assets)		-2.13	-1.404		1.743	1.61
		[4.980]	[5.409]		[5.485]	[6.515]
Correlation between Investment Returns and Claims Costs$_t$		-151.344	629.984		546.652	465.244
		[1,395.493]	[1,455.167]		[1,420.769]	[1,536.666]
Tax Rate$_t$		-8.176	-6.913		-6.831	-6.703
		[7.195]	[7.290]		[7.407]	[7.869]
Herfindahl Index for Direct Premiums Written by Line$_t$		-44.905	55.803		38.203	45.019
		[91.785]	[107.825]		[88.204]	[104.031]
Number of States Licensed$_t$		0.289	0.654		0.767	1.711
		[0.959]	[1.097]		[1.006]	[1.246]
AM Best Rating of Group$_t$		4.639	3.952		5.84	4.681
		[1.135]***	[1.325]***		[1.182]***	[1.453]***
Concentration of Group Ownership Herfindahl$_t$		37.464	25.613		21.679	-23.202
		[64.338]	[74.893]		[66.906]	[83.715]
Growth in Direct Premiums Written$_t$ ($ Trillion)		0.158	0.444		-0.037	0.122
		[1.585]	[1.700]		[1.647]	[1.844]
Loss Ratio$_t$		0.009	2.03		0.526	2.566
		[2.331]	[3.003]		[2.401]	[3.195]
1-Year Return to Shareholders$_t$		-207.909	-200.825		-225.933	-218.422
		[59.772]***	[68.052]***		[61.682]***	[74.184]***
Percentage of Assets Invested in Stocks and Bonds		-7.632	-7.401		-9.305	-9.567
		[1.748]***	[2.347]***		[1.822]***	[2.530]***
Constant	-3,946.49	-3,429.21	-3,522.14	-4,073.28	-3,575.55	-3,512.70
	[41.627]***	[201.800]***	[257.395]***	[27.972]***	[192.444]***	[254.997]***
Observations	423	307	245	419	299	232
R-squared	0.02	0.23	0.22	0	0.25	0.2

5.5 Size of Effects and Relative Importance

Even if managerial incentives are important, there still remains the question of where they rank as a factor in determining firm decisions. If firm structure is more important and incentives are a secondary effect then this reduces the importance of paying a premium to hire any one CEO and give him the right incentives. Alternatively, it may be because the right CEO has already been hired and given a correct pay package that the firm structure decision drives effects. Thus, it is difficult to make an argument about the optimality of the market for executive talent, although I can examine it as it stands.

Making a manager more sensitive to stock volatility by one standard deviation, that is increasing his reward from a 0.01 change in stock volatility by $163,000 increases the risk retention of the firm by about 2% from a mean of 81% to 83% or 1/10th of a standard deviation, reduces the proportion of business in long-tailed lines by about 8% from 61% to 53%, would not have any significant effect on the premium/surplus ratio, and increases Best's Capital Adequacy ratio by about 25, or 1/3rd of a standard deviation of this ratio though this last result it not significant. Naturally, the exact effect depends on which coefficients are used and which specification is preferred. The theoretically preferred specification uses instrumental variables with controls. Delta rarely appears to be significant in driving firm decisions and when it is, its effect is much smaller than the effect due to vega. The only significant effect for delta was in business in long-tailed lines, where increasing delta by one standard deviation reduces business in thelse lines by 4%. Most of the power of vega is derived from the time-to-maturity of outstanding and granted options, a factor that is controllable by the granting boards. When included in specification regressions, time to maturity is positively associated with the retention of risk and subsumes most of the effect of vega. Clearly, small changes in executive incentives can have a large effect on corporate decisions, although the actual effect of these changes and their relative size varies depending on the empirical specification.

To give an idea of how risk decisions respond to level of pay, I note that an executive seems to increase his group's risk retention by 0.4% for every $100,000 paid in cash compensation in the IV regressions. $100,000 is about 1/8th of a standard deviation of pay for the normal CEO. At the average pay for an executive, risk retention is increased by 5.6 percent due to this cash pay according to the preferred IV regressions. Business in long-tailed lined of business does not seem to be affected by cash pay, but an executive who ages one year increases the proportion of this risky business by 0.18%. These effects can be put into perspective by looking at the change in firm size necessary to replicate them. An increase in firm size of one percent will decrease the firm's risk retention by about 0.2% according to the IV regression. Note that this increase in firm size can represent a change of $35 million for the average firm. This illustrates how pay given to executives can actually be a relatively cheap way of implementing firm policy, rather than trying to adjust firm structure or the firm's book of business. These structural costs increase greatly as firms increase in size, while the costs of incentives rise only with the wealth of the executive. The actual cost of increasing delta and vega varies with the executive's specific wealth and options grants, but adjusting executive compensation is relatively cheaper, especially for large firms, than changing other aspects of firm structure such as size, premiums, and business.

6. Further Robustness Checks

6.1 Change in Business in Long-Tailed Lines

If executives are taking on more relatively risky business in response to their incentives it should be possible to observe an increase in the business in these lines, even when controlling for the general increase in business. As before, I estimate two specifications whose results are presented in table 15. Columns 1and 2 contain the least-squares fixed-effects regressions while columns 3 and 4 use instrumental variables with the *t-2* value of Vega used to instrument $Vega_{t-1}$.

The story of decisions for the regressions in sections 6.1-6.3 is as follows: the executive receives his incentives at the beginning of the year (t-1) in and a level of premiums is observed. I then measure if the granted incentives have an effect on the change in the variable and in what change that direction runs, so that I measure how much growth there is in these variables over a year. The dependent variable is thus the difference in the observed risk variable. If executives respond to incentives then a higher vega should lead them to adjust that variable over the coming year. I run regressions both with and without control variables. The two general equations are:

Equation 13

$$\Delta SchedP_{i,t} = \beta_1 \upsilon_{i,t-1} + \beta_3 \delta_{i,t-1} + Y_t + \eta_i + \varepsilon_{i,t}$$

and

Equation 14

$$\Delta SchedP_{i,t} = \beta_1 X_{i,t} + \beta_2 \upsilon_{i,t-1} + \beta_3 \delta_{i,t-1} + \beta_4 C_{i,t} + Y_t + \eta_i + \varepsilon_{it}$$

Where *SchedP* is the amount of premiums written in long-tailed lines and *X* represents the standard control variables. *Y* represents the year dummies.

In most of the regressions incentive variables are insignificant, except for the instrumental-variable regression with controls. Here, vega is correlated with a positive growth in premiums in long-tailed lines. Thus, this test provides evidence that executives are following their incentives to invest more in lines traditionally considered riskier, although this risk may only manifest itself in the long-term. As expected, the only other significant determinant in the growth in business in long-tailed lines is the growth in total business. When controlling for endogeneity, it appears that vega has the effect of inducing the firm to conduct relatively more of its business in risky lines – more of the gain in business comes from doing business in risky lines than would be expected. This indicates that vega may play a role in encouraging executives to take on more risky business than they otherwise would, although it contradicts the earlier finding that vega appears to reduce the proportion of business in risky lines.

