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Hedging and Firm Value: Evidence from US Property-Liability Insurance Companies*

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This study examines the effect of derivatives hedging on firm value in US publicly traded property-liability insurance firms. We find that derivatives hedging is positively related to insurer's firm value. For non-hedging activities, derivatives usage is not found to significantly affect firm value. We also provide evidence that the positive effect of derivatives hedging on firm value is more pronounced for firms with a higher level of leverage and utilizing more reinsurance, and firms that are larger; however, the positive impact is weakened for firms that have more geographic concentration and a larger portion of long-tail lines.

Key words: Derivatives Hedging, Firm Value, Return on Assets(ROA)
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I. Introduction

This paper examines the effect of derivatives hedging on firm value in US publicly traded property-liability insurance firms. Financial derivatives have been widely used as a risk management strategy in insurance companies in an effort to efficiently manage a variety of risks. For example, property-liability insurers can transfer a part of catastrophic risk to capital markets through swap transactions, and insurers doing their business internationally can hedge against risk associated with foreign exchange rate fluctuations via derivatives. Furthermore, insurer's exposure to counterparty credit risk can be mitigated by utilizing derivatives such as credit default swap (CDS). Derivatives usage for hedging in the insurance sector has grown substantially over the last decades. For US property-liability insurance firms, the total notional value of derivatives increased from $32.2 billion to $104.2 billion over the period 2001-2015, and on average, over 60 percent of total notional value of derivatives use are for hedging purposes.

The effect of derivatives hedging on firm value has been widely studied in the literature. However, previous studies find the mixed results for the relationship between derivatives hedging and firm value. Prior literature has shown that corporate hedging can increase firm value by reducing the probability of bankruptcy and financial distress costs and by expanding debt capacity to utilize the debt tax shield (e.g., Smith and Stulz 1985; Froot et al. 1993; Graham and Rogers 2002). However, some studies find that hedging has negative impacts on the value of a firm and financial profitability (e.g., Fauver and Naranjo 2010; Fung et al. 2012; Altuntas et al. 2017).

Despite extensive research on the impact of derivatives hedging on firm value, very few studies have examined this issue in the insurance industry.[1]

The extant insurance literature suggests that a variety of factors, including capital structure, firm size, the degree of diversification, reinsurance demand, a proportion of long-tail lines, can substantially affect both derivatives use and firm value (e.g., Mayers and Smith 1990; Hardwick and Adams 1999; Pottier and Sommer 1999; Cummins et al. 2001). So far prior literature has studied separately the effect of derivatives use on firm value and the impact of various factors on the value of a firm. Given the importance of insurers' usage of derivatives in achieving their financial stability and solvency, the limited attention on this issue in the insurance industry is somewhat surprising. Therefore, we attempt to fill this gap by investigating how derivatives hedging affects firm value and how the impact of derivatives hedging on firm value varies depending on a variety of factors for US public property-liability insurers.

We compile a sample of US publicly traded property-liability insurance firms with 527 firm-year observations over the period 2000-2015. Particularly, insurance companies are required to report a detailed information on a specific purpose of derivatives use and derivatives transactions in their annual statutory financial statements. Therefore, insurance industry provides a good testing ground to analyze the effect of derivatives hedging on firm value in combination with various factors. Our empirical results are summarized below. We find that derivatives hedging is positively related to firm value, indicating that derivatives hedging is value-increasing, consistent with the

1) To our knowledge, the only study examining the issue is Altuntas et al. (2017), which finds that derivatives hedging is negatively related to firm value, and hedging mitigates the negative effect of cash flow volatility on firm value in publicly traded life insurance companies. Our study differs from Altuntas et al. (2017) in several ways. Besides focusing on the property-liability insurers, we explore the underlying channels behind the relationship between derivatives hedging and firm value.

findings of Graham and Rogers (2002) and Adam and Fernando (2006). We also provide evidence that derivatives usage is not significantly associated with firm value for non-hedging activities, implying that investors regard derivatives use for non-hedging purposes as unimportant. More importantly, our evidence shows that the effect of derivatives hedging on firm value can vary based on several factors for US public property-liability insurers. Specifically, we find that the positive impact of derivatives hedging on firm value is stronger for firms with a higher level of leverage and utilizing more reinsurance, and firms that are larger, but the positive impact is less pronounced for the firms that have more geographic concentration and a larger portion of long-tail lines.

This study contributes to the literature by first demonstrating the potential mechanisms of the effect of derivatives hedging on firm value in US public property-liability insurance companies. Considering the significant differences across insurers in capital structure, firm size, the degree of product and geographic diversification, portion of long-tail lines, and reinsurance demand, how derivatives hedging influences firm value in relation to these several factors is an important empirical question. We provide new evidence that derivatives hedging not only positively affects firm value by itself, but also the positive effect can change through various types of interaction effects. Therefore, our results help to clarify the mixed findings on the impact of hedging on firm value in existing studies. The rest of the paper proceeds as follows. The following section reviews the literature on the effect of derivatives hedging on firm value and formulates our hypotheses to be tested. Next, sample selection criteria, the methodology and empirical framework employed are discussed in Section 3. Section 4 provides the definitions of variables. Section 5 presents the descriptive statistics of the data and our empirical results. Section 6 concludes our paper with the summary of our main findings.

