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How Does Financial Firm's Diversification Affect Its Cost of Equity Capital: Evidence from the US P/L Insurance Market

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〈Abstract〉

This study focuses on how insurers' cost of equity capital can be affected by diversification type and its degree: product diversification, geographical diversification, and unrelated diversification. Overall, results show that insurers' cost of equity capital is not significantly related with product diversification and unrelated diversifications, rejecting hypotheses of the coinsurance effect, internal capital market, and agency costs whereas geographical diversification shows a significant and negative relationship with the cost of equity capital. In addition, firm type and concentration on personal business lines are found as significant factors which influence insurers' cost of capital. This study also provides interesting empirical evidence that the potential bias of the rate of return from infrequent trading becomes smaller when CAPM and FF3F betas are estimated, which is comparable to the study conducted by Cummins and Phillips (2005). This change implies that the financial market efficiency has improved.

Key Words: P/L Industry, Diversification, Costs of Equity Capital, CAPM, and FF3F
JEL Classification: D22, D24, G22

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Ⅰ. Introduction

From the perspective of economic theory, firm’s all business activities aim at maximizing firm value and profits. In this respect, insurers' diversification should be considered as an activity to improve firm value. In general, diversification brings several benefits such as economies of scope (Markides and Williamson, 1994), risk reduction (Cummins and Trainar, 2009), market power enhancement (Caves, 1981), efficiency improvement (Barney, 1997), and access to low cost of capital (Froot, Scharfstein, and Stein, 1994). However, diversification also carries several costs due to the cost of governance and monitoring, incentive degradation, and bureaucratic distortions (Riordan and Williamson, 1985). Therefore, firms have to seek the optimal level of diversification (Coase, 1937). Coase (1937) insists that the optimal strategy is achieved when the marginal benefit is equal to the marginal cost.

On the other hand, firm’s cost of capital is a return that investors require as compensations for their contributions of capital. If the return is not enough to satisfy investors’ expectation, investors will avoid borrowing their money. In the insurance market, the cost of capital may affect insurers' capital budgeting, pricing, and other applications. Therefore, the estimation of the cost of capital is very important. If the projection is incorrect, it may lead to the losses of the market share or market values (Cummins and Phillips, 2005).

One of initial studies on insurers' cost of capital is conducted by Launie (1971). Launie (1971) discusses whether the accounting data contained in the insurers' balance sheet could be construed in a conventional cost of capital framework. In addition, information asymmetry has been examined as a determinant of insurers' cost of capital by several studies. Loss reserve errors are used as a proxy of information risk in the insurance literature (e.g., Beaver, McNichols, and Nelson, 2003; Gaver and Peterson 2004; Eckles et al., 2011[1]). One of the recent studies on insurer's cost of capital is conducted by Eckles, Halek, and Zhang (2013). Eckles, Halek, and Zhang (2013) find that an accrual quality (information risk) is priced into debt capital, whereas there is no evidence that accrual quality is reflected to the equity capital.

Diversification may also reduce firm's cost of capital since the coinsurance effect among firm's business units can alleviate systematic risk (Elton et al., 2001; Almeida and Philippon, 2007; Hann, Ogneva, and Ozbas, 2013). However, there is little attention to the role of diversification as a determinant of insurer's cost of capital. Most prior literature seems to focus on production diversification only. That is, degrees of geographical diversification and relatedness between business units are not well dealt with. Without considering the effect of such diversification activities, empirical results might be biased (Singh et al., 2003; Low and Chen, 2004). Therefore, this study has a motination to examine whether insurer's cost of equity capital is reduced by diversification types and its degrees.

Overall, the empirical results show that the insurer's cost of equity capital can be more effectively reduced through geographical diversification than product diversification and unrelated diversification. In addition, the firm type and specific business concentration are significant factors, affecting insurers' cost of equity capital. Interestingly, there is empirical evidence that the financial market efficiency is improved since the bias of rate of return from the infrequent trading becomes smaller.

This paper is organized as follows. In Section 2, it suggests hypotheses

1) In finance literature, an earning quality is frequently used as a proxy of information asymmetry (e.g., Aboody, Hughes, and Liu, 2005; Francis et al., 2005).

about the effect of diversification on insurers' costs of equity capital. Section 3 describes methodologies and data set used for analyses. Moreover, empirical results and conclusions are provided in Section 4 and in Section 5 respectively.

Ⅱ. Hypothesis Development

To clarify the relationship between firm diversification and insurers' cost of equity capital, several hypotheses are suggested based on theories of coinsurance effect, internal capital market, and agency costs. Overall coinsurance effect and internal capital market theories expect a negative relation with insurers' cost of equity capital, whereas agency costs are expected to make insurers' cost of equity capital more expensive.

From the perspective of the coinsurance effect, diversification brings the reduction of the operating risk since aggregating business segments may decrease the variability of earnings for diversified firms (e.g., Lewellen (1971) ; Cummins, Phillips, and Smith (2001) ; Cummins and Trainar (2009)). In addition, the coinsurance effect will be prominent if business lines are less related (Rocca et al., 2009). In this respect, increases in the level of product diversification, unrelated diversification, and geographical diversification help to decrease insurer's earning volatilities, reducing firm risk. Therefore, more diversified firm’s required cost of capital is expected to be lower than less diversified firm’s.

Next, the internal market theory expects that diversification reduces the cost of capital by creating an internal capital market. When insurers raise funds from outside, insurers have to pay more since it is hard to evaluate firm’s actual value by outside investors due to the lack of firm transparency.

Therefore, investors require higher cost of equity capital in return for the risk from opaqueness. However, firms may reduce the burden of cost of capital. Once insurers diversify their business, they can access internal fund from new business at the cheaper price, enhancing transparency. In addition, an appropriate use of unutilized resources may help improve firm's overall efficiency, reducing the risk (Penrose, 1995). As a result, the theories of coinsurance effect and internal market suggest a negative relationship between diversification and insurers' cost of capital as shown in (H3-1a).