Table 15: Growth in Business in Long-Tailed Lines

Panel regressions on the growth in business in long-tailed lines is given. The dependent variable is premiums written in long-tailed lines in millions of dollars. All other variables are as described in section 3. Dollar values are as listed and calculated in 2004 dollars. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Panel 1 Growth in Premiums in Long-Tailed Lines	Panel 2 Growth in Premiums in Long-Tailed Lines	IV 3 Growth in Premiums in Long-Tailed Lines	IV 4 Growth in Premiums in Long-Tailed Lines
$Delta_{t-1}$ ($/1000000)	-27.01	-202.731	-28.705	-340.891
	[429.396]	[511.762]	[615.218]	[781.775]
$Vega_{t-1}$ (.01/$1000000)	5,631.20	7,206.10	9,100.02	19,955.90
	[4,454.678]	[5,120.271]	[8,987.659]	[11,173.102]*
$Firm Size_t$ (ln of admitted assets)		-105.125		-1,609.80
		[1,522.880]		[2,751.165]
Correlation between Investment Returns and Claims $Costs_t$		26,199.74		2,152.86
		[54,393.227]		[76,696.895]
Tax $Rate_t$		-42.063		28.349
		[205.704]		[272.323]
Herfindahl Index for Direct Premiums Written by $Line_t$		-2,824.62		-5,311.86
		[5,105.249]		[7,586.515]
Number of States $Licensed_t$		36.644		37.056
		[45.892]		[78.564]
AM Best Rating of $Group_t$		17.773		-17.65
		[52.773]		[100.978]
Concentration of Group Ownership $Herfindahl_t$		4,826.26		5,415.64
		[3,103.834]		[6,094.056]
Growth in Direct Premiums $Written_t$ ($ Trillion)		221.075		309.194
		[46.498]***		[69.212]***
Loss $Ratio_t$		27.293		-67.61
		[81.942]		[149.824]
1-Year Return to $Shareholders_t$		-706.379		-2,053.42
		[2,554.615]		[3,944.822]
Percentage of Assets Invested in Stocks and Bonds		31.9		18.821
		[109.822]		[189.318]
Age of CEO		-43.011		-85.893
		[52.043]		[79.539]
Tenure as CEO		-181.398		-582.146
		[254.933]		[541.818]
Tenure at Current Company		-44.147		-54.963
		[111.448]		[182.951]
Observations	281	267	187	178
Number of A.M. Best Group Number	60	59	42	41
R-squared	0.07	0.22		

6.2 Relative Growth in Business in Property Lines and Liability Lines

Similar to the test in section 6.1, I examine the growth in both property and liability lines. Liability lines are generally riskier than property lines, so vega should cause the change in these lines to increase more. Results for the regressions (similar to those in equations 13 and 14) are presented in tables 16 and 17. Again, the growth in premiums, the natural hedge due to correlation of investments and losses, and firm size are the most significant variables In the incentives-only IV regressions in column 3, vega has a negative effect. The coefficients on vega in column 3 of tables 16 and 17 are significantly different from each other – business in liability lines drops off significantly faster than business in property lines when vega is increased. This result implies that a higher vega leads to the firm taking on less risk, to the extent that liability lines are more risky than property lines. However, in my earlier robustness tests I could not reject that these lines were significantly different from each other in their effects on firm risk. Because I consider the measure of long-tailed lines to be more applicable than the naïve designation of property and liability, I consider the results of section 6.1 to be more sensible. However, there is evidence that managers are responding to incentives selectively by considering what business they focus on.

Table 16: Growth in Business in Property Lines

Panel regressions on the growth in business in property and casualty lines is given. The dependent variable is premiums written in property and casualty lines in billions of dollars. All other variables are as described in section 3. Dollar values are as listed and calculated in 2004 dollars. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Panel 1 Growth in Premiums in PC Lines	Panel 2 Growth in Premiums in PC Lines	IV 3 Growth in Premiums in PC Lines	IV 4 Growth in Premiums in PC Lines
$Delta_{t-1}$ ($/1000000)	121.417	-332.183	22.296	-760.62
	[371.597]	[298.613]	[475.218]	[404.574]*
$Vega_{t-1}$ (.01/$1000000)	-5411.076	-4538.746	-17184.212	-6460.103
	[3,855.055]	[2,987.682]	[6,942.420]**	[5,782.152]
Firm $Size_t$ (ln of admitted assets)		-2217.018		-547.299
		[888.601]**		[1,423.745]
Correlation between Investment Returns and Claims $Costs_t$		79226.263		108317.216
		[31,738.487]**		[39,691.136]***
Tax $Rate_t$		-69.047		-52.852
		[120.028]		[140.929]
Herfindahl Index for Direct Premiums Written by $Line_t$		3049.358		6037.974
		[2,978.917]		[3,926.070]
Number of States $Licensed_t$		-0.006		-36.942
		[26.778]		[40.658]
AM Best Rating of $Group_t$		5.032		-42.844
		[30.793]		[52.257]
Concentration of Group Ownership $Herfindahl_t$		1649.72		5154.187
		[1,811.089]		[3,153.713]
Growth in Direct Premiums $Written_t$ ($ Trillion)		425.979		459.174
		[27.132]***		[35.817]***
Loss $Ratio_t$		61.095		63.336
		[47.813]		[77.535]
1-Year Return to $Shareholders_t$		-1314.914		199.581
		[1,490.620]		[2,041.471]
Percentage of Assets Invested in Stocks and Bonds		46.436		45.08
		[64.081]		[97.973]
Age of CEO		-20.303		0.444
		[30.367]		[41.162]
Tenure as CEO		62.978		41.329
		[148.754]		[280.394]
Tenure at Current Company		-101.586		-183.745
		[65.030]		[94.678]*
Observations	281	267	187	178
Number of A.M. Best Group Number	60	59	42	41
R-squared	0.12	0.66		

Table 17: Growth in Business in Liability Lines

Panel regressions on the growth in business in liability lines are presented. The dependent variable is premiums written in liability lines in billions of dollars. All other variables are as described in section 3. Dollar values are as listed and calculated in 2004 dollars. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Panel 1 Growth in Premiums in Liability Lines	Panel 2 Growth in Premiums in Liability Lines	IV 3 Growth in Premiums in Liability Lines	IV 4 Growth in Premiums in Liability Lines
$Delta_{t-1}$ ($/1000000)	278.332	-205.052	176.46	-595.249
	[521.683]	[292.394]	[658.433]	[427.615]
$Vega_{t-1}$ (.01/$1000000)	-7,326.95	-3,111.64	-27,431.91	-6,209.82
	[5,412.083]	[2,925.454]	[9,618.985]***	[6,111.448]
$Firm Size_t$ (ln of admitted assets)		-1739.497		-331.79
		[870.093]**		[1,504.828]
Correlation between Investment Returns and $Claims Costs_t$		96,351.46		131,051.90
		[31,077.431]***		[41,951.564]***
$Tax Rate_t$		-41.505		-24.441
		[117.528]		[148.955]
Herfindahl Index for Direct Premiums Written by $Line_t$		3,019.27		5,686.02
		[2,916.871]		[4,149.662]
Number of States $Licensed_t$		-15.41		-45.373
		[26.220]		[42.973]
AM Best Rating of $Group_t$		3.211		-39.624
		[30.152]		[55.233]
Concentration of Group Ownership $Herfindahl_t$		961.90		3,798.88
		[1,773.367]		[3,333.319]
Growth in Direct Premiums $Written_t$ ($ Trillion)		701.288		704.811
		[26.567]***		[37.857]***
Loss $Ratio_t$		50.596		45.5
		[46.817]		[81.951]
1-Year Return to $Shareholders_t$		-953.341		273.93
		[1,459.573]		[2,157.734]
Percentage of Assets Invested in Stocks and Bonds		34.765		29.686
		[62.747]		[103.553]
Age of CEO		-16.293		-9.91
		[29.734]		[43.506]
Tenure as CEO		25.854		-7.579
		[145.655]		[296.363]
Tenure at Current Company		-52.377		-125.574
		[63.676]		[100.070]
Observations	281	267	187	178
Number of A.M. Best Group Number	60	59	42	41
R-squared	0.2	0.85		

6.3 Growth in surplus

I next examine the question of whether or not executives respond to incentives by changing the level of surplus at the firm. Earlier results indicated little effect on firm leverage and the earlier robustness tests indicate that managers appear to be reducing the risk in their business. I also wish to examine whether managers are reducing their surplus as well – whether the change in the ratio is due to an increase in premiums or a decrease in surplus. Regressions are run as in sections 6.1 and 6.2. I find that the growth in surplus is strongly related to the growth in premiums written, as is sensiblem but positively correlated wit hthe natural hedge, which is counterintuitive. However, column 3, the IV incentives regression, indicates that firms appear to be reducing surplus in response to a higher vega. That is they are taking on a more risky action. This could be due to the correlation of one of the structural variables with both vega and surplus as vega is not significant in column 4. However, an increase in delta results in a relative decrease in surplus when firm structure variables are considerd. Given the overall results in tables 15-17 and 8, it appears that firms respond to an increase in vega by cutting premiums and surplus, but not cutting one more strongly than the other. Incentives do not appear to inspire managers to increase the risk profile of a firm through drastically altering its leverage in a particular way. This is, naturally, subject to the specification of these regressions.