II. Literature Review and Hypothesis Development

1. Derivatives Hedging and Firm Value

The extant literature has provided the mixed and inconsistent results about the relationship between derivatives hedging and firm value. On one hand, Allayannis and Weston (2001) find that the use of foreign currency derivatives increases firm value. Graham and Rogers (2002) show that increased debt capacity and tax benefit from derivatives hedging result in a higher firm value. Adam and Fernando (2006) document that derivatives use help firms generate positive cash flows, thereby increasing shareholder value in gold mining companies. Carter et al. (2006) report that hedging activities are positively associated with firm value in the US airline industry. Perez-Gonzalez and Yun (2013) reveal that hedging with weather derivatives enhances firm value in US electric and gas utility companies.

In contrast, there are also some studies that refutes the hypothesis that hedging has a positive effect on firm value. For example, Tufano (1996) find no evidence that derivatives hedging maximizes shareholder value in the North American gold mining industry. Jin and Jorion (2006) show that derivatives hedging is not significantly related to firm's market value for US oil and gas producers. Nguyen and Faff (2007) report that the use of financial derivatives is negatively associated with firm value for large non-financial Australian firms. Fauver and Naranjo (2010) find that derivatives use negatively affects firm value when firms have a weak corporate governance.

For the insurance literature, Cummins et al. (2001) state that insurers can maximize firn value by keeping a low probability of insolvency through derivatives hedging. González et al. (2011) find that derivatives hedging is associated with value creation for Spanish life insurers. On the contrary, Fung et al. (2012) show that the use of credit default swap is negatively related to Tobin's Q and return on equity (ROE) for both life and property-casualty insurers. Altuntas et al. (2017) provide evidence that derivatives hedging reduces firm value in US publicly traded life insurance companies. In summary, it appears that there is no single dominating view about the effect of derivatives hedging on firm value. Given the two competing views, we formulate the following hypothesis:

Hypothesis 1: Derivatives hedging is positively or negatively related to firm value in property-liability insurance companies.

2. How Derivatives Hedging Affects Firm Value

In this section, we develop several hypotheses pertaining to how several factors have impacts on the relationship between derivatives hedging and firm value in US. public property-liability insurance firms. First, we examine the effect of capital structure on the relation between derivatives hedging and firm value. Froot et al. (1993) note that as firms having higher leverage face difficulty in raising external capital, they tend to use more derivatives to increase debt capacity. Wolf et al. (2017) document that highly leveraged firms benefit more from hedging with derivatives because hedging can help mitigate financial distress costs and probability of bankruptcy. Taken together, the above arguments and empirical findings suggest that the positive effect of derivatives hedging on firm value would be stronger for insurers with a higher level of leverage.

Next, we examine the effect of insurer size on the value of a firm. Two competing views exist regarding the impact of firm size on derivatives hedging and firm value. Cummins et al. (1997) report that large firms are more likely to hire managers who have expertise in managing hedging program, thus leading to a higher firm value. Aretz and Bartram. (2010) find that larger firms are more likely to hedge more than small firms because hedging displays substantial informational economies and economies of scale. Conversely, Warner (1977) provide evidence that firm size is negatively related to derivatives use, indicating that bankruptcy costs are less than proportional to firm size. Haushalter (2000) points out that smaller firms benefit more from derivatives hedging than large firms, since hedging helps small companies to reduce the bankruptcy costs and information asymmetries across investors. Therefore, we hypothesize that insurer size can affect the relationship between derivatives hedging and firm value, but we cannot predict the sign.

Previous studies have found that the degree of diversification can affect the relationship between derivatives hedging and firm value. Lin et al. (2007) contend that diversified firms are more likely to use derivatives to mitigate informational asymmetries, thus creating firm value. Pramborg (2004) document that hedging increases firm value for geographically diversified firms. However, Altuntas et al. (2017) state that geographic and line of business diversification can offer a natural hedge, suggesting that diversified firms are less prone to use derivatives. Brunzell et al. (2011) find that better diversified firms are less likely to utilize derivatives for hedging purposes. Thus, we expect that product line and geographic diversification have an influence on the relationship between derivatives hedging and firm value, but the sign is unclear.

Long-tail lines are lines of business for which losses may not be known for some period, and it takes a long period of time for the claims to be settled (e.g., general liability, directors and officers (D&O) liability, and workers' compensation). Cummins et al. (1997) find that property-casualty insurers having a larger portion of long-tail lines tend to use less derivatives because these insurers are heavily invested in long-term bonds and the long-tail liabilities can serve as a natural hedging against interest rate risk. Cummins et al. (2009) find that percentage of long-tail lines is found to be negatively related to firm performance. Therefore, we propose that a larger proportion of long-tail lines would weaken (strengthen) the impact of positive (negative) effect of derivatives hedging on firm value.