H3-1a (coinsurance effect and internal capital market) : *Insurers with a higher level of (product, geographical, unrelated) diversification have lower costs of equity capital than insurers with a lower level of (product, geographical, unrelated) diversification. (-)*

On the other hand, according to the perspective of agency theory, insurers' diversification may increase agency costs and overall firm risk, since diversification makes a firm more complex and complicated. For that reason, it is harder to monitoring firm business. In this situation, managers are less likely to align managerial interests with those of owners in a diversified firm (Liebenburg and Sommer, 2008). In addition, cross-subsidization between businesses may increase firm risk and default probability (Berger and Ofek, 1995). Therefore, H3-1b suggests a competing hypothesis.

H3-1b (agency cost) : *Insurers with a higher level of (product, geographical, unrelated) diversification have lower costs of equity capital than insurers with a lower level of (product, geographical, unrelated) diversification. (+)*

In order to capture the relationship between diversification and insurers' cost of equity capital without bias, it is reasonable to control factors such as firm type, size, personal, leverage, firm age, and reinsurance as control variables. Initially, firm size and firm age may affect firm's cost of capital. In general, larger firms are perceived to be safer (Sommer, 1996). Fama and French (1997) find that firms with larger capital tend to have lower cost of capital than firms with smaller capital. Moreover, larger firms are more likely to have larger risk pools than smaller firms (Berry-Stolzle et al., 2012). Therefore, it is reasonable that larger insurers pay lower costs of capital than smaller insurers (H3-2a). Furthermore, firms with longer business history tend to have larger firm size. Then, similar hypothesis could be suggested as shown in (H3-2b). However, the positive effect of firm size and firm age can be offset by agency cost since the increase of firm size makes firms more complex, accompanying agency costs. In addition, firm's diversification may increase the firm size. The competing hypotheses are suggested in (H3-2c) and (H3-2d).

H3-2a (firm size) : *Insurers with larger capitalization have lower costs of equity capital than insurers with smaller capitalization. (-)*
H3-2b (firm age) : *Insurers with longer history have lower costs of equity capital than insurers with shorter history. (-)*
H3-2c (firm size) : *Insurers with larger capitalization have higher costs of equity capital than insurers with smaller capitalization. (+)*
H3-2d (firm age) : *Insurers with longer history have higher costs of equity capital than insurers with shorter history. (+)*

Next, organization type may affect insurers' cost of equity capital. As suggested by prior literature, stock firms tend to have more powerful mechanism to control the agency problem (e.g., Fama and Jenson, 1983; Mayers and Smith, 1988 and 1990; Liebenberg and Sommer, 2008). Therefore, it is not surprising that mutual insurers in the P/L market have higher costs than stock insurers (Berger et al., 2000). This study focuses on two types of publicly traded firms: stock firms and combined firms. Both two types of firms are publicly traded and monitored by investors. However, combined firms seem to have more diversified opportunities, which cannot be estimated with product diversification, unrelated diversification, and geographical diversification in the P/L market. Although there is little attention to compare stock firm and combined firms, this study expects that the combined firms have lower cost of equity capital if other conditions are the same (H3-2e).

H3-2e : *Combined firms have lower cost of equity capital than stock firms. (-)*

Moreover, insurance is a useful financing tool, recovering the negative outcomes of risk. In general, insurance products help to reduce the need for the balance-sheet capital in a company and thus alleviate the financial distress costs. Therefore, purchasing insurance products alleviates firm's operating risk and required returns in the capital market (Wieczorek-Kosmala, 2012). This logic could be also applied to insurers, who purchase reinsurance policies. Reinsurance primarily manages insurers' risk that arises on the liability side of the property-liability insurers (Sommer, 1996). Therefore, by purchasing reinsurance products, primary insurer can reduce their overall financial risk, alleviating required cost of equity capital in the market.

H3-2f : *Insurers with a higher level of reinsurance usage have lower cost of equity capital than insurers with a lower level of reinsurance usage. (-)*

Last, it includes leverage and portion of commercial business lines in business as control variables for the following reasons. In the insurance market, leverage plays an important role in firm's operation for the relatively cheaper capital (Colquitt and Hoyt, 1997). In addition, leverage can be used as a proxy of firm's financial stability (Launie, 1971). Therefore, firms with higher leverage have to pay more costs of capital (H3-2g). On the other hand, insurers' risk could be affected by the ratio of concentrated business types: personal and commercial. The commercial business lines tend to be more complicated and riskier than personal lines. As a result, firms focusing more commercial lines are expected to pay more due to higher risk (H3-2h).

H3-2g : *Insurers with a higher level of leverage pay more cost of equity capital than insurers with a lower level of leverage. (+)*
H3-2h : *Insurers with a higher level of commercial lines have more cost of equity capital than insurers with a lower level of commercial lines. (+)*

Ⅲ. Methodology and Data

1. Measures of Diversification

As a determinant of insurers' cost of equity capital, this study considers three types of diversification : product diversification, geographical diversification, and unrelated diversification. In the insurance literature, Hirschman-Herfindahl Index (HHI) is widely used to estimate firm's diversification level (e.g., Mayers and Smith, 1994 ; Baranoff and Sager, 2003; Choi and Weiss, 2005). The value of HHI is between zero and one, and firm's business is more concentrated if the value is closer to one.

To measure the degree of product diversification (PDHHI), it categorizes business into 24 lines (see Appendix 1 for more details). Then, a degree of insurers' product diversification is measured based on Equation (1).

$$PDHHI_{kt} = \sum_{j=1}^{24} \left(\frac{NPW_{kjt}}{NPW_{kt}}\right)^2 \tag{1}$$

where NPW_{kjt} denotes net premiums written in line j=1… 24 for firm k in year t.