This effect only shows up significantly in one specification of the results, so it cannot be considered to be strongly confirmed, but the coefficients in other specifications are generally in the same direction, although they are not significant.

Table 18: Growth in Surplus

Panel regressions on the growth in firm surplus are presented. The dependent variable is growth in reported firm surplus in billions of dollars. All other variables are as described in section 3. Dollar values are as listed and calculated in 2004 dollars. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Panel 1 Growth in Surplus	Panel 2 Growth in Surplus	IV 3 Growth in Surplus	IV 4 Growth in Surplus
$Delta_{t-1}$ ($/1000000)	16.422	-676.49	20.455	-1366.795
	[896.656]	[629.261]	[1,201.770]	[946.836]
$Vega_{t-1}$ (.01/$1000000)	-10,907.63	153.63	-40,443.56	-3,321.95
	[9,302.163]	[6,295.876]	[17,556.550]**	[13,532.144]
$Firm Size_t$ (ln of admitted assets)		-2371.166		28.14
		[1,872.530]		[3,332.034]
Correlation between Investment Returns and Claims $Costs_t$		156,118.60		206,387.86
		[66,881.815]**		[92,890.360]**
Tax $Rate_t$		-81.714		-41.219
		[252.933]		[329.820]
Herfindahl Index for Direct Premiums Written by $Line_t$		4,700.05		8,516.81
		[6,277.405]		[9,188.300]
Number of States $Licensed_t$		-48.101		-115.08
		[56.429]		[95.152]
AM Best Rating of $Group_t$		62.695		22.935
		[64.890]		[122.298]
Concentration of Group Ownership $Herfindahl_t$		3,392.53		9,541.76
		[3,816.468]		[7,380.730]
Growth in Direct Premiums $Written_t$ ($ Trillion)		1108.668		1187.514
		[57.174]***		[83.825]***
Loss $Ratio_t$		0.82		-29.22
		[100.756]		[181.458]
1-Year Return to $Shareholders_t$		-1384.218		802.63
		[3,141.150]		[4,777.716]
Percentage of Assets Invested in Stocks and Bonds		129.349		227.828
		[135.037]		[229.290]
Age of CEO		-17.878		-30.026
		[63.992]		[96.332]
Tenure as CEO		34.276		-34.835
		[313.466]		[656.215]
Tenure at Current Company		-89.335		-265.707
		[137.036]		[221.578]
Observations	281	267	187	178
Number of A.M. Best Group Number	60	59	42	41
R-squared	0.15	0.75		

6.4 Management Team Regressions

There is the possibility that decisions are made not solely by the chief executive, but by the management team as a whole. If this is the case then the incentives given to the entire management team will be important. I calculate these by summing the values of delta and vega for each executive at a company in each year. The regressions and results presented in tables 6-9 are repeated using the equivalent incentive variables for the management team and results are presented in tales 19-22. As noted in the data description section, executives at levels below chief executive often receive significantly less pay, both in cash and incentives.

Regressions on risk retained indicate that delta appears to have little effect on risk retention, while an increase in vega causes managers to purchase less reinsurance, as theory predicts. Vega and delta also appear to be negatively associated with the proportion of business conducted in long-tailed lines, although the effect for vega is not significant and delta is only significant in one specification. There is only one significant results when considering the leverage decision – where vega is associated with a higher adequacy ratio in the fixed-effects regression with no incentives. The other insignificant specifications indicate that vega incourages leverage while an increase in delta discourages leverage. These results are similar to the CEO regressions for reinsurance purchase. The main conclusion to draw from these is that incentives given to the management team are similar to those given to CEOs and tend to confirm the previous results.

Table 19: Panel Regressions on Risk Retained: Management Team

Least squares and instrumental variable panel regressions of the firm's reinsurance purchase decision, defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings.

Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		(A) Least-Squares				(B) Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	0	0			0	0	0.001
		[0.001]	[0.001]			[0.001]	[0.001]	[0.001]
$Vega_{t-1}$ (.01/$1000000)	(+)	0.024	0.028			0.033	0.031	0.066
		[0.007]***	[0.007]***			[0.010]***	[0.010]***	[0.033]**
Predicted $Delta_{t-2}$	(+/-)			-0.002	-0.002			
				[0.002]	[0.002]			
Predicted $Vega_{t-2}$	(+)			0.046	0.073			
				[0.024]*	[0.028]**			
Delta $Residual_{t-2}$	(+/-)				0			
					[0.001]			
Vega $Residual_{t-2}$	(+)				0.015			
					[0.008]*			
Age of CEO_t			0.021	-0.348	0.16		0.04	0.025
			[0.065]	[0.407]	[0.507]		[0.066]	[0.072]
Tenure as CEO_t			0.083	0.32	-0.287		0.163	0.049
			[0.271]	[0.266]	[0.437]		[0.276]	[0.327]
Tenure at $Company_t$			0.193	0.043	0.201		0.194	0.337
			[0.145]	[0.151]	[0.183]		[0.146]	[0.206]
Firm $Size_t$ (ln of admitted assets)	(+)		-0.394	0.669	-2.249		1.011	0.538
			[1.449]	[1.343]	[2.536]		[1.396]	[1.528]

	Predicted Direction of Effect	(A) Least-Squares 1 Incentive Variables	2 Incentive and Control Variables	3 Predicted	4 Predicted + Residuals	(B) Instrumental Variable Regressions 5 Incentive Variables	6 Incentive and Control Variables	7 Predicted
Correlation between Investment Returns and Claims Costs$_t$	(+)		57.241	40.915	81.93		125.627	56.82
			[61.067]	[62.964]	[77.664]		[63.535]**	[70.767]
Tax Rate$_t$			1.007	0.18	4.969		1.48	-0.114
			[1.614]	[3.005]	[4.340]		[1.882]	[3.436]
Herfindahl Index for Direct Premiums Written by Line$_t$			8.486	5.16	7.822		22.214	10.929
			[6.580]	[7.813]	[8.990]		[7.037]***	[8.407]
Number of States Licensed$_t$	(-)		0.018	-0.082	-0.065		-0.023	-0.064
			[0.069]	[0.071]	[0.096]		[0.072]	[0.079]
A.M. Best Rating of Group$_t$			0.03	0.004	-0.001		0.024	0.021
			[0.061]	[0.064]	[0.092]		[0.065]	[0.071]
Concentration of Group Ownership Herfindahl$_t$	(+)		-0.081	0.242	10.419		-0.202	-2.776
			[3.807]	[4.046]	[5.798]*		[4.268]	[5.114]
Growth in Direct Premiums Written$_t$ ($ Trillion)			0.096	0.128	0.082		0.115	0.067
			[0.081]	[0.081]	[0.097]		[0.080]	[0.090]
Loss Ratio$_t$			0.125	-0.151	-0.057		0.037	-0.016
			[0.123]	[0.152]	[0.188]		[0.141]	[0.182]
1 Yr Return to Shareholders$_t$			3.087	1.031	1.657		-0.911	-1.169
			[3.000]	[2.975]	[4.123]		[2.976]	[3.340]
Percentage of Assets Invested in Stocks and Bonds			0.039	0.098	0.234		0.122	0.069
			[0.112]	[0.115]	[0.179]		[0.126]	[0.142]
Observations		295	286	234	177	236	227	218
Number of A.M. Best Group Number		57	57	51	45	47	47	46
R-squared		0.19	0.3	0.44	0.51			

Table 20: Panel Regressions on Proportion of Business in Long-Tailed Lines: Management Team

