Strategic Interaction, Relative Performance Evaluation and CEO Compensation: Evidence from the U.S. Insurance Industry

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By

Jingshu Luo

Department of Risk, Insurance, and Healthcare Management
Temple University
Alter Hall, 601K
1801 Liacouras Walk
Philadelphia, PA 19122

jingshu.luo@temple.edu

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Abstract

Recent studies advocate that the use of relative performance evaluation (RPE) in a CEO's compensation contract is associated with the type of strategic competition (strategic substitute or strategic complement) the firm faces. Specifically, CEO pay should be negatively (positively) associated with peer-group performance when firms compete as strategic substitutes (complements). Due to the difficulty of adequately identifying the strategic interaction form, empirical evidence on this issue is scarce. In this paper, I offer evidence to this issue by analyzing the CEO compensation of public-traded firms and their disclosed peer groups in the U.S. Insurance industry. In particular, employing spatial econometrics models, I find that insurers are strategic complements to their peer groups in financial performance. On top of it, I find that CEO pay is positively associated with peer-group performance.

Key Words: Relative Performance Evaluation, CEO Compensation, Strategic Substitute, Strategic Complement, Spatial Econometrics

1. Introduction

Incentive conflicts between stakeholders and managers has long been a topic of concern. A considerable amount of literature has explored the relationship between executive compensation and individual firm's performance. However, in the market environment of more interdependence, firms' behaviors tend to be affected not only by their own characteristics but also by the performance of peer firms. As stated in the annual report of the health insurance company, Aneta: "Although a significant portion of the Company's executive compensation is performance-based, we do not believe that our programs encourage excessive or unnecessary risk-taking. Overall, our compensation mix is generally consistent with competitive market practice." Under this background, relative performance evaluation (RPE) hypothesis is introduced. The incentive behind relative performance measure is to remove industry-wide risk factors and systemic risk that CEOs are unable to control, thus improving the efficiency of incentive contracting (Vrettos, 2013).

Recent studies broader the understanding of RPE from traditional agency theory and advocate that the use of RPE in a CEO's incentive contract is also associated with the type of strategic competition (strategic substitutes or strategic complements) the firm faces. Competition as strategic substitutes occurs when one good provider reduces production of as a response to a rival's increased production. Competition as strategic substitutes occurs when one good provider increases production to respond a rival's production of the good. (Barr, 2013). Aggarwal and Samwick (1999) and Vrettos (2013) point out that CEO compensation is negatively associated with peer-group performance when firms compete as strategic substitutes. On the flip side, the relationship is positive if firms are strategic complements.

Due to the difficulty of adequately capturing firms' strategic conduct, especially distinguishing between strategic substitutes and complements, there has been scarce empirical evidence on this issue. In this paper, I fill the gap by providing evidence of the existence of relative

performance measure based on testing the type of strategic interactions. In particular, I use spatial econometrics to systematically examine the strategic interaction form of public-traded insurers and their disclosed peer groups in the U.S. insurance industry. I find that public-traded insurers are systematically strategic complements. On top of it, I test the relationship between CEO compensation and financial performance of peer firms and find strong positive relationship. The results support Vrettos (2013), which states that CEO pay should be positively associated with peer-group performance when firms compete as strategic complements. The logic behind the finding is that, if insurers respond positively to aggressive financial performance such as writing more insurance premium of peer firms, the strategic complement action will then increase the executive pay of CEOs.

The insurance industry is particularly interesting to analyze strategic interaction and relative performance measures. Insurers are financial institutions which have highly-paid CEOs and face the most typical agent-principle problem. Also, insurers in the industry are widely interconnected through reinsurance, making them more interdependent and thus the resulting interaction must be taken into account in characterizing the insurance equilibrium. In addition, insurance products provide financial reimbursement to insured in events such as damage in hazard and hence insurance industry is more vulnerable to specific exogenous risks. The risk-undertaking and risk-sharing system in the insurance industry make some shocks to earnings out of management control. The existence of relative performance measure to CEO compensation thus reasonable in this industry.

This might be the first paper applying spatial econometrics to relative performance measure studies. Most of previous CEO compensation and RPE research mainly relies on statistical models that assume that the individual observations are independent of one another. This assumption makes linear regression models suffer from the reflection problem because they cannot measure

interactions such as endogenous peer effect, spillover effect and feedback effect (Manski, 1993). Spatial econometrics, a subfield of econometrics, focuses on how the occurrence of one event at a specific place is affected by or connected with similar events in other places. It provides a solution to such drawbacks and allows us to better understand how financial performance as well as executive pay is affected by the peer group.