However, PDHHI represents a concentration level of product lines rather than a degree of diversification. Therefore, it uses a complement index PD as a measure of product diversification as shown in Equation (2). Then, an insurer with a higher value of PD has a more diversified business portfolio. Undiversified firms would take a zero value.

$$PD_{kt} = 1 - PDHHI_{kt} \tag{2}$$

Next, the degree of geographical diversification can be also measured with HHI. The National Association of Insurance Commissioners (NAIC) database provides the net premiums written by each state in the Exhibit of Premiums and Losses–State Page. This study divides geographical components into 58 states and protectorates. The value of geographical diversification HHI (GDHHI) for firm k in year t can be measured as shown in Equation (3).

$$GDHHI_{kt} = \sum_{j=1}^{58} \left(\frac{NPW_{kjt}}{NPW_{kt}}\right)^2 \tag{3}$$

where NPW_{kt} denotes net premiums written in state j=1⋯ 58.

Alike PD, the high value of GDHHI indicates that insurers' businesses are geographically less diversified. Therefore, a supplemental index GD for firm k in year t is suggested as shown in Equation (4). The value of GD ranges between zero and one. The higher value of GD indicates that insurers' businesses are geographically more diversified than other insurers with lower values. If an insurer operates business only in one state, the value of GD would be zero.

$$GD_{kt} = 1 - GDHHI_{kt} \tag{4}$$

Last, to measure the degree of unrelated diversification (RD), the approach of Berry−Stolzle et al. (2012) is used. In the prior literature, Bryce and Winter (2009) estimate an inter−industry relatedness index. Then, Berry−Stolzle et al. (2012) apply it in the P/L market to measure the degree of unrelated diversification. In addition, it uses relatedness scores suggested by Berry−Stolzle et al. (2012) (see Appendix. 2 for more details). Using the relatedness scores will not distort the overall results of this study because the relatedness scores are measured with samples including both hard and soft market conditions. Moreover, the relatedness between two product lines would not significantly vary by times. Then, the weighted average relatedness of business line (1 to 24) for insurer k in year t can be estimated based on Equation (5).

$$RD_{kit} = \left(\frac{\sum R_{ij} NPW_{kjt}}{\sum_{i \neq j} NPW_{kjt}}\right)^2 \tag{5}$$

where R_{ij} denotes the relatedness score between line and line, and NPW_{kjt} denotes net premiums written of insurer in year *t*.

Now, a degree of related diversification for insurer k in year t can be measured by adding all values of RD_{kit} multiplied by insurers' fraction of net premiums written across lines as following Equation (6).

$$RD_{kt} = \sum \left(\frac{NPW_{kit}}{Total\,NPW_{kt}} \right) \times RD_{kit} \tag{6}$$

In addition, to grasp the level of unrelated diversification, it uses a complement index, unrelated diversification (UD). The range of UD is between zero and one. The higher value of UD indicates that the insurer has more unrelated business lines. In addition, undiversified insurance companies would have a zero-value.

$$UD_{kt} = 1 - RD_{kt} \tag{7}$$

2. Measure of Cost of Equity Capital

There are several approaches to measure firm's cost of capital in prior literature. In this study, insurers' costs of equity capital are measured based on two approaches: capital asset pricing model (CAPM) and Fama-French three factor model (FF3F).

A. Capital Asset Pricing Model (CAPM)

CAPM is the most popular and traditional model measuring firm's cost of equity capital. The cost of equity capital in CAPM consists of risk-free rate and a market risk premium based upon systematic risk as follows.

$$COC_1 = E(r_{i,t}) = r_f + \beta_{m,i}(r_{m,t} - r_f) \tag{8}$$

where $r_{i,t}$ denotes the expected rate of return for firm i at time t,

r_f denotes the risk-free rate of return at time t,

$\beta_{m,i}$ denotes firm i' s beta coefficient for systematic market risk, and

$r_{m,t}$ denotes the market rate of return at time t.

To measure CAPM cost of equity capital, this study follows a two-stage model suggested by Cummins and Phillips (2005). At the first stage, returns on specific stock are regressed on a market risk factor in order to calculate the CAPM beta coefficients ($\beta_{m,i}$) for each firm as shown in equation (9). Then, estimated beta coefficients are inserted in equation (8) at the second stage.

$$r_{i,t} - r_f = \alpha_i + \beta_{m,i}(r_{m,t} - r_f) + \epsilon_{i,t} \tag{9}$$

In this process, an average one-month U.S. Treasury-bill rate for last 60 months is used as a proxy of risk-free rate. In addition, the value-weighted return on all New York Stock Exchange (NYSE), American Stock Exchanges (AMEX), and National Association of Securities Dealers Automated Quotations (NASDAQ) for last five years (60 months) is used as a proxy of the market rate of return.

Furthermore, this study adopts the sum-beta approach (Scholes and Williams, 1977) to capture the bias from the infrequent trading, as shown in Equation (10). The CAPM sum-beta coefficient, $\hat{\beta}_{m,i}$ is calculated by adding $\hat{\beta}_{m,i,0}$ and $\hat{\beta}_{m,i,1}$. Then, the estimated values of $\hat{\beta}_{m,i,0}$ and $\hat{\beta}_{m,i,1}$ are inserted into equation (11) to obtain another types of the CAPM cost of equity capital which considers bias from lack of trading.

$$r_{i,t} - r_{f,t} = \alpha_1 + \beta_{m,i,0}(r_{m,t} - r_{f,t}) + \beta_{m,i,1}(r_{m,t-1} - r_{f,t-1}) + \epsilon_{i,t} \tag{10}$$

where, $\beta_{m,i,0}$: Firm i's contemporaneous beta coefficient for systematic market risk,
$\beta_{m,i,1}$ Firm i's lagged beta coefficient for systematic market risk.