Prior literature suggests two conflicting arguments (i.e., complementarity and substitution) about the relationship between reinsurance and derivatives. Colquitt and Hoyt (1997) show that insurer's reinsurance purchase is positively related to the insurer's decision to use derivatives, indicating that reinsurance could serve as a signal that a firm is predisposed for hedging activities. Shiu (2011) finds evidence in supporting of the complementarity hypothesis in the U.K. life insurance industry. On the contrary, Hardwick and Adams (1999) find that derivatives usage is negatively associated with the extent of reinsurance in the U.K. life insurance industry. Cummins et al. (2001) mention that to the extent that underwriting risk and financial risk are correlated, reinsurance that limits the volatility of loss ratios can serve as a substitute for hedging with derivatives. According to the above arguments and empirical findings, the usage of reinsurance would affect the relationship between derivatives hedging and firm value, but the sign remains ambiguous. On the basis of the above arguments on the impact of several factors on the relationship between derivatives hedging and firm value, we propose the following hypothesis:

Hypothesis 2: Various factors have a substantial impact on the relationship between derivatives hedging and firm value in property-liability insurance companies.

Ⅲ. Data and Methodology

1. Data

We use a variety of databases to generate our sample. First, we use the Compustat database, which covers publicly traded insurance firms, to calculate firm value as measure by Tobin's Q. All other insurance company-specific data are obtained from the annual statutory statements filed with the National Association of Insurance Commissioners (NAIC). We utilize the data on derivatives hedging from the Schedule DB of annual statement from the NAIC. The insurance industry is highly regulated in the area of invested assets, and thus, property-liability insurers are mandated to report detailed information about their investment activities, including the identification of the purpose of derivative transactions in their financial statements.[2] To measure insurer's hedging activities, we only include the derivatives contracts reported as a hedging transaction in our sample. Our sample includes only publicly traded property-liability insurance companies, since the data on Tobin's Q is not

2) NAIC provides derivative trading data from 2000. Prior to 2010, the purpose of derivatives use had two categories, such as hedging and other. From 2010, Parts A and B of Schedule DB provide the different objectives of derivative instruments, including (1) Hedging Effective; (2) Hedging Other; (3) Replication; (4) Income Generation; (5) Other.

available for non-stock insurers. Thus, we use 527 insurer-year observations from 48 US publicly traded property-liability insurers over the period 2000-2015 to investigate the effect of derivatives hedging on firm value.

2. Methodology

We conduct regression analyses using a series of pooled, cross-sectional, and time-series data. The estimates of coefficients derived from OLS regression may be biased if there are some unknown variables or variables that cannot be controlled for that affect the dependent variable. To address this potential bias, we employ a two-way fixed effects model.3) Following Allayannis and Westo (2001), we utilizethe natural log of Tobin's Q as a dependent variable to deal with the skewness of the ratio. Given the cross-sectional and time-series data structure, the functional form of the two-way fixed effects model for the relationship between derivatives hedging and firm value is expressed using the following equation:

$$\begin{aligned} \text{In}(\textit{Tobin's } Q_{i,t}) = & \alpha_0 + \alpha_1 \textit{Hedging}_{i,t} + \alpha_2 \textit{Leverage}_{i,t} + \alpha_3 \textit{Size}_{i,t} \\ & + \alpha_4 \textit{ProdHHI}_{i,t} + \alpha_5 \textit{GeoHHI}_{i,t} + \alpha_6 \textit{Longtail}_{i,t} \\ & + \alpha_7 \textit{Reinsurance}_{i,t} + d_t + f_i + \varepsilon_{i,t} \end{aligned}$$

where i indexes the insurance company and t represents time (year), d_t is a vector of time fixed-effects, f_i is a vector of firm fixed-effects, and $\varepsilon_{i,t}$ is the error term. $Hedging_{i,t}$ is a measure of derivatives hedging (participation decision or volume of derivatives transactions).

3) We perform a Hausman test of the null hypothesis that the firm-specific error term is uncorrelated with the residuals to determine which model to use between fixed effects or random effects. The Hausman test rejects the null hypothesis for all the estimations, suggesting that the fixed effects model fits the data better.

Ⅳ. Variables

We use participating decision and volume of derivatives transactions as our key variables of interest. We follow the prior literature (e.g., Colquitt and Hoyt 1997; Cummins et al. 2001) to measure derivatives participation and the extent of derivatives transactions. First, participation decision of derivatives is defined as a binary variable. Derivatives participation is a dummy set to one if an insurer reports any derivatives trading as measured by notional amounts in year t. The extent of derivative transactions is measured by the volume of derivatives transactions in notional amounts of derivatives in year t divided by insurer's total admitted assets in year t.[4] For both measures of derivatives usage, we only use derivatives positions for hedging purposes.

Following the insurance literature on derivatives use