Least squares and instrumental variable panel regressions of the firm's decision of amount of business conducted in long-tailed lines at the end of year t. Long-tailed lines are as defined in Phillips, Cummins, and Allen (1996) and are listed in Appendix 1. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings.
Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-0.001	0			-0.001	-0.001	-0.001
		[0.001]	[0.001]			[0.001]	[0.001]	[0.001]*
$Vega_{t-1}$ (.01/$1000000)	(+)	-0.006	-0.009			-0.005	-0.016	-0.036
		[0.007]	[0.007]			[0.012]	[0.010]	[0.028]
Predicted $Delta_{t-2}$	(+/-)			0.002	0.002			
				[0.002]	[0.002]			
Predicted $Vega_{t-2}$	(+)			-0.058	-0.052			
				[0.022]***	[0.023]**			
Delta $Residual_{t-2}$	(+/-)				0.001			
					[0.001]			
Vega $Residual_{t-2}$	(+)				-0.012			
					[0.008]			
Age of CEO_t			0.083	-0.486	-0.861		0.12	0.118
			[0.066]	[0.410]	[0.453]*		[0.065]*	[0.069]*
Tenure as CEO_t			-0.12	0.26	1.058		0.288	0.337
			[0.294]	[0.282]	[0.388]***		[0.292]	[0.332]
Tenure at $Company_t$			0.103	-0.258	-0.377		-0.021	-0.081
			[0.134]	[0.147]*	[0.157]**		[0.130]	[0.157]
Firm $Size_t$ (ln of admitted assets)	(+)		0.722	-0.158	2.434		0.664	0.937
			[1.479]	[1.301]	[1.927]		[1.339]	[1.370]

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
Correlation between Investment Returns and Claims Costs$_t$	(+)		-373.887	-382.049	-419.793		-449.511	-430.154
			[69.356]***	[67.127]***	[76.171]***		[69.133]***	[72.436]***
Tax Rate$_t$			0.004	0.343	-0.626		-0.099	-1.696
			[0.337]	[2.910]	[3.685]		[0.299]	[3.292]
Herfindahl Index for Direct Premiums Written by Line$_t$			-62.009	-54.561	-61.278		-67.848	-63.878
			[6.409]***	[7.168]***	[7.685]***		[6.809]***	[7.856]***
Number of States Licensed$_t$	(+)		-0.04	-0.145	-0.066		-0.158	-0.157
			[0.065]	[0.068]**	[0.079]		[0.069]**	[0.072]**
A.M. Best Rating of Group$_t$			0.177	0.019	0.126		0.146	0.13
			[0.068]***	[0.070]	[0.089]		[0.074]**	[0.077]*
Concentration of Group Ownership Herfindahl$_t$	(+)		6.34	6.996	1.046		10.443	15.164
			[3.791]*	[4.282]	[5.298]		[4.443]**	[6.143]**
Growth in Direct Premiums Written$_t$ ($ Trillion)			0.008	0.106	0.095		0.042	0.068
			[0.072]	[0.071]	[0.073]		[0.069]	[0.072]
Loss Ratio$_t$			-0.066	0.071	0.067		0.029	0.023
			[0.116]	[0.118]	[0.119]		[0.123]	[0.129]
1 Yr Return to Shareholders$_t$			-0.212	-1.556	-0.211		1.519	0.594
			[3.278]	[3.139]	[3.873]		[3.206]	[3.374]
Percentage of Assets Invested in Stocks and Bonds			0.326	0.258	0.337		0.119	0.124
			[0.126]**	[0.126]**	[0.176]*		[0.138]	[0.143]
Observations		369	357	287	225	293	281	269
Number of A.M. Best Group Number		62	62	56	51	52	52	51
R-squared		0.29	0.52	0.55	0.62			

Table 21: Panel Regressions on Premium/Surplus Ratio: Management Team

Least squares and instrumental variable panel regressions of the firm's premium/surplus decision, defined as total net premiums written to insurer-reported surplus at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-0.001	-0.006			-0.005	-0.006	-0.014
		[0.019]	[0.019]			[0.022]	[0.023]	[0.023]
$Vega_{t-1}$ (.01/$1000000)	(+)	0.3	0.127			0.137	0.097	0.468
		[0.189]	[0.192]			[0.371]	[0.358]	[0.880]
Predicted $Delta_{t-2}$	(+/-)			-0.028	-0.051			
				[0.056]	[0.077]			
Predicted $Vega_{t-2}$	(+)			0.468	1.165			
				[0.764]	[0.942]			
Delta $Residual_{t-2}$	(+/-)				-0.043			
					[0.026]*			
Vega $Residual_{t-2}$	(+)				0.039			
					[0.318]			
Age of CEO_t			-1.306	-3.105	6.136		-2.125	-2.737
			[1.909]	[14.136]	[17.823]		[2.298]	[2.281]
Tenure as CEO_t			7.407	-1.5	-11.703		6.929	4.663
			[8.435]	[9.705]	[15.156]		[10.253]	[10.830]
Tenure at $Company_t$			-5.083	-0.15	-1.674		-5.527	-5.267
			[3.861]	[5.070]	[6.144]		[4.557]	[5.130]

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
Firm Size$_t$ (ln of admitted assets)	(+)		35.117	32.409	20.489		32.499	17.337
			[42.747]	[44.938]	[75.327]		[47.008]	[45.139]
Correlation between Investment Returns and Claims Costs$_t$	(+)		1295.014	248.333	763.972		133.254	-362.128
			[1,993.244]	[2,314.726]	[2,977.830]		[2,424.043]	[2,381.597]
Tax Rate$_t$			-2.434	-223.542	-31.806		-2.919	-218.882
			[9.678]	[101.267]**	[147.002]		[10.496]	[108.566]**
Herfindahl Index for Direct Premiums Written by Line$_t$			269.748	217.094	221.559		293.514	190.101
			[184.054]	[247.313]	[300.709]		[238.736]	[257.948]
Number of States Licensed$_t$	(+)		3.445	3.29	5.331		4.109	2.742
			[1.856]*	[2.337]	[3.095]*		[2.423]*	[2.375]
A.M. Best Rating of Group$_t$			0.986	2.127	1.471		1.99	1.584
			[1.947]	[2.429]	[3.499]		[2.594]	[2.520]
Concentration of Group Ownership Herfindahl$_t$	(+)		181.278	58.947	-11.215		178.276	50.951
			[108.912]*	[147.604]	[207.103]		[155.726]	[199.508]
Growth in Direct Premiums Written$_t$ ($ Trillion)			0.917	-1.634	-1.685		0.607	-0.906
			[2.073]	[2.452]	[2.894]		[2.408]	[2.374]
Loss Ratio$_t$			6.52	13.055	14.319		11.01	13.225
			[3.328]*	[4.077]***	[4.666]***		[4.307]**	[4.236]***
1 Yr Return to Shareholders$_t$			-64.472	-0.645	21.104		-31.168	4.14
			[95.155]	[108.786]	[152.105]		[112.993]	[111.570]
Percentage of Assets Invested in Stocks and Bonds			-9.374	-10.964	-17.278		-12.317	-13.339
			[3.622]**	[4.331]**	[6.926]**		[4.839]**	[4.705]***
Observations		369	355	286	224	293	280	268
Number of A.M. Best Group Number		63	62	56	51	53	52	51
R-squared		0.06	0.19	0.27	0.36			

Table 22: Panel Regressions on A.M. Best's Capital Adequacy Ratio: Management Team

Least squares and instrumental variable panel regressions of the firm's leverage decision based upon Best's Capital Adequacy Ratio, defined as risk-adjusted surplus to net required capital at the end of year t. The full calculation for risk adjustment and required capital is available from A.M. Best and takes into account standard insurance industry practice. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings. Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		Least-Squares				Instrumental Variable Regressions		
		1	2	3	4	5	6	7
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Predicted + Residuals	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	0.002	0.001			0.001	0.001	-0.001
		[0.002]	[0.002]			[0.002]	[0.003]	[0.003]
$Vega_{t-1}$ (.01/$1000000)	(-)	0.043	0.018			-0.005	-0.022	-0.07
		[0.023]*	[0.022]			[0.042]	[0.040]	[0.105]
Predicted $Delta_{t-2}$	(+/-)			-0.001	0.007			
				[0.007]	[0.009]			
Predicted $Vega_{t-2}$	(-)			-0.039	-0.077			
				[0.096]	[0.109]			
Delta $Residual_{t-2}$	(+/-)				0.006			
					[0.003]**			
Vega $Residual_{t-2}$	(-)				-0.019			
					[0.037]			
Age of CEO_t			-0.045	-0.876	-2.521		0.088	0.102
			[0.213]	[1.774]	[2.067]		[0.256]	[0.272]
Tenure as CEO_t			-1.213	-0.281	0.055		-0.862	-0.473
			[0.946]	[1.218]	[1.758]		[1.141]	[1.290]
Tenure at $Company_t$			-0.179	-0.383	-0.482		-0.055	-0.204
			[0.433]	[0.636]	[0.713]		[0.508]	[0.611]
Firm $Size_t$ (ln of admitted assets)	(-)		-8.815	-7.635	-7.788		-7.982	-7.232
			[6.710]	[8.180]	[8.737]		[7.566]	[7.772]
Correlation between Investment Returns and Claims $Costs_t$	(-)		-106.845	-276.078	-123.939		-46.251	-118.233
			[223.386]	[290.964]	[345.404]		[270.399]	[284.720]
Tax $Rate_t$			-0.974	-0.802	5.904		-1.047	5.894