$$COC_2 = E(r_{i,t}) = r_f + \beta_{m,i,0}(r_{m,t} - r_{f,t}) + \beta_{m,i,1}(r_{m,t-1} - r_{f,t-1}) \tag{11}$$

B. Fama-French Three-Factor (FF3F) Model

The Fama-French three factors (FF3F) model is suggested to improve the explanation power of the model by including two more components: firm size and book-to-market equity ratio (Fama and French, 1993). These two additional factors have been proven as important components explaining the realized returns (e.g., Barber and Lyon, 1997; Wang, 2003). The basic form of FF3F is shown in Equation (12).

$$COC_3 = E(r_{i,t}) = r_{f,t} + \beta_{m,i,0}(r_{m,t} - r_{f,t}) + \beta_{s,i}\pi_{s,t} + \beta_{h,i}\pi_{h,t} \tag{12}$$

where, $\beta_{m,i}$ denotes firm *i*'s beta coefficient for the size factor,

$\pi_{s,t}$ denotes the expected rate of market risk-premium for the firm size,

$\beta_{h,i}$ denotes firm *i*'s beta coefficient for the book-to-market equity factor, and

$\pi_{h,t}$ denotes the expected market risk-premium for the book-to-market equity.

Like a CAPM model, it also uses the two-stage model to estimate insurers' cost of equity capital. At the first stage, returns on specific stock are regressed on three market risk factors, and FF3F beta coefficients for each firm are obtained based on Equation (13). At the second stage, the estimated FF3F beta coefficients are inserted in Equation (12).

$$r_{i,t} - r_{f,t} = \alpha_1 + \beta_{m,i}(r_{m,t} - r_{f,t}) + \beta_{s,i}\pi_{s,t} + \beta_{h,i}\pi_{h,t} + \epsilon_{i,t} \tag{13}$$

Furthermore, it considers the potential bias from the infrequent trading by setting the Equation (14) and Equation (15). The logic is the same as of Equation (10) and Equation (11). Here, the FF3F sum-beta is measured by summing $\hat{\beta}_{m,i,0}$ and $\hat{\beta}_{m,i,1}$.

$$\begin{aligned} r_{i,t} - r_{f,t} = \alpha_1 &+ \beta_{m,i.0}(r_{m,t} - r_{f,t}) + \beta_{s,i,0}\pi_{s,t} + \beta_{h,i,0}\pi_{h,t} \\ &+ \beta_{m,i,1}(r_{m,t-1} - r_{f,t-1}) + \beta_{s,i,1}\pi_{s,t-1} + \beta_{h,i,1}\pi_{h,t-1} + \epsilon_{i,t} \end{aligned} \tag{14}$$

$$COC_4 = r_{f,t} + \beta_{m,i,0}(r_{m,t} - r_{f,t}) + \beta_{s,i,0}\pi_{s,t} + \beta_{h,i,0}\pi_{h,t} + \beta_{m,i,1}(r_{m,t-1} - r_{f,t-1}) + \beta_{s,i,1}\pi_{s,t-1} + \beta_{h,i,1}\pi_{h,t-1} \quad (15)$$

Overall, four types of cost of equity capital are measured with the CAPM and FF3F models. COC1 and COC2 are measured based on the CAPM and COC3 and COC4 are estimated based on the FF3F model. In addition, both COC2 and COC4 capture the potential bias of the rate of return due to infrequent trading in the market. By comparing results with Cummins and Phillips (2005), it is possible to examine whether the market efficiency in the financial market has been improved.

3. Regression Model

In this study, it uses samples of publicly traded firms. However, it is not possible to directly compare the effect of diversification on insurers' cost of equity capital between diversified firm and non-diversified firm since most of these firms are already diversified. Instead, it examines the relationship between degree of diversification and insurers' cost of equity capital among (publicly traded) diversified firms based on the regression model in Equation (16).[2)]

2) A multicollinearity issue may distort the empirical results. However, multicollinearity seems not a big problem in my research. To check the multicollinearity among variables, I conducted variance inflation factor (VIF) test. If the value is larger than 10, the results can be distorted due to the multicollinearity problem. However, the values are less than 2 in all regression models. I also checked the correlations between PD and GD, PD and UD, and GD and UD. The correlations are −0.0000, 0.0119, and 0.0031 respectively. Moreover, all figures are not significant at the 10% significance level.

$$
\begin{aligned}
COC_{j,t}(\%) = {} & \beta_0 + \underset{(+/-)}{\beta_1 PD_{j,t-1}} + \underset{(+/-)}{\beta_2 GD_{j,t-1}} + \underset{(+/-)}{\beta_3 UD_{j,t-1}} \\
& + \underset{(+)}{\beta_4 Firm\,type_{j,t-1}} + \underset{(+/-)}{\beta_{5,} Firm\,size_{j,t-1}} + \underset{(-)}{\beta_6 Personal} \\
& + \underset{(-)}{\beta_7 Leverage_{j,t-1}} + \underset{(+/-)}{\beta_8 Firm\,Age_{j,t-1}} + \underset{(-)}{\beta_9 Reinsurance_{j,t-1}} + \epsilon_{j,t}
\end{aligned} \tag{16}
$$

According to the coinsurance hypothesis, the imperfect cash-flows among business segments may reduce earning volatility and operating risk. Therefore, a negative sign is expected in coefficient of PD. Moreover, both GD and UD are expected to have a similar (coinsurance) effect on insurers' cost of equity capital. The internal capital market theory also expects that diversification reduces demand funds from external financial market and improves firm efficiency by creating internal capital market. Therefore, a negative coefficient in each diversification supports hypothesis on theory of the internal capital market.