Identifying relevant peer group had been a crucial issue of RPE studies because public-traded firms had seldom reported the actual composition of peer group. However, it became a requirement under the updated disclosure rules of the U.S. Securities and Exchange Commission (SEC) in 2006. I manually collect over 4000 pairs of firm-peer group information from the DEF 14A form on the SEC website for all public-traded insurers from 2006 to 2016. Based on it, I could capture the economic closeness between insurers and their comparative peer firms and hence test strategic interaction and RPE.

Spatial econometrics has several advantages in analyzing the formation of reinsurance networks. First, while previous RPE literature mainly only use median performance to measure the performance of peer group, spatial econometrics models can measure different types of economic distance between any two firms. Second, the peer group relationship is not totally equal. Insurers pick those who have similar characteristics or have economic connections as peer firms. However, these insurers might not be treated as a competitor by peer firms they select. In contrast to other econometrics methods, spatial econometrics approach can be used to model this kind of asymmetric relationship and capture firms' relative importance in a peer group. Third, the Spatial Durbin Model has a design of spatial lag of independent variables which allows us to clearly measure the effect of peer performance on CEO compensation. More details will be discussed in the part 5 of empirical specification.

The rest of the paper is organized as follows: Section 2 reviews relevant literature; Section

3 introduces empirical specification, including hypotheses development, strategic interaction modelling, identifying peer groups. Section 4 introduces data and summary statistics. Section 5 explains the empirical results. The last part will introduce the upcoming work based on this proposal.

2. Literature Review

Relative performance evaluation (RPE) theory is initially motivated by agency theory, which suggests that CEO compensation should be linked to firm performance to give CEO motivation to optimize shareholders value. Based on it, Holmstrom (1982) and Holmstrom and Milgrom (1987) introduce the hypothesis of relative performance evaluation and state performance measures for CEO compensation should exclude the effects of external shocks to yield a more informative measure of CEO actions. However, the empirical evidence on the RPE hypothesis is inconsistent. Stock return and accounting return are generally used to measure firm performance. Some paper (such as Antle andSmith,1986 and Hall and Liebman, 1998) found empirical results supporting RPE. Meanwhile, a considerable amount of literature (such as Jensen and Murphy,1990; Garvey and Milbourn, 2003, 2006; Gong et al. 2011) found no or weak support for RPE hypothesis.

The mixed evidence with regard to RPE in stock returns for the average CEO has given rise to a new branch of RPE literature which try to explore whether the use of RPE varies across Industry, organization, firm and CEO characteristics. Aggarwal and Samwick (1999) argue that RPE is used less in more concentrated industries. Himmelberg and Hubbard (2000) indicate that a manager especially talented CEOs' outside job opportunities are positively related to the industry stock performance. Albuquerque (2009) argue that the mixed evidences are due to the mis-specified group selected. In his paper, he points out that a firm's technology, complexity of the organization and the ability to access to external capital are depend on firm size. Firms with similar size that are exposed to common shocks and have similar ability to respond to shocks should be

chosen as RPE peer group. After constructing peer groups with similar industry size, he finds consistent evidence with the use of RPE in CEP compensation. Based on Albuquerque (2009), this paper will extend the relevant RPE peer group analysis to more characteristics.

This paper is highly related to Vrettos (2013), which explains the mixed RPE evidence using strategic interaction hypotheses of industrial organization theory. Vrettos (2013) classifies the strategic interaction form of the airline industry and tests RPE separately. He finds that "strategic substitute behavior is motivated through a negative incentive weight on peer performance, while strategic complement behavior is motivated through a positive incentive weight on peer performance." After combining the observations with the same type of strategic interaction form, the evidence of RPE is no longer clear. In my paper, I will use the data of insurance industry to test the relationship between strategic interaction form and PRE in CEO compensation. The main difference between my paper and Vrettos (2013) is that he determines the form of strategic interaction of the airline industry not by systematic test but by his own classification. In contrast, using spatial econometrics model, I will be able to clearly test the strategic interaction forms of insurers in different peer groups and distinguish between strategic substitutes and strategic complements. The next section will introduce spatial models that will be used.

3. Empirical Specification and Spatial Modeling

3.1. Hypotheses Development

The relationship between PRE and strategic interaction come from industrial organization theory. While traditional agency theory only considers the role of RPE in contract efficiency, industrial organization theory considers the value of RPE in motivating managerial strategic action in an interdependent market environment. Papers including Aggarwal and Samwick (1999) and Vrettos (2013) show that managerial incentives can be used to motivate managers to take strategic

actions. The strategic actions will be then observed by peers, resulting the desired competitive response.