	Predicted Direction of Effect	Least-Squares: 1. Incentive Variables	2. Incentive and Control Variables	3. Predicted	4. Predicted + Residuals	Instrumental Variable Regressions: 5. Incentive Variables	6. Incentive and Control Variables	7. Predicted
			[1.085]	[12.712]	[17.051]		[1.168]	[12.968]
Herfindahl Index for Direct Premiums Written by Line$_t$			-12.1	-43.469	-50.647		-15.11	-31.422
			[20.663]	[31.066]	[34.880]		[26.617]	[30.828]
Number of States Licensed$_t$	(-)		-0.088	-0.261	-0.5		-0.099	-0.225
			[0.209]	[0.294]	[0.359]		[0.271]	[0.284]
A.M. Best Rating of Group$_t$			-0.944	-0.913	-1.029		-0.824	-0.895
			[0.220]***	[0.306]***	[0.406]**		[0.290]***	[0.301]***
Concentration of Group Ownership Herfindahl$_t$	(-)		34.643	42.119	57.79		47.343	49.091
			[12.208]***	[18.506]**	[24.022]**		[17.332]***	[23.784]**
Growth in Direct Premiums Written$_t$ ($ Trillion)			-0.184	-0.308	-0.122		-0.234	-0.256
			[0.232]	[0.308]	[0.336]		[0.268]	[0.283]
Loss Ratio$_t$			-0.525	-0.359	-0.673		-0.296	-0.405
			[0.377]	[0.515]	[0.541]		[0.483]	[0.509]
1 Yr Return to Shareholders$_t$			15.591	9.437	7.168		8.453	5.272
			[10.691]	[13.732]	[17.643]		[12.657]	[13.375]
Percentage of Assets Invested in Stocks and Bonds			1.523	1.643	1.677		2.106	2.179
			[0.406]***	[0.543]***	[0.803]**		[0.539]***	[0.561]***
Observations		366	355	285	224	289	279	267
Number of A.M. Best Group Number		63	62	56	51	53	52	51
R-squared		0.42	0.59	0.39	0.45			

6.5 Contemporaneous Instrumental Variable Regressions

To examine the robustness of regression results to model specification, I repeat the instrumental variable regressions using the contemporaneous (t) values of delta and vega, instrumenting vega with lagged (t-1) and predicted values. By using contemporaneous variables, these regressions are similar to the simultaneous equations. The exact specifications should be clear from tables 23 and 24 – the regressions are similar to those in columns 4,5 and 6 of tables 6-9.

These regressions indicate that there is little relationship between contemporaneous incentives and observable firm risk decisions. If the story I propose is true, then this is because managers are uncertain of the final value of their portfolios and hence te exact incentives that they have and firms have not had time to incorporate the decisions fully during the year. Contemporaneous vega is positively associated with more risk retain when only incentives are examined. Contemporaneous delta decreases the risk retention as well as the capital adequacy ratio, similar to previous findings. The age and tenure of the CEO as well as the AM best rating of the group are positively associated with business decisions, while there are mixed results for the concentration of group business. Leverage decisions are positively associated geographic diversification, concentration of ownership, AM Best rating and shareholder return. There are mixed findings for the loss ratio. Broadly, the incentives story is similar to what is established in the main regressions, but lagged values provide a better measure of the actual incentives given to management, given the timing of the variables and the ability to interpret and set optimal firm policy.

Table 23: Panel Contemporaneous IV Regressions on Business Decisions

Least squares and instrumental variable panel regressions of the firm's reinsurance purchase decision, defined as total premiums written and reinsurance assumed less reinsurance ceded all divided by total premiums written and reinsurance assumed at the end of year t. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings.

Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

	Predicted Direction of Effect	(A) IV Regressions: Risk Retained 1 Incentive Variables	2 Incentive and Control Variables	3 Predicted	(B) IV Regressions: Schedule P Lines 4 Incentive Variables	5 Incentive and Control Variables	6 Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-0.811	-1.1	-2.391	-0.15	-0.028	-0.07
		[0.715]	[1.280]	[1.364]*	[0.705]	[0.704]	[0.669]
$Vega_{t-1}$ (.01/$1000000)	(+)	24.45	24.735	-14.605	-3.023	1.799	33.772
		[12.695]*	[18.462]	[33.301]	[10.319]	[9.879]	[23.277]
Age of CEO_t			0.198	0.21		0.115	-0.004
			[0.137]	[0.126]*		[0.092]	[0.107]
Tenure as CEO_t			0.24	0.871		0.769	-0.213
			[0.621]	[0.699]		[0.426]*	[0.496]
Tenure at $Company_t$			0.069	-0.29		0.006	0.129
			[0.311]	[0.374]		[0.153]	[0.151]
Firm $Size_t$ (ln of admitted assets)	(+)		-3.398	-0.54		2.876	0.85
			[3.077]	[1.692]		[2.161]	[1.513]
Tax $Rate_t$			0.475	0.712		-0.079	0.054
			[2.121]	[2.239]		[0.272]	[0.322]
Herfindahl Index for Direct Premiums Written by $Line_t$			25.899	12.144		-75.861	-68.894
			[13.138]**	[9.841]		[7.326]***	[7.181]***
Number of States $Licensed_t$	(-)		0.063	0.032		0.089	0.111
			[0.109]	[0.097]		[0.066]	[0.069]
A.M. Best Rating of $Group_t$			-0.06	0.058		0.192	0.241
			[0.122]	[0.097]		[0.095]**	[0.077]***
Concentration of Group Ownership $Herfindahl_t$	(+)		4.802	5.053		-3.369	-2.729
			[6.596]	[5.102]		[4.177]	[3.942]
Growth in Direct Premiums $Written_t$ ($ Trillion)			0.031	0.114		-0.03	-0.047
			[0.109]	[0.110]		[0.063]	[0.071]
Loss $Ratio_t$			0.087	0.174		-0.112	-0.051
			[0.151]	[0.139]		[0.110]	[0.111]
1 Yr Return to $Shareholders_t$			7.021	3.958		-2.071	-5.311
			[5.165]	[4.052]		[3.752]	[3.665]
Percentage of Assets Invested in Stocks and Bonds			0.004	-0.066		0.149	0.211
			[0.244]	[0.169]		[0.172]	[0.156]
Observations		205	197	226	257	246	288
Number of A.M. Best Group Number		53	53	53	59	58	59

Table 24: Panel Contemporaneous IV Regression: Leverage Decisions

Least squares and instrumental variable panel regressions of the firm's decision of amount of business conducted in long-tailed lines at the end of year t. Long-tailed lines are as defined in Phillips, Cummins, and Allen (1996) and are listed in Appendix 1. Vega is the dollar change in the CEO's wealth for a 0.01 change in the standard deviation of stock returns. Delta is the dollar change in the CEO's wealth for a 1% change in stock price. Predicted and residual incentives are the predicted values and residuals from the regressions of vega and delta on control variables, presented in table 3. Control variables, and their creation, are described in section 3 of the paper. Loss ratio is the ratio of losses and loss adjustment expenses to premiums earned. Time subscripts indicate year-end values. Dollar values are as listed and calculated in 2004 dollars. Predicted signs, are given in parenthesis to the left of the columns. Standard errors for key variables are given in brackets and significance at the 1%, 5%, and 10% values are denoted by ***, **, and *, respectively. Time subscripts are as denoted and the instruments used in the IV specifications are noted in the column headings.
Observations are identified at firms in a given year. Year and missing dummy variables are included but not reported.