On the other hand, the agency costs or cross-subsidization may increase firm's default risk when it overwhelms the benefits of coinsurance effect. In this case, significant and positive coefficients of PD, GD, and UD would support the hypothesis on agency costs (H3-1b).

Moreover, the FF3F model implies that large firms have lower cost of equity capital. In addition, the older firms tend to be larger. In this situation, the coefficients of firm size and firm age are expected to be negative, supporting (H3-2a) and (H3-2b) respectively. However, the larger firms and older firms are more likely to confront agency problems. So, if the agency costs overwhelm the benefits from coinsurance effect and/or internal capital market, positive signs will be found in Size and Age respectively, supporting (H3-2c) and (H3-2d).

Next, diversification effect could be different by firm types. Although there is little attention to compare stock firms and combined firm, it is expected that combined firms have more opportunities to have more diversified business which cannot be measured with PD, GD, and UD. For this reason, the significant and positive coefficient supports that stock firms are more likely to have higher cost of equity capital than combined firms (H3-2e). Furthermore, as a risk financing tool, reinsurance helps reduce operating risk and financial distress, reducing insurers' cost of equity capital. Therefore, the negative coefficient of reinsurance supports (H3-2f). Last, the coefficients of leverage and commercial lines are expected to be positive since higher level of leverage and commercial line business may increase overall firm risk.

4. Data Selection

This study obtains data from two sources: NAIC annual statutory statement from 1996 to 2012 and Wharton Research Data Services (WRDS) from 1992 to 2012. Overall, NAIC data are used to estimate insurers' degree of diversification, firm age, firm size, reinsurance usage, and leverage, and portion of personal lines. On the other hand, data from WRDS are used for estimating insurers' beta and cost of equity capital. These two types of market data include both conditions of the soft market and hard market.

The initial data from NAIC database consist of 51,928 firm-year samples, of which 37,708 are affiliated and 14,420 are not affiliated. For the analysis, insurers reporting positive values of total direct premiums written and total admitted assets are included in order to ensure that insurance firms actively engage in their businesses. Then, affiliated insurance companies that belong to the same group are aggregated at the group level based on NAIC group codes because insurers' business strategies are more likely to be determined at the group level rather than individual level (Berger et al., 2000). Considering group and non-affiliated firms as units of observation is consistent with an approach of Lamm-Tennant and Starks (1993). In the case where multiple insurers are grouped as one unit, the organizational structures of the groups follow the largest insurers in the group based on the size of total assets (Shim, 2011). Then, it excludes observations if the ratio of reinsurance ceded to the sum of direct premiums written and reinsurance assumed is larger than one or smaller than zero due to the concern of ability to sustain their business. Then, the number of group-year sample is 20,266. However, this study focuses on analyzing the relationship between diversification and cost of equity capital. Therefore, the number of final sample is significantly smaller than initial one when publicly traded firms are only selected. The final sample contains only 511 group-year data from 1996 to 2012.

〈Table 1〉 Fama-French Factors (Monthly Average for Last 60 months)

Year	Market Excess Return	Size Factor	Book-to-Equity	Risk-Free Return
1996	0.0086	0.0006	0.0065	0.0034
1997	0.0115	-0.0012	0.0047	0.0037
1998	0.0135	-0.0056	0.0003	0.0040
1999	0.0172	-0.0030	-0.0046	0.0042
2000	0.0101	-0.0021	0.0011	0.0042
2001	0.0053	0.0015	0.0033	0.0040
2002	-0.0024	0.0029	0.0038	0.0034
2003	-0.0011	0.0098	0.0061	0.0028
2004	-0.0026	0.0084	0.0125	0.0022
2005	0.0007	0.0082	0.0081	0.0018
2006	0.0046	0.0050	0.0076	0.0019
2007	0.0088	0.0028	0.0034	0.0024
2008	-0.0032	0.0006	0.0033	0.0025
2009	-0.0004	0.0011	0.0018	0.0023
2010	0.0021	0.0034	0.0000	0.0018
2011	0.0007	0.0024	-0.0031	0.0011
2012	0.0031	0.0039	0.0000	0.0003

Note: 1) Fama-French and Liquidity Factors, Wharton Research Data Services (WRDS)

Furthermore, data on risk-free return, market return, size premium, and the book to equity premium for beta estimation are obtained from WRDS. More specifically, Fama French & Liquidity Factors (FFLF) in WRDS provides market excess return, size factor, book-to-equity, and risk-free return as shown in 〈Table 1〉. In addition, rates of return of specific firms are gathered from the center for research in security prices (CRSP) in WRDS. Because the beta estimates are measured using data for last 60 months, the sample period is from 1992 to 2012.

Ⅳ. Empirical Results

To examine the relationship between diversification and insurers' cost of equity capital, CAPM beta and FF3F beta on the market risk are measured based on Equation (9), (10), (13), and (14) in advance. 〈Table 2〉 describes the estimated coefficients and descriptive statistics. Especially, CAPM beta and sum-beta coefficients are in column 2 and column 3 respectively. FF3F beta and sum-beta coefficients are in column 4 and column 5. For better understanding, it compares the results with overall findings of Cummins and Phillips (2005). Then, it will give more direct implications how the insurance market condition has changed.

〈Table 2〉 shows that the CAPM beta tend to be smaller than the CAPM sum-beta for overall sample period. On average, the value of CAPM beta is 0.798. On the other hand, the value of CAPM sum-beta is 0.823. These trends are consistent with Cummins and Phillips (2005). Cummins and Phillips (2005) interpret this difference between CAPM beta and CAPM sum-beta as evidence that P/L insurers are affected by infrequent trading which leads to potential bias. Therefore, they insist that sum-beta approach should be considered to obtain insurers' accurate costs of capital. However, in terms of the FF3F model, the FF3F beta tend to be larger than FF3F sum-beta. The measured FF3F beta and FF3F sum-beta for sample period are 0.936 and 0.841 respectively. These are inconsistent with Cummins and Phillips (2005). Although different aspects are found in CAPM and FF3F, there is a similar trend that the gap between beta and sum-beta becomes smaller. It means that the bias from the infrequent trading has been reduced. Especially, the trend is prominent since 2008. Although the reason is not obvious, financial crisis in 2007-2008 can be one of possible reasons. Therefore, it can be deduced that the market efficiency has been improved.