Aggarwal and Samwick (1999) and Vrettos (2013) indicate that when firms are strategic substitutes, CEO's compensation increases with own-firm performance and decreases with peer-firm performance. In this case, managers will have incentive to perform aggressively to grab recourses and opportunities from potential competitors. In the insurance industry, insurers selling similar insurance products may attract insureds from potential peer competitors.

On the contrary, when firms are strategic complements. CEO's compensation should increase with both own-firm performance and peer-firm performance. This always happen in differentiated product market. In the insurance industry, it may be the case when insurers sell differentiated and highly related insurance products. For instance, losses from earthquake may be not covered by some homeowner insurance but are covered specific earthquake insurance. The aggressive performance of insurers which sell homeowner insurance may raise the performance of the earthquake insurers. This situation may also happen in the insurance-reinsurance relationship. Insurers are interconnected through reinsurance. Insurers which have outstanding market performance also raise the assumed premium of their connected reinsurers. Even in the market selling similar products, strategic complements may also exist if insurers are trying to outdo each other to achieve better profitability.

In two strategic interaction forms, pay-for-peer-group-performance sensitivities are directionally opposite. Without distinguishing between them, the effect will be cancel in aggregate. Based on the above three arguments, I generate the following three hypotheses.

Hypothesis 1a: CEO compensation sensitivity is *negative* related to peer performance if public-traded insurers compete in strategic substitutes.

Hypothesis 1b: CEO compensation sensitivity is *positive* related to peer performance if public-traded insurers compete in strategic complements.

Hypothesis 1c: If we cannot differentiate the two strategic interaction forms, the CEO compensation sensitivity should be *insignificantly* related to peer performance.

In addition, strategic interaction is not even. Insurers only compete and strategic interacted with their relevant peer firms. In a relevant peer group, insurers should be similar along several characteristics such as industry, size, diversification, and financing constraints (Albuquerque, 2009) or are economically interacted. Albuquerque (2009) points out previous tests choose incorrect peer groups and thus lack power to detect evidence supporting RPE. Identifying the set of firms which have same shocks exposure and have similar ability to respond to shocks is crucial to RPE analysis. Regarding economic distance, insurers with more similarity are more strategic interacted. Albuquerque (2009) find that firms of different size face different shocks and are constrained differently in response to those shocks. Because of it, I generate the second hypothesis.

Hypothesis 2: Insurers have more strategic interaction (both strategic substitute and strategic complements) with economic neighbors.

To test the relative performance measures under different strategic competition, this study should firstly explore and distinguish between strategic substitutes and complements in the property casualty insurance industry. In the following part, this paper will introduce how spatial modeling can be used to achieve this goal.

3.2. Strategic Interaction Modelling

Different from previous RPE literature which use OLS in their empirical analysis, I use spatial econometrics model to test strategic interaction. The major reason is that OLS assumes that the individual observations are independent of one another and thus fails measure interaction and peer effects. According to Elhorst (2014), spatial econometrics tools can be used to deal with spatial interaction effects among geographical units such as zip codes, cities and countries or can be used to examine the behavior of economic agents other than geographical units such as firm which are interdependent to each other. Because of these superior characteristics, spatial

econometrics now is widely used in various subfields of economics such as political economics and environment economics. For example, using spatial econometrics, Brueckner (1998) provides an empirical evidence on strategic interaction among local governments. Yu, Zhou and Zhu (2016) find strong spatial effect for city-level total investment, which is driven by strategic interactions among political rivals in tournament competition.

In a most typical spatial econometrics model introduced by Anselin (1988, 2001)., a weighted average of performance level of neighboring firms (computed by applying a predetermined weight matrix to the data) appears as a lagged regressor in the regression. In the following standard linear spatial autoregressive model (SAR) for spatial lag,

$$Y = \rho WY + \beta X + \varepsilon$$

$Y = \text{a dependent variable}$
$\rho = \text{spatial autoregressive coefficient}$
$W = \text{spatial weight matrix}$
$X = \text{a matrix of all other explanary variables}$
$\varepsilon = \text{a vector of unobservable errors}$

The coefficient on this lagged regressor or "competing controls" variable indicates how a given insurer responds to tighter controls in the relevant peer group. An extended form of SAR is Spatial Durbin Model (SDM).

$$Y = \rho WY + \beta X + WX\theta + \varepsilon$$

Spatial Durbin Model (SDM) considers spatial interaction in dependent variable, explanatory variables and error terms and is the major model used in this paper.