		(A) IV Regressions: Premium/Surplus			(B) IV Regressions: Best's Adequacy Ratio		
		1	2	3	4	5	6
	Predicted Direction of Effect	Incentive Variables	Incentive and Control Variables	Predicted	Incentive Variables	Incentive and Control Variables	Predicted
$Delta_{t-1}$ ($/1000000)	(+/-)	-20.194	-24.22	-35.654	-0.389	-5.045	-2.415
		[24.726]	[28.968]	[23.243]	[2.480]	[2.517]**	[2.257]
$Vega_{t-1}$ (.01/$1000000)	(+)	-2.39	-329.393	363.368	37.772	-44.65	-18.627
		[350.072]	[398.356]	[801.922]	[36.699]	[35.301]	[76.539]
Age of CEO_t			-2.059	-2.542		0.703	0.474
			[3.735]	[3.727]		[0.330]**	[0.355]
Tenure as CEO_t			3.776	8.092		0.498	0.4
			[17.189]	[16.844]		[1.521]	[1.614]
Tenure at $Company_t$			-3.484	-7.963		-0.623	-0.242
			[6.200]	[5.305]		[0.548]	[0.503]
Firm $Size_t$ (ln of admitted assets)	(+)		116.474	43.348		-12.592	-7.166
			[87.391]	[52.592]		[7.719]	[7.469]
Tax $Rate_t$			0.512	-3.625		-0.924	-1.272
			[11.002]	[11.104]		[0.973]	[1.073]
Herfindahl Index for Direct Premiums Written by $Line_t$			419.211	373.634		-9.119	-22.304
			[296.234]	[247.963]		[26.183]	[23.961]
Number of States $Licensed_t$	(-)		5.004	4.472		-0.077	-0.21
			[2.673]*	[2.374]*		[0.236]	[0.231]
A.M. Best Rating of $Group_t$			1.187	-1.199		-1.019	-0.513
			[3.840]	[2.667]		[0.339]***	[0.262]**
Concentration of Group Ownership $Herfindahl_t$	(+)		161.841	231.589		55.891	49.394
			[168.865]	[135.857]*		[14.924]***	[13.141]***
Growth in Direct Premiums $Written_t$ ($ Trillion)			0.135	1.494		-0.023	-0.036
			[2.550]	[2.446]		[0.225]	[0.236]
Loss $Ratio_t$			10.933	5.877		-0.674	-0.659
			[4.474]**	[3.813]		[0.395]*	[0.372]*
1 Yr Return to $Shareholders_t$			-74.752	1.033		8.834	21.895
			[153.920]	[127.529]		[13.564]	[12.374]*
Percentage of Assets Invested in Stocks and Bonds			-9.985	-5.003		1.766	1.195
			[6.970]	[5.384]		[0.614]***	[0.519]**
Observations		255	244	286	253	245	286
Number of A.M. Best Group Number		59	58	58	59	58	58

7. Conclusion

This study provides evidence that the incentives given to managers are an important determinant of the risk-management decision of insurance groups, although the statistical significance of their role shifts based on model specification and the decision being examined. The risk management decisions examined in this paper are a cleaner measure of corporate risk management than other proxies used in the literature as they are a pure measure of a company's risk retention relative to bankruptcy risk and the riskiness of their business in general. By limiting my analysis to one specific industry, I am also able to include industry-specific control variables directly related to the business the firm conducts. This is an advancement of this study over others in the risk-management field.

Managerial incentives appear to have an important effect on risk retention and are more important than several firm structure factors. The specific results of the examination of firm decisions and their relationship to risk management presented in this paper represent a puzzle. Executives do appear to be responding to the incentives that they are given in their compensation packages by retaining more of their business risk on firm's own books, but they also appear to be conducting less business in risky lines. Perhaps executives are selectively choosing to reinsure less of their preferred risk while conducting less risky business in general.

The market appears to be basing its valuation of the firm mainly on the general riskiness of the firm's business – what proportion of the firm's premiums come from long-tailed lines. My results indicate that firms with more business in risky lines seem less volatile and this coincides with the results from the firm-decision regressions. If executives are behaving rationally, then they should adjust their firm business in a way which causes the market to reward them. Executives should therefore be particularly sensitive to this decision variable when determining their firm policy. The leverage decision does not seem to be affected by executive incentives – they are finding other ways of responding.

It is important to examine the strategies of groups, rather than individual companies, especially in the insurance industry, where intra-group reinsurance has significant effects on the cost of capital faced by an individual company and which can only be accurately accounted for by examination at the group level. Further, I show that it is important to include managerial, as well as structural, incentives when examining the decision processes of a firm. A useful robustness check would to be to examine banks, investment houses, and other risk-bearing institutions to see if these risk and incentive connections hold. Further expanding the insurance data set could also help to resolve some of the effects where managers seem to be operating contrary to their risk-reward incentives.

This study has examined executive compensation as a key policy variable of firms. It has been shown here that risk-management decisions are significantly determined by managerial incentives, although not always as theory would predict, and it may be that this variable is one path by which incentives affect firm performance. The data set may also be used to provide detailed answers to other questions of to the insurance industry and their relation to the management team. Thus, there is significant opportunity for future research in this promising field.

Appendix 1: Insurance Lines of Business

Line Number	Line Description
1	Fire [P]
2	Allied Lines [P]
3	Farmowners Multiple Peril*
4	Homeowners Multiple Peril*
5	Commercial Multiple Peril*
6	Mortgage Guaranty
8	Ocean Marine*
9	Inland Marine [P]
10	Financial Guaranty
11.1	Medical Malpractice (Occurrence)*[L]
11.2	Medical Malpractice (Claims Made) [L]
12	Earthquake [P]
13	Group Accident and Health
14	Credit Accident and Health (Group and Individual)
15	Other Accident and Health
16	Workers Compensation* [L]
17.1	Other Liability (Occurrence)* [L]
17.2	Other Liability (Claims Made) [L]
18.1	Products Liability (Occurrence)* [L]
18.2	Products Liability (Claims Made) [L]
19.1	Private Passenger Auto Liability* [L]
19.2	Private Passenger Auto Liability* [L]
19.3	Commercial Auto Liability* [L]
19.4	Commercial Auto Liability* [L]
21	Auto Physical Damage [P]
22	Aircraft (All Perils)*
23	Fidelity
24	Surety
25	Glass
26	Burglary and Theft [P]
27	Boiler and Machinery*
28	Credit
29	International*
30	Reinsurance (Non-Proportional Assumed – Property)*
31	Reinsurance (Non-Proportional Assumed – Liability)*
32	Reinsurance (Non-Proportional Assumed – Financial Lines)*
33	Aggregate Other

* = Denotes Long-Tailed line as identified in Phillips, Cummins & Allen(1996). Adjustments are made for lines whose definitions have since changed, particularly in claims vs. occurrence based lines.
[L] = Line is defined as mainly a Liability line
[P] = Line is defined as mainly a Property line