〈Table 2〉 CAPM and FF3F Beta Coefficients and Descriptive Statistics (N=511)

	CAPM Coefficients		FF3F Coefficients	
Year	Model 1	Model 2	Model 3	Model 4
1996	0.689	0.674	0.853	0.800
1997	0.747	0.828	0.997	1.036
1998	0.793	0.871	1.101	1.139
1999	0.750	0.811	1.228	1.242
2000	0.542	0.512	1.242	1.050
2001	0.416	0.434	1.062	0.878
2002	0.399	0.426	0.912	0.776
2003	0.376	0.427	0.834	0.626
2004	0.455	0.578	0.807	0.634
2005	0.580	0.676	0.698	0.607
2006	0.760	0.926	0.747	0.829
2007	1.079	1.082	1.109	1.090
2008	1.004	0.926	0.941	0.787
2009	1.161	1.134	0.951	0.831
2010	1.074	1.070	0.866	0.784
2011	1.071	1.051	0.868	0.761
2012	1.041	1.015	0.842	0.723
Total	0.798	0.823	0.936	0.841

Variable	Mean	Median	SD
COC1(%)	0.529	0.281	0.555
COC2(%)	0.794	0.357	1.022
COC3(%)	0.799	0.582	0.813
COC4(%)	0.829	0.604	0.842
PD	0.590	0.661	0.266
GD	0.789	0.085	0.275
UD	0.166	0.156	0.093
Size	22.742	22.775	1.772
Personal	0.187	0.097	0.238
Leverage	1.812	1.761	0.743
Age	82.153	61.000	54.018
Reinsurance	0.143	0.093	0.144

Note: 1) The CAPM beta and sum-beta in model 1 and model 2 are measured based on Equation (11) and (12). The FF3F beta and sum-beta in model 3 and model 4 are estimated based upon the Equation (15) and (16). The sum-betas in Equation (12) and (14) are sum of the contemporaneous and lagged beta estimates. The betas in model 2 and model 4 consider the potential biases from infrequent trading in the market. COC1 and COC2 are monthly required cost of equity capital measured with the CAPM model based on Equation (10) and (13). COC3 and COC4 are monthly required equity capital estimated with the FF3F model based on Equation (14) and (17). An average 30 day T-bill rate for previous 60-months is used as a proxy of risk free return. The excess return on the market is measured with the value-weighted return on all NYSE, AMEX, and NASDAQ stocks minus the one-month T-bill rate for last 60 months. Product Diversification (PD) is equal to one minus the Herfindahl index of net premiums written across 24 business lines. Unrelated Diversification (UD) is equal to one minus weighted relatedness across insurers' underwriting portfolio. Geographical diversification (GD) is equal to one minus Herfindahl index of NPW written across 58 state and protectorates. Size is a natural logarithm of total assets. Personal is a proportion of net premiums written from personal lines to total net premiums written. Leverage is a proportion of equities to liabilities. Age is fiscal year minus year that insurer begins business.

Next, the results of regression on product diversification (PD), geographical diversification (GD), and unrelated diversification (UD) are shown in the 〈Table 3〉. Overall, product diversification and unrelated diversification do not have significant impacts on insurers' cost of equity capital, rejecting hypotheses on coinsurance effect, internal capital market, and agency costs in (H3-1a). These results are somewhat embarrassing inasmuch as both product diversification and unrelated diversification are significantly correlated with insurers' performance(Elango, Ma, and Pope, 2008). These unexpected results call into questions why these two types of diversification are insignificant to reduce insurers' cost of equity capital. However, at least, these results imply that the increased benefits from insurers' diversification are not directly from the lowered cost of capital itself. In addition, insurers' primary purpose of diversification is not for risk reduction (Berry-Stolzle et al., 2012). Therefore, investors in the market do not need to reduce the required cost of equity capital due to the effect of risk reduction from diversification.

On the other hand, geographical diversification is regarded as an important firm activity to reduce the cost of equity capital, supporting (H3-1a). For example, the regression results measured with the CAPM in column 2 and column 3 show that geographical diversification has a significant and negative relationship with the insurers' cost of equity capital at the 5% of significance level. Moreover, the FF3F model also partly supports the finding at the 10% of significance level. At least, market participants tend to perceive that geographical diversified firms are more stable and safer. Therefore, insurers can reduce the overall equity cost by increasing the degree of geographical diversification.

〈Table 3〉 Effect of Diversification on insurers' Cost of Equity Capital

		CAPM				FF3F			
		(1)		(2)		(3)		(4)	
	Expected Sign	COC1		COC2		COC3		COC4	
PD	±	0.103		0.192		0.264	**	0.135	
		(0.064)		(0.121)		(0.115)		(0.124)	
GD	±	-0.169	**	-0.311	**	-0.238	*	-0.206	
		(0.085)		(0.156)		(0.126)		(0.131)	
UD	±	0.068		0.190		-0.371		-0.479	
		(0.293)		(0.534)		(0.460)		(0.521)	
Firm Type	+	0.668	***	1.216	***	0.774	***	0.872	***
		(0.080)		(0.149)		(0.114)		(0.122)	
Size	±	-0.007		-0.004		-0.074	***	-0.033	
		(0.017)		(0.031)		(0.023)		(0.025)	
Personal	−	0.286	**	0.529	**	0.806	***	0.582	***
		(0.121)		(0.225)		(0.186)		(0.186)	
Leverage	+	0.023		0.042		0.146	***	0.147	***
		(0.036)		(0.067)		(0.047)		(0.052)	
Age	±	0.001		0.001		0.001		-0.001	
		(0.001)		(0.001)		(0.001)		(0.001)	
Reinsurance	−	0.319		0.526		0.671	*	0.482	*
		(0.195)		(0.361)		(0.267)		(0.263)	
Intercept		0.362		0.274		1.740	***	1.103	*
		(0.357)		(0.657)		(0.499)		(0.548)	
Adj. R-square		0.193		0.185		0.179		0.170	