In the spatial regression model, the most important focus is spatial weight matrix W and the spatial coefficient ρ. The matrix W specifies which of the other locations in the system influence the value at a specific location in the same system (Anselin, 2001). The coefficient of W is the spatial autoregressive coefficient which measures to what extent the spatial

interconnectedness affects value of interested variables ρ. To test the strategic interaction of insurers' performance, we build the following SDM model.

$$\mathbf{Insurers'\ performance_{it} = \rho WInsurers'\ performance_{it} + \beta X_{it} + \theta WX_{it} + \varepsilon}$$

In this SDM model, I measure annual firm performance using return on assets. This model is used to test the determinants of insurers' performance. In contrast to previous literature which only test the effects of individual firm characteristics on performance, SDM considers interdependence of insurers' performance in different peer groups. In the above SDM, the form of strategic interaction is captured in the spatial coefficient $\boldsymbol{\rho}$. If strategic substitute dominates the peer group tested, $\boldsymbol{\rho}$ should be significantly negative, showing that the more aggressive play of insurers which increases its profitability lower the profitability of its peer insurer on average. In contrast, if $\boldsymbol{\rho}$ is significantly positive, it shows that strategic complements relationship dominates the peer. Regarding relevant peer groups, spatial weight matrix W is used to identify firms with similarity or firms with economic connection. The definition of W in insurers strategic interaction model will be defined and explained more later.

3.3. Identify Relevant Peer Group.

To capture the distance between insurers and firms in the peer group, I define several spatial weight matrices with different measures. In a cross sectional background with n (re) insurers, the matrix is an $n \times n$ matrix that defines the relative "distance" between (re)insurer *i* and (re)insurer *j*. In a panel background with a total of n (re)insurers and t years, the matrix will be a $nt \times nt$ matrix. (Re)insurers with positive weights are regarded as "neighbors" and neighbors that are presumably more interdependent with (re)insurer *i* are given more weights. A (re)insurer has 0 weight on itself. Technically, this paper will restrict W to be row-standardized to ensure that all the weights are between 0 and 1. The construction of spatial weight matrices will be discussed

below.

(1) Pure Peer Group Matrix

In the Compensation Discussion and Analysis section in firm SEC DEF-14A, firms which use peer group in CEO compensation decision are required to list all peer firms. Based on it, I design the first matrix with the weight of defined as:

$$w_{ij} = \begin{cases} 1, j\ is\ a\ disclosed\ peer\ firm\ of\ i \\ 0, otherwise \end{cases}$$

For instance, if there are two firms in the market and j is treated as a peer firm of i while i is also treated as a peer firm of j, the matrix will be built as follow.

	i	j
i	0	1
j	1	0

(2) Peer Group with Assets Distance Matrix.

Even in the same peer group, the importance of firms differs. Companies may choose those with similar size, measured as admitted assets as the most important peer firm. Because of it, I design the second matrix with the weight defined as:

$$w_{ij} = \begin{cases} w_{ij} = \dfrac{1}{|\text{Yearly Assets Difference between i and j}|}, if\ j\ is\ a\ disclosed\ peer\ firm\ of\ i \\ 0, otherwise \end{cases}$$

Two firms with similar size are treated as neighbors or close peer firms and their weight is expected to be high.

(3) Peer Group with Premium Distance Matrix.

While most insurance literature use admitted assets to measure size, most RPE literature uses sales to measure size. Considering it, I build a weight matrix similar to matrix (2) but use

premium written to measure size. The weight is defined as below as:

$$w_{ij} = \begin{cases} w_{ij} = \dfrac{1}{|\text{Yearly Premium Difference between i and j}|}, if\ j\ is\ a\ disclosed\ peer\ firm\ of\ i \\ 0, otherwise \end{cases}$$

Two firms with similar premium written amount are treated as neighbors or close peer firms. Thus, their weight is expected to be high.

(4) Size(Assets/Premium) Difference Matrix for All Potential Peer Firms.

Because insurers select and disclose peer firms by themselves, they may choose to not disclose some competitor or comparative firms by purpose. The two matrices consider all potential peer firms and are built to compare with the matrix (2) and (3).

$$w_{ij} = \frac{1}{|\text{Size between i and j}|}$$

In upcoming work, more matrices such as matrix based on rating will also be built to capture the economic distance between insurance firms.To clarify, the paper is not able to find all possible interaction between insurers. The main purpose is to provide an idea of how various economic linkage can affect the identification of relevant peer group.