Lines 7 and 20 are historical do not exist for the years in this data set

Appendix 2: Insurance Group Names Appearing In Data Set

ACE LTD AETNA LIFE & CASUALTY ALLIED GROUP ALLSTATE INS GRP AMBAC ASSURANCE CORP AMERICAN FINANCIAL INS GRP AMERICAN HEALTHCARE SPECIALTY AMERICAN INTL GRP AMERIN GROUP AMERISURE COMPANIES AXIS Capital Grp American Financial Grp Arch Ins Grp BANKERS INS GRP CAPITOL COUNTY GRP CENTRIS GROUP INC CHUBB & SON INC CIGNA HEALTH GRP CINCINNATI FNCL CP CMAC GROUP CNA INS GRP CRUM & FORSTER I C ENHANCE FNCL GRP EXECUTIVE RISK COMPANIES FIDELITY NATL FIN INC	FIRST AMN TITLE FIRST STATE GROUP FRONTIER INS GRP GE GLOBAL GRP GENERAL ELECTRIC GENERAL REINSURANCE CP GOVERNMENT EMPLYS GREAT AMER PROP & CAS HARTFORD FIRE & CASUALTY GROUP HARTFORD STEAM BOILER GRP HORACE MANN GROUP INTEGON CORP INTERCARGO CORP GRP Infinity Prop & Cas Ins Grp LEUCADIA GRP LINCOLN NATIONAL LUMBERMENS MUT CAS GRP MASTERCARE CO INC METROPOLITAN GRP MGIC GRP MILWAUKEE INS GRP MORTGAGE GUARANTY CORP S/G OF MUNICIPAL BOND INV ASR CORP GRP MUTUAL ASSURANCE NAC RE CORP OHIO CASUALTY GRP OLD REPUBLIC GRP	OMNI INS GRP ORION CAPITAL GROUP PMI GROUP OF COMPANIES PROGRESSIVE GRP PROTECTIVE LIFE INS GRP ProAssurance Corp Grp RHINE RE GRP RLI INSURANCE GROUP Radian Grp SAFECO INSURANCE GROUP SCOR REINS CO SELECTIVE INSURANCE SENTRY INSURANCE GROUP SKANDIA AMERICA GROUP ST PAUL COMPANIES SUTTER INS GRP TRENWICK GROUP INC UNITRIN GRP US FIDELITY & GUARANTY GROUP W R BERKLEY CORP WABASH LIFE INSURANCE GROUP WHITE MOUNTAINS GROUP WILLIAM LIFE INS GROUP X L AMERICA ZENITH NATIONAL INS GRP

Appendix 3: Correlation Coefficient Matrix

	Risk Retained	Premium / Surplus Ratio	Proportion of Business in Long-Tailed Lines	Capital Adequacy Ratio	Firm Size	Corr Btwn Investmnent Returns and Claims Costs	STD of Investment Earnings	STD of Claims Costs	STD of Premiums	Tax Rate	Herfindahl Index for Direct Premiums Written
Risk Retained	1										
Premium / Surplus Rati	-0.1287	1									
Proportion of Business	0.1364	0.1264	1								
Capital Adequacy Ratio	-0.2421	0.0792	0.0473	1							
Firm Size	-0.0336	0.0261	-0.1625	0.1283	1						
Corr Btwn Investmnent Returns and Claims Costs	0.0555	0.0401	-0.0286	0.0294	0.0437	1					
STD of Investment Earnings	0.0069	0.0038	-0.0289	-0.0602	-0.0364	0.0523	1				
STD of Claims Costs	0.0715	0.06	0.1917	0.1655	0.2526	0.1059	0.0325	1			
STD of Premiums	0.0477	0.0211	0.1385	0.162	0.2455	0.0864	0.0177	0.9379	1		
Tax Rate	0.0668	-0.0992	0.0009	0.0015	-0.0652	-0.0175	0.0197	-0.0855	-0.0549	1	
Herfindahl Index for Direct Premiums Written	0.1477	-0.1241	-0.5551	-0.4202	-0.1326	-0.315	-0.0259	-0.1673	-0.1266	0.0214	1
Number of States Licensed	0.0358	-0.1171	-0.1129	-0.076	0.1727	-0.0392	-0.0024	0.1926	0.1773	-0.0619	0.1028
A.M. Best Rating	0.0637	-0.1266	-0.4388	-0.329	0.2981	-0.1546	0.0655	-0.2001	-0.1481	0.0042	0.4612
Concentration of Ownership Herfindahl	-0.0296	0.0275	-0.1306	0.1	-0.0182	-0.0833	-0.1142	-0.1374	-0.1299	0.0804	0.0634
Growth in Direct Premiums Written	0.0426	0.0065	0.0176	-0.0251	0.3018	0.0128	0.002	0.1331	0.1148	-0.0616	-0.0305
Loss Ratio	-0.0508	0.02	0.0468	0.0416	0.0041	0.0094	0.0003	0.0623	0.0649	-0.0133	-0.0994
1-Yr Return to Shareholdesr	0.1297	-0.0717	-0.0376	0.0006	-0.1712	-0.2651	-0.0351	-0.0405	-0.0129	0.0285	0.1156
Missing: Loss Ratio	0.0296	0.2646	-0.0022	0.1219	-0.1011	0.0941	-0.0264	-0.0477	-0.0525	0.0333	-0.0708
Missing: 1-Yr Return to Sharedholers	-0.0709	-0.0745	0.0146	-0.0579	-0.0828	0.0061	-0.0184	-0.0653	-0.045	0.0387	0.0087
Missing: Growth in Direct Premiums Written	-0.033	-0.0626	0.0693	-0.1821	-0.2096	-0.0496	-0.0571	-0.0833	-0.073	-0.0318	0.0929
CashComp	-0.4035	0.1388	-0.0829	0.2292	0.1391	-0.2295	0.0186	0.1905	0.187	-0.0675	-0.1036
Age of CEO	-0.2826	0.1015	-0.0372	0.2881	-0.0069	-0.1944	0.0016	-0.0672	-0.0204	0.0463	0.0159
Tenure as CEO	-0.0732	0.0036	0.0035	0.0831	0.0071	0.0387	0.0278	-0.0639	-0.0404	-0.0162	-0.072
Tenure at Company	0.0882	-0.2063	0.0823	0.0753	-0.0043	0.0384	-0.0457	0.0953	0.1144	0.0411	-0.0436

	Number of States Licensed	A.M. Best Rating	Concentration of Ownership Herfindahl	Growth in Direct Premiums Written	Loss Ratio	1-Yr Return to Shareholdesr	Missing: Loss Ratio	Missing: 1-Yr Return to Sharedholers	Missing: Growth in Direct Premiums Written	CashComp	Age of CEO	Tenure as CEO	Tenure at Company
Risk Retained													
Premium / Surplus Rati													
Proportion of Business													
Capital Adequacy Ratio													
Firm Size													
Corr Btwn Investmnent Returns and Claims Costs													
STD of Investment Earnings													
STD of Claims Costs													
STD of Premiums													
Tax Rate													
Herfindahl Index for Direct Premiums Written													
Number of States Licensed	1												
A.M. Best Rating	0.2168	1											
Concentration of Ownership Herfindahl	0.1817	0.1613	1										
Growth in Direct Premiums Written	0.0647	0.0057	-0.0116	1									
Loss Ratio	0.0634	-0.007	0.0219	-0.1762	1								
1-Yr Return to Shareholdesr	0.0627	0	0.0664	-0.0472	-0.0041	1							
Missing: Loss Ratio	-0.2131	0.0149	-0.0042	-0.0831	-0.0977	0.092	1						
Missing: 1-Yr Return to Sharedholers	-0.1273	-0.1226	-0.033	-0.0163	-0.03	-0.0852	-0.0038	1					
Missing: Growth in Direct Premiums Written	-0.0658	-0.1091	-0.0291	-0.0478	-0.0112	0.0825	-0.024	0.2481	1				
CashComp	0.0619	0.0633	0.0381	-0.0404	0.1037	-0.0533	-0.0418	-0.0966	-0.14	1			
Age of CEO	-0.1064	0.0471	-0.0246	-0.0803	0.1048	-0.012	0.0521	-0.0422	-0.0583	0.2461	1		
Tenure as CEO	-0.1231	0.0194	-0.0255	-0.0306	0.0519	-0.0719	0.0534	-0.1304	-0.0472	0.1018	-0.0716	1	
Tenure at Company	0.2156	0.0013	0.0329	-0.0116	0.0664	0.0182	0.0634	-0.0653	-0.0926	0.024	-0.1428	0.1613	1

References

Aggarwal, Rajesh K. and Andrew A. Samwick, 1999b, "Executive Compensation, Strategic Competition, and Relative Performance Evaluation: Theory and Evidence," Journal of Finance (December) 54(6): 1999-2043.

Altman , A., 1984. A Further Empirical Investigation of the Bankruptcy Cost Question. *The Journal of Finance.* 39(4): 1067-1089.