Notes: 1) COC1 and COC2 are monthly required cost of equity capital measured with the CAPM model based on Equation (10) and (13). COC3 and COC4 are monthly required equity capital estimated with the FF3F model based on Equation (14) and (17). An average 30 day T-bill rate for previous 60-months is used as a proxy of risk free return. The excess return on the market is measured with the value-weighted return on all NYSE, AMEX, and NASDAQ stocks minus the one-month T-bill rate for last 60 months (see the appendix 3 for details). Product Diversification (PD) is equal to one minus the Herfindahl index of net premiums written across 24 business lines. Unrelated Diversification (UD) is equal to one minus weighted relatedness across insurers'underwriting portfolio. Geographical diversification (GD) is equal to one minus Herfindahl index of NPW written across 58 state and protectorates. Size is a natural logarithm of total assets. Personal is a proportion of net premiums written from personal lines to total net premiums written. Leverage is a proportion of equities to liabilities. Age is fiscal year minus year that insurer begins business.

2) ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

However, the size and age do not seem to be critical factors which affect the insurers' cost of equity capital. Although the coefficient of size in each regression shows negative sign supporting H3-2a, it is insignificant except the model of FF3F Beta. The coefficient of age in each regression is inconsistent and insignificant at the 10% of significant level.

Furthermore, firm type presents a significantly positive sign in both the CAPM and FF3F model, implying that stock firms are required to pay a higher cost of equity capital than combined firms if other conditions are equal. Therefore, this result supports H3-2e. Moreover, firms with higher level of personal line business are required to pay higher costs to investors at the 5% of significance level. Last, the leverage and reinsurance usage are significant factors only in the FF3F model.

Ⅴ. Conclusion

This study focuses on how insurers' cost of equity capital can be affected by diversification type and its degree in the US P/L market : PD, GD, and UD. To analyze the effect of diversification, it obtains data from NAIC and WRDS. The sample includes conditions of both soft market and hard market, and the number of final sample is 511.

Overall, the empirical results show that product diversification and unrelated diversification are not significant factors even though these factors have significant impacts on firm performance, whereas geographical diversification helps to reduce insurers' cost of equity capital. These results imply that market participants perceive geographically diversified firms more stable and safer, reducing the costs of equity capital. In addition, firm types and concentrated business types affect insurers' cost of capital. However, firm size and age seem not significant factors affecting the cost. This study also finds interesting empirical evidence that the potential bias of rate of return in the insurance market from the infrequent trading becomes smaller compared to results of Cummins and Phillips (2005), when sum-betas are measured with CAPM and FF3F models. This change implies that the financial market efficiency has been improved.

However, this study has several limitations. First, it examines the relationship between diversification and insurers' cost of equity capital with two standard CAPM and FF3F models. However, there are more approaches to estimate the cost of equity capital. For example, Kielholz (2000) utilizes the capital asset pricing model (CAPM) and discounted cash flow (DCF) analysis to obtain the cost of capital. Wen et al. (2008) utilize a Rubinstein-Leland (RL) model which considers the skewness of rates of return. Especially, Wen et al. (2008) suggest that the RL model is superior to the CAPM when the insurers' size is small and its returns are not symmetrical (skewed). Therefore, it needs to check the robustness when these approaches are applied. Second, the empirical results do not give more detailed explanations why only geographical diversification is significant, what makes the combined firms pay less cost of equity capital, and what makes the financial market more efficient. Therefore, such questions should be answered in future study. Third, this study focuses on the effect of diversification on the cost of equity capital only. However, it does not deal with the cost of debt capital. Therefore, it needs to consider both costs at once. Last, these implications are hard to directly apply for Korean insurance market where the business environment is totally different. Therefore, additional study resolving these problems should be conducted in the future.

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[Appendix 1] Category of Business Lines (based on Year 2012)

Product Group	Components	Line No.
Accident and Health	Group Accident and Health	#13
	Credit Accident and Health (group and individual)	#14
	Other Accident and Health	#15
Aircraft (all perils)	Aircraft	#22
Auto	Private Passenger Auto Liability	#19.1, 19.2
	Commercial Auto Liability	#19.3, 19.4
	Auto Physical Damage	#21
Boiler and Machinery	Boiler and machinery	#27
Burglary and Theft	Burglary and theft	#26
Commercial Multi-Peril	Commercial multiple peril	#5
Credit	Credit	#28
Earthquake	Earthquake	#12
Farmowners	Farmowners multiple peril	#3
Financial Guaranty	Financial guaranty	#10
Fidelity	Fidelity	#23
Fire and Allied lines	Fire	#1
	Allied lines	#2
Homeowners	Homeowners multiple peril	#4
Inland Marine	Inland marine	#9
International	International	#29
Medical Malpractice	Medical Malpractice–Occurrence	#11.1
	Medical Malpractice–Claims Made	#11.2
Mortgage Guaranty	Mortgage guaranty	#6
Ocean Marine	Ocean marine	#8
Other	Warranty	#30
	Aggregate write-ins for other lines of business	#34
Other Liability	Other liability—occurrence	#17.1
	Other liability—claims-made	#17.2
Products Liability	Products Liability–Occurrence	#18.1
	Products Liability–Claims Made	#18.2
Reinsurance	Reinsurance-nonproportional assumed property	#31
	Reinsurance-nonproportional assumed liability	#32
	Reinsurance-nonproportional assumed financial lines	#33
Surety	Surety	#24
Workers' Compensation	Workers' compensation	#16
	Excess workers' compensation	#17.3

Note: 1) Net Written Premium by line of business are obtained from the Underwriting and Investment Exhibit (Part 1-Premiums Earned) of NAIC annual statement.