3.4. Empirical Model to test Relevant Performance Evaluation in CEO compensation

Previous sections mainly focuses on identify relevant peer group and modelling strategic interaction of insurers. Based on it, I build another Spatial Durbin Model to test the relationship between RPM in CEO compensation and strategic interaction form in the insurance industry. To achieve this goal, I build the following regression model. Because CEO compensation of insurers may also have strategic interaction, this paper considers the spatial lag of CEO compensation and

$\boldsymbol{W_{11}}$ measures the spatial interaction between i and other peer firms on a peer group.

$$\mathbf{CEO\ compensation_{it}} = \boldsymbol{\alpha_0} + \boldsymbol{\rho W_{11}}\mathbf{CEOcompensation_{it}} + \boldsymbol{\alpha_1 Firm Perf_{it}} + \boldsymbol{\alpha_2 W_{12} PeerPerf_{(-i)t}} + \boldsymbol{\alpha_3}\mathbf{ControlV_{it}} + \boldsymbol{\varepsilon_{it}}$$

Following previous literature, I use the logarithm of real total annual compensation flow to measure CEO compensation. Total annual compensation flow include salary, bonus, other annual compensation, long-term incentive payouts, restricted stock grants, Black and Scholes value of stock option grants, and all other compensation (named as "Tdc1" in Executcomp database). Also, similar to section 3, I measure annual firm performance and Peer performance using stock returns and *ROA*.New Premium written is also considered. Peer performance is spatial weighted *ROA* of all peer firms but not the interested insurer itself. The weight $\boldsymbol{W_{12}}$ is based on its position in the specific peer group. Based on the hypotheses mentioned in 3.1, I assume that for if strategic substitute dominates, $\boldsymbol{\alpha_1}$ is statistically positive while $\boldsymbol{\alpha_2}$ is statistically negative. In contrast, if strategic substitute dominates, both $\boldsymbol{\alpha_1}$ and $\boldsymbol{\alpha_2}$ are statistically positive. Other major control variables are defined as below:

- *Leverage:* Leverage is defined as the ratio of the total liabilities to total admitted assets.
- *Liquidity*: Liquidity is measured by the ratio of cash and short-term investments divided by total assets.
- *Size*: Size is measured by the natural logarithm of an (re)insurer's total admitted assets or premium written.
- *CEO Individual Variables*: A series of CEO characteristics such as gender and age are also included
- *Fixed Effect*: Year fixed effect and SIC codes (to identify different sections in insurance industry) fixed effect.

4. Data and Summary Statistics

4.1. CEO, Financial and Market Data

To empirically test the RPE in property casualty insurance industry, I start to obtain data for CEO compensation and CEO characteristics of all public-traded insurers from Compustat North America's Executive Compensation (ExecuComp) from 2006 to 2016. Since previous literature such as Gong, Li and Shin (2011) consistently find that firms prefer to select RPE firms from two-digit SIC industry, I collect all CEO data of companies whose SIC starts from 63. There are six small sections (4-digital SIC) in the insurance industry. The list of sections and sample size of each section is in table 1. In addition, financial information such as assets and premium are collected from Compustat and Market price and market return data are collected from CRSP. The three databases can be merged using CUSIP code and GVKEY code.

Table 1

SIC	Description	Firm-Year Obs
6321	Accident & Health Insurance	44
6331	Fire, Marine, Casalty Insurance	352
6324	Hospital&Medical Service Plans	99
6311	Life Insurance	88
6351	Surety Insurance	66
6361	Title Insurance	33

4.2. Peer Group Data

In 2006, the SEC amended its rules on executive compensation disclosures to increase the transparency of executive compensation contracts. Prior to 2006, proxy disclosures on peer group information was not mandatory. Under the new disclosure rules, firms are required to provide a "Compensation Discussion and Analysis" (CD&A) report in their proxy statements, in which firms must provide a detailed description of peer group selection.

In order to find peer groups of public-traded insurers, I manually collected peer group information from the Compensation Discussion and Analysis section of SEC DEF-14A form of

each firm each year. If a firm does not disclose peer firms in some specific year, the peer firm information of close year will be used as a replace. The final sample includes 4664 peer firm information in total.

The following table 2 shows the summary statistics. Firms which are merged, acquired, or bankrupt before 2016 are removed from the sample. Firms should also disclose at least one peer firm to be included in the sample. The initial sample includes 94 firms. The final sample includes 62 firms each with full CEO, financial and market return information.

Table 2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Firms in the Peer Group	682	6.508	3.469	1	18
Year	682	2011	3.164599	2006	2016
Total Admitted Assets	682	6.61E+10	1.52E+11	4.91E+08	1.06E+12
Total Employments	682	13044.15	23292.08	129	230000
Total Premium Written	682	1.00E+10	1.76E+10	5.31E+07	1.44E+11
Total Compensation	682	7579485	6438833	204058	4.55E+07
Leverage	682	0.754	0.132	0.249	1.178618
Liquidity	682	0.132	0.129	0.001	0.664
ROA	682	0.022	0.037	-0.325	0.199
Cumulative Market Return	682	0.129	0.410	-0.971	4.146
age	682	56.957	6.228	38	77