Anderson, R., T. Bates, J. Bizjak, and M. Lemmon, 2000. Corporate Governance and Firm Diversification. *Financial Management.* 2: 5–22.

Bartram, S.M., 2000. Corporate Risk-Management as a Lever for Shareholder Value Creation, *Financial Markets, Institutions and Instruments*. 9(5): 279-324.

Berger, P., E. Ofek and D. Yermack, 1997. Managerial Entrenchment and Capital Structure Decisions. *Journal of Finance.* 52: 1411–1438.

Bhagat, S. and I. Welch, 1995. Corporate Research and Development Investments: International Comparisons. *Journal of Accounting and Economics.* 19: 443–470.

Bryan, Stephen, Lee-Seok Hwang, and Steven B. Lilien, 2000, "CEO Stock-Based Compensation: An Empirical Analysis of Incentive-Intensity, Relative Mix, and Economic Determinants," Journal of Business (October) 73(4): 661-693.

Chakraborty, A., S. Sheikh, and N. Subramanian, 2007. Termination Risk and Managerial Risk Taking. *Journal of Corporate Finance.* 13: 170-188.

Cohen, R., B. Hall, and L. Viceira, 2000. Do Executive Stock Options Encourage Risk-Taking? Working Paper. Harvard Business School.

Coles, J.L., N.D. Daniel, and L. Naveen, 2006. Managerial Incentives and Risk-Taking, *Journal of Financial Economics.* 79: 431-468.

Core Guay Thomas 2004

Core, J., and W. Guay, 2002. Estimating the Value of Employee Stock Option Portfolios and Their Sensitivities to Price and Volatility. *Journal of Accounting Research.* 40: 613–630.

Core, John and Wayne Guay, 2001, "The Other Side of the Trade-Off: The Impact of Risk on Executive Compensation. A Comment," Working Paper (October).

DeFusco, R., R. Johnson, and T. Zorn, 1990. The Effect of Executive Stock Option Plans on Stockholders and Bondholders. *Journal of Finance.* 45: 617–627.

Demsetz, H. and K. Lehn, 1985, The Structure of Corporate Ownership: Causes and Consequences. *The Journal of Political Economy*. No. 93 (6): 1155-1177.

Fok, Robert and Carolyn Carroll, Ming Chiou, 1997, Determinants of Corporate Hedging and Derivatives: A Revisit. *Journal of Economics and Business.* No. 49: 569-585.

Garen, John E., 1994, "Executive Compensation and Principal-Agent Theory," Journal of Political Economy 102(6): 1175-1199.

Garven, J.R. and H. Louberge, 1996. Reinsurance, Taxes, and Efficiency: a Contingent Claims Model of Insurance Market Equilibrium. *Journal of Financial Intermediation.* 4: 74-93.

Garven, J.R. and J. Lamm Tennant, 2003. The Demand for Reinsurance: Theory and Empirical Tests. *Insurance and Risk Management*. 7(3): 217-237.

Gay, G.D., and J. Nam, 1998. The Underinvestment Problem and Corporate Derivatives Use. *Financial Management* 27(4): 53-69.

Guay, W.R., 1999. The Impact of Derivatives on Firm Risk: An Empirical Examination of New Derivatives Users. *Journal of Accounting and Economics* 26: 319-351.

Hall, Brian J. and Jeffrey B. Liebman, 1998, "Are CEOs Really Paid Like Bureaucrats?" *The Quarterly Journal of Economics* (August) 113(3): 653-691.

Haushalter, G.D., 1997. The Role of Corporate Hedging: Evidence from Oil and Gas Producers. University of Oregon Working Paper.

Holmstrom, B., 1979. Moral Hazard and Operability. *The Bell Journal of Economics.* 10: 74–91.

Holmstrom, B., and P. Milgrom, 1987. Aggregation and Linearity in the Principal–Agent Relationship. *Econometrica.* 55: 303–328.

Jensen, Michael C., 1983. Organization Theory and Methodology. *Accounting Review* 58:2: 319-339.

Jensen, Michael C. and Kevin J. Murphy, 1990b, "Performance Pay and Top-Management Incentives," Journal of Political Economy 98(2): 225-264.

John, T., and K. John, 1993. Top-Management Compensation and Capital Structure. *Journal of Finance.* 48: 949–974.

Ju, N., H. Leland, and L. Senbet, 2002. Options, Option Repricing and Severance Packages in Managerial Compensation: Their Effects on Corporate Risk. Working paper. University of Maryland.

Knopf, J., J. Nam Jr., and J. Thornton, 2002. The Volatility and Price Sensitivities of Managerial Stock Option Portfolios and Corporate Hedging. *Journal of Finance.* 57: 801–814.

Lewellen, K., 2003. Financing Decisions When Managers are Risk Averse. Working paper. MIT.

Mayers, D., and C.W. Smith Jr., 1982. On the Corporate Demand for Insurance. *Journal of Business 55(2):281-296.*

Mayers, D., and C.W. Smith Jr., 1990 On Corporate Demand for Insurance: Evidence from the Reinsurance Market. *Journal of Business 63(1): 19-40.*

Murphy, K., 1999. Executive Compensation. In: Ashenfelter, O., Card, D. (Eds.), Handbook of Labor Economics, vol. 3b (Chapter 38). Elsevier Science, North Holland, pp. 2485–2563.

Murphy, Kevin J., 1985, "Corporate Performance and Managerial Remuneration: An Empirical Analysis," Journal of Accounting & Economics (April) 7(1-3): 11-42.

Murphy, Kevin J., 1986a, "Top Executives Are Worth Every Nickel They Get," Harvard Business Review (March/April) 64(2): 125-132.

Myers, S.C. and J.A. Read Jr. 2001. Capital Allocation for Insurance Companies. *The Journal of Risk and Insurance.* 68(4): 545-580.

Parrino, R., A. Poteshman, and M. Weisbach, 2005. Measuring Investment Distortions When Risk-Averse Managers Decide Whether to Undertake Risky Projects. *Financial Management.* 34: 21–60.

Phillips, R. D., J. D. Cummins and F. Allen, 1996, Financial Pricing in the Multiple Line Insurance Company. *Financial Institutions Center*, WP 96-09.

Powell, L.S., and D.W. Sommer, 2007. Internal Versus External Capital Markets in the Insurance Industry: The Role of Reinsurance. *Journal of Financial Services Research.* 31: 173-188.

Rajgopal, S., and T. Shevlin, 2002. Empirical Evidence on the Relation Between Stock Option Compensation and Risk Taking. *Journal of Accounting and Economics.* 33: 145–171.

Rogers, D., 2002. Does Executive Portfolio Structure Affect Risk Management? CEO Risk-Taking Incentives and Corporate Derivatives Usage. *Journal of Banking and Finance.* 26: 271–295.

Rosen, S., 1982. Authority, Control and the Distribution of Earnings. *Bell Journal of Economics.* Pp311-323.

Ross, S., 2004. Compensation, Incentives, and the Duality of Risk Aversion and Riskiness. *Journal of Finance.* 59: 207–225.

Schrand, C.M., and H. Unal 1998. Hedging and Coordinated Risk Management: Evidence from Thrift Conversions. *Journal of Finance.* 53(3): 979-1013.

Sigler, Kevin. 1997. CEO Pay in the American Insurance Industry. *Management Research News.* 20(8): 18-25.

Smith, C. W., and R.M. Stulz, 1985. The Determinants of Firms' Hedging Policies, *Journal of Financial and Quantitative Analysis.* 20: 391-405.

Stulz, R.M., 1984. Optimal Hedging Policies. *Journal of Financial and Quantitative Analysis.* 19(2): 127-140.

Stulz, R.M., 1990. Managerial Discretion and Optimal Financing Policies. *Journal of Financial Economics.* 26(1): 3-27.

Tufano, P., 1996. Who Manages Risk? An Empirical Examination of the Risk Management Practices in the Gold Mining Industry. *Journal of Finance.* 51(4): 1097-1137.

Warner, J., 1977, Bankruptcy Costs: Some Evidence, *Journal of Finance.* 32: 337-348.