[Appendix 2] Relatedness Scores

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Accident and Health	1																							
Aircraft	2	0.483																						
Auto	3	0.870	0.490																					
Boiler and Machinery	4	0.125	0.052	0.197																				
Burglary and Theft	5	0.081	0.030	0.139	0.005																			
Commercial Multi-Peril	6	0.784	0.459	0.939	0.184	0.144																		
Credit	7	0.738	0.304	0.682	0.091	0.050	0.610																	
Earthquake	8	0.194	0.108	0.285	0.027	0.020	0.291	0.146																
Farm Owners'	9	0.721	0.390	0.916	0.183	0.150	0.920	0.533	0.299															
Financial Guaranty	10	0.575	0.314	0.784	0.143	0.062	0.700	0.579	0.171	0.642														
Fidelity	11	0.279	0.152	0.415	0.057	0.021	0.359	0.218	0.074	0.320	0.392													
Fire and Allied Lines	12	0.738	0.415	0.924	0.203	0.184	0.928	0.575	0.346	0.932	0.656	0.329												
Homeowners	13	0.799	0.438	0.943	0.201	0.167	0.947	0.600	0.324	0.954	0.707	0.361	0.958											
Inland Marine	14	0.570	0.339	0.800	0.148	0.108	0.834	0.794	0.230	0.737	0.490	0.237	0.846	0.810										
International	15	0.359	0.293	0.515	0.120	0.038	0.488	0.256	0.114	0.437	0.297	0.137	0.496	0.494	0.326									
Mortgage Guaranty	16	0.691	0.374	0.891	0.180	0.093	0.840	0.592	0.210	0.782	0.880	0.504	0.802	0.843	0.600	0.394								
Medical malpractice	17	0.626	0.328	0.744	0.097	0.057	0.723	0.441	0.160	0.600	0.495	0.256	0.626	0.659	0.448	0.285	0.605							
Other Liability	18	0.720	0.442	0.910	0.161	0.112	0.901	0.586	0.238	0.829	0.675	0.343	0.863	0.876	0.660	0.424	0.803	0.819						
Ocean Marine	19	0.503	0.686	0.706	0.095	0.057	0.713	0.374	0.156	0.588	0.414	0.217	0.613	0.651	0.542	0.317	0.525	0.476	0.694					
Other	20	0.810	0.365	0.866	0.125	0.083	0.779	0.656	0.196	0.716	0.549	0.273	0.745	0.792	0.731	0.354	0.664	0.530	0.746	0.467				
Products Liability	21	0.431	0.290	0.636	0.065	0.042	0.590	0.337	0.124	0.494	0.375	0.193	0.509	0.556	0.366	0.240	0.463	0.578	0.632	0.477	0.415			
Reinsurance	22	0.755	0.527	0.864	0.132	0.090	0.793	0.501	0.205	0.716	0.614	0.271	0.771	0.793	0.556	0.494	0.734	0.609	0.801	0.482	0.644	0.424		
Surety	23	0.443	0.310	0.639	0.072	0.044	0.605	0.357	0.220	0.508	0.362	0.280	0.527	0.573	0.393	0.249	0.456	0.371	0.562	0.410	0.575	0.301	0.430	
Workers' compensation	24	0.850	0.477	0.948	0.178	0.124	0.936	0.662	0.258	0.886	0.735	0.381	0.895	0.909	0.723	0.476	0.866	0.799	0.912	0.736	0.808	0.670	0.813	0.602

Source: Berry-Stolzle et al. (2012)

다각화가 금융사의 자기자본비용에 미치는 영향: 미국 손해보험시장을 중심으로

최명훈*

〈요 약〉

본 연구는 미국의 손해보험사를 대상으로 다각화 유형 및 다각화 정도가 기업의 자기자본비용에 어떠한 영향을 미치는지 분석하고 있다. 본 연구를 위해 기업다각화를 상품다각화, 지역다각화, 그리고 관련다각화 등 세 가지 유형으로 구분하고, 다각화 정도는 허핀달-허쉬만지수(HHI)를 응용하여 산출하였다. 또한 기업의 자기자본비용은 자본자산가격결정모형(CAPM)과 Fama-French 3요인 모형(FF3F)을 통해 도출하였다. 연구의 결과는 다음과 같다. 첫째, 미국 손해보험 시장 내에서 상품다각화와 관련다각화는 보험사의 자기자본비용에 유의한 영향을 미치지 않는다. 이는 공동보험이론, 내부자본시장이론, 그리고 대리인이론 모두가 기각됨을 의미한다. 둘째, 상기의 결과와는 달리, 지역 다각화는 자본비용구조와 유의한 수준에서 음의 상관관계를 가진다. 셋째, 지역다각화 뿐 아니라 기업의 지배구조 및 주력 사업 분야의 특징 또한 기업의 자기 자본비용의 결정에 상당한 영향력을 가진다. 마지막으로, 본 연구는 주식거래의 부재에 따르는 편의(bias)로서 CAPM과 FF3F 모델에서 추정된 beta와 sum-beta의 차이(gap)가 시간이 경과함에 따라 줄어드는 것을 보여준다. 그리고 이러한 변화가 금융시장의 효율성 개선의 증거가 될 수 있음을 제시하고 있다.

핵심 주제어: 손해보험시장, 기업다각화, 자기자본비용구조, 자본자산가격결정모형, Fama-French 3요인 모형

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