5. Empirical Results

5.1. Moran's I test of Spatial Autocorrelation

Before using spatial econometrics to analyze strategic interaction and relative performance measure, one important step is to use Moran' I statistics to test the spatial autocorrelation of dependent variable and independent variables. Moran's I is similar to correlation coefficient but measures the overall spatial autocorrelation. In other words, Moran's I statistics measures how one observation is similar to neighbors surrounding it. If observations are found highly influenced by each other, it means that the basic assumption of OLS is violated and spatial econometrics should

be used. The following is the Moran I test results

Table 3—Moran I test for Spatial Autocorrelation

	Total Compensation	Total Premium Written	Total Assets	ROA
	(1)	(2)	(3)	(4)
W1	0.289***	0.517***	0.584***	0.22***
	(0.000)	(0.000)	(0.000)	(0.000)
W2	0.351***	0.584***	0.710***	0.286***
	(0.000)	(0.000)	(0.000)	(0.000)
W3	0.333***	0.633***	0.667***	0.336***
	(0.000)	(0.000)	(0.000)	(0.000)
W4	0.030***	-0.007	-0.008	0.004***
	(0.000)	(0.390)	(0.307)	(0.000)

*W1 is the pure peer group matrix. W2 is the assets matrix based on peer firms. W3 is the premium matrix based on peer firms. The definition of matrices is introduced in section 3.3.1. The last matrix gives same weight to all possible neighbors of one observation, except the observation itself (W4 is only used for comparison).

From the above table 3. We can clearly see that total compensation, total premiums, total assets, and ROA of insurers are highly correlated with their peer firms and the correlation is statistically positive. Also, firms' performances are highly correlated with those who have similar assets level, premiums level and ROA levels. From the result for W4, we can see that if we give same weight to all possible peer firms, the spatial autocorrelation becomes very weak. It means that insurers don't compete and interacted with all firms in the market. They give each peer firm different weight and build their peer group based on different characteristics including the firm assets and premium.

5.2. Strategic Interaction Form Analysis.

The follow table 2 shows the strategic interaction analysis results using Spatial Durbin Model. Spatial coefficient, Rho measures how the ROA of a firm is affected by the ROA of firms in the peer group. With three different weight matrices definition, we can see positive and significant Rho in all regressions. Take the first regression using weight matrix 1 for instance, one percentage increase of ROA of peer firms, the center insurer will increase ROA by 0.4 percentage. In other words, the increase of ROA of peer firms strongly motivate the central firm to increase

ROA. Therefore, I can conclude that public-traded insurers in my sample are strategic complements.

Table 4: Strategic Interaction Analysis Using Spatial Durbin Model.
Dependent Variable:ROA

Rho	**0.455*** (0.000)**	**0.283*** (0.000)**	**0.300*** (0.000)**
LnAssets	0.006*** (0.003)	0.005** (0.019)	0.006*** (0.001)
Liquidity	-0.037*** (0.006)	-0.050*** (0.008)	-0.033* (0.08)
Leverage	-0.167*** (0.000)	-0.160*** (0.000)	-0.155*** (0.000)
SIC4 Dummy	Yes	Yes	Yes
StateDummy	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes
Weight Matrix	W1	W2	W3
Observations	682	682	682

5.3. Relative Performance Evaluation Analysis.

After testing the strategic interaction form between public-traded insurers and their peer groups, the next step is to find if RPE exists in CEO compensation. The advantage of Spatial Durbin Model is that the coefficient of a spatial lagged exogenous variable no longer measures the marginal effect of one unit change in the exogenous variable of firm i on itself. The coefficient now measures the effect of one unit change in the spatial lagged exogenous variable of firms in the peer group of i on i. If this exogenous variable is performance and the dependent variable is CEO compensation. The coefficient can be interpreted as how the CEO compensation of one firm i is affected by the financial performance change of peer firms of firm i. In other words, this coefficient measure the effect of RPE in CEO compensation. The following three tables, 5a, 5b, 5c show the regression results based on three weight matrices. Since one insurer is not peer firm of itself and the weight on its own financial performance is zero. The variables *Slag. ROA, Slag. Lnassets,* and *Slag.Premiums* only indicate the financial performance of peer group. The coefficient of the three variables are the RPE coefficient, reflecting how financial performance of

the peer group affects CEO pay of the central firms. In the first two tables which use weight matrix 1 and weight matrix 2, we cannot find very strong effect on a firm's CEO pay of ROA change of peer firms especially after adding fixed effect and control variables. However, we can clearly see that while peer firms increase their premium or assets, an individual firm i will be increase its' CEO pay. The reason is that while peer firm become aggressive in premium writing, firm i will also modify its strategy and perform more aggressively to obtain premium. The strategic interaction increase the premium written of firm i and finally will increase CEO compensation. The table 5c shows the strongest positive effect of RPE regarding to ROA. If premium similarity is one of the most important standards to select peer firms (the definition of matrix 3) and firms with similar premium volume are the closest peers, then ROA increase of these peer firms will result in CEO compensation increase of firm i.

Table 5a: Relative Performance Measure Analysis Using Spatial Durbin Model. Dependent Variable: Total CEO Compensation. Weight Matrix=W1

Rho	**0.227*** **	**0.324*** **	**-0.107**	**0.138***	**0.116**	**-0.05**
	(0.001)	**(0.000)**	**(0.17)**	**(0.06)**	**(0.11)**	**(0.517)**
LnAssets	0.232***	0.218***	0.264***			
	(0.000)	(0.000)	(0.000)			
LnPremium				0.284***	0.291***	0.236***
				(0.000)	(0.000)	(0.000)
ROA	*5.500***		*4.237***	*3.010***		*4.706***
	(0.000)		(0.000)	(0.000)		(0.000)
Stock Return		*0.174***	0.104*		*0.148***	*0.103*
		(0.027)	(0.14)		(0.04)	(0.15)
CEO Age	-0.013***	-0.016***	-0.021***	-0.004	-0.007	-0.018***
	(0.003)	(0.001)	(0.000)	(0.260)	(0.114)	(0.007)
CEO Gender	0.657***	0.562***	0.720***	0.406**	0.359**	0.428***
	(0.000)	(0.002)	(0.000)	(0.018)	(0.038)	(0.008)
Liquidity			-0.130			-0.255
			(015)			(0.549)
Leverage			-0.288			0.60**
			(0.303)			(0.022)
Slag.LnAssets	**0.147*** **	**0.090***	**0.349*** **			
	(0.002)	**(0.069)**	**(0.000)**			
Slag.LnPremium				**0.117** **	**0.123** **	**0.400*** **
				(0.014)	**(0.011)**	**(0.000)**
Slag.ROA	***4.797*** **		*2.936*	*0.961*		***3.632****
	(0.005)		(0.159)	(0.554)		**(0.086)**
Slag.Stock Return		*0.194*	0.139*		*0.169*	*0.085*
		(0.122)	(0.347)		(0.158)	(0.570)
Slag.Liquidity			1.075*			0.134
			(0.088)			(0.832)
Slag.Leverage			-0.660			-1.577**
			(0.0518)			(0.016)
SIC4 Dummy	No	No	Yes	No	No	Yes
Year Dummy	No	No	Yes	No	No	Yes
Observations	682		682	682	682	

Note: Rho is the spatial coefficient.

Note: standard errors are in parentheses. ***, **, * indicate statistical significance at the 1, 5, 10 percent level, respectively.

Table 5b: Relative Performance Measure Analysis Using Spatial Durbin Model. Dependent Variable: Total CEO Compensation. Weight Matrix=W2

Rho	**0.185*** **	**0.264*** **	**-0.004**	**0.056**	**0.066**	**-0.02**
	(0.000)	**(0.000)**	**(0.399)**	**(0.294)**	**(0.21)**	**(0.654)**
LnAssets	0.317***	0.297***	0.317***	0.258***		
	(0.000)	(0.000)	(0.000)	(0.000)		
LnPremium					0.263***	0.263***
					(0.000)	(0.000)
ROA	*5.212***		*3.891***	*2.68***		*4.351***
	(0.001)		(0.000)	(0.001)		(0.000)
Stock Return		*0.152**	0.111*		*0.157***	*0.106*
		(0.052)	(0.119)		(0.03)	(0.13)
CEO Age	-0.01**	-0.014***	-0.018***	-0.02	-0.005	-0.018***
	(0.027)	(0.001)	(0.000)	(0.639)	(0.202)	(0.007)
CEO Gender	0.713**	0.628***	0.800***	0.435**	0.398**	0.464***
	(0.000)	(0.001)	(0.000)	(0.010)	(0.020)	(0.004)
Liquidity			-0.127			-0.320
			(0.679)			(0.295)
Leverage			-0.425			0.449
			(0.131)			(0.102)
Slag.LnAssets	**-0.011**	**-0.040**	**0.219*** **			
	(0.821)	**(0.437)**	**(0.000)**			
Slag.LnPremium				**0.172** **	**0.171*** **	**0.333*** **
				(0.000)	**(0.000)**	**(0.000)**
Slag.ROA	***3.762*** **		*1.583*	***2.467*** **		*1.603*
	(0.001)		(0.211)	**(0.019)**		(0.086)
Slag.Stock Return		*0.243***	0.155*		*0.191**	*1.603*
		(0.034)	(0.190)		(0.07)	(0.210)
Slag.Liquidity			0.903**			0.354
			(0.029)			(0.377)
Slag.Leverage			-1.38***			-1.372***
			(0.002)			(0.002)
SIC4 Dummy	No	No	Yes	No	No	Yes
Year Dummy	No	No	Yes	No	No	Yes
Observations	682		682	682	682	

Note: Rho is the spatial coefficient.

Note: standard errors are in parentheses. ***, **, * indicate statistical significance at the 1, 5, 10 percent level, respectively.

Table 5c: Relative Performance Measure Analysis Using Spatial Durbin Model. Dependent Variable: Total CEO Compensation. Weight Matrix=W3						
Rho	**0.146*** **	**0.215*** **	**-0.009* **	**0.101* **	**0.009* **	**-0.002 **
	(0.006)	**(0.000)**	**(0.09)**	**(0.066)**	**(0.076)**	**(0.973)**
LnAssets	0.244***	0.220***	0.294***	0.306***		
	(0.000)	(0.000)	(0.000)	(0.000)		
LnPremium					0.306***	0.267***
					(0.000)	(0.000)
ROA	*5.520***		*4.300***	*2.323***		*4.227***
	(0.001)		(0.000)	(0.004)		(0.000)
Stock Return		*0.238***	0.145*		*0.207***	*0.140**
		(0.003)	(0.14)		(0.006)	(0.06)
CEO Age	-0.01**	-0.012**	-0.019***	-0.002	-0.004	-0.013***
	(0.029)	(0.010)	(0.000)	(0.578)	(0.320)	(0.004)
CEO Gender	0.687***	0.576***	0.769***	0.389**	0.346**	0.471***
	(0.000)	(0.002)	(0.000)	(0.024)	(0.047)	(0.004)
Liquidity			0.007			-0.286
			(0.982)			(0.368)
Leverage			-0.283			0.547**
			(0.316)			(0.04)
Slag.LnAssets	**0.114*** **	-0.040	**0.292*** **			
	(0.006)	(0.437)	**(0.000)**			
Slag.LnPremium				**0.172** **	0.073	**0.239*** **
				(0.000)	(0.114)	**(0.000)**
Slag.ROA	***2.628*** **		***2.614*** **	***2.467*** **		**2.820** **
	(0.023)		**(0.030)**	**(0.019)**		**(0.026)**
Slag.Stock Return		*0.243***	-0.07		*0.005*	*-0.142*
		(0.034)	(0.439)		(0.951)	(0.182)
Slag.Liquidity			1.946***			1.025**
			(0.000)			(0.027)
Slag.Leverage			-0.339			0.008***
			(0.467)			(0.985)
SIC4 Dummy	No	No	Yes	No	No	Yes
Year Dummy	No	No	Yes	No	No	Yes
Observations	682		682	682	682	

Note: Rho is the spatial coefficient.
Note: standard errors are in parentheses. ***, **, * indicate statistical significance at the 1, 5, 10 percent level, respectively.

Briefly, in section 5.2, the spatial Durbin Model shows that public-traded firms and their peer groups are systematically strategic complements. After that, I test the existence of relative performance evaluation in CEO compensation and find that CEO compensation of a public-traded insurers are positively associated with ROA, assets and premium of peer firms. The results fully support Hypothesis 1a**:** CEO compensation sensitivity is *negative* related to peer performance if

public-traded insurers compete in strategic substitutes. The evidence also supports hypothesis 2: Insurers have more strategic interaction (both strategic substitute and strategic complements) with economic neighbors in the peer group disclosed.

6. Summary and Upcoming Work

In agent theory, relative performance measure is used to remove exogenous risk factors that CEOs cannot control, thus improving CEO incentive contracting efficiency. Recent studies use industrial organization theory to interpret RPE and advocate that RPE is associated with the strategic interaction forms. Due to the difficulty to distinguish between strategic substitutes and strategic complements, the evidence on this hypothesis is still scares. In this paper, I fill this gap by providing empirical evidence of the relationship between strategic interaction forms and RPE in CEO compensation. In particular, I use a relatively new but powerful methodology, spatial econometrics to build relevant peer group and test to the strategic interaction within each group. Although strategic substitutes may exist between firms, systematically, public-traded insurers are strategic complements. In addition, using spatial durbin model, I find evidence to support RPE in CEO compensation in the insurance industry. CEO pay is positively associated with financial performance of peer firms. The results support previous literature which believes that positive effect of RPE in CEO pay exists in a strategic complemental market.

The following step of this paper is to add rating data to the analysis and to find if firms would like to treat firms with higher rating as peer firms. Also, I will compare the effect of relative performance evaluation and effect of CEO pay comparison on CEO compensation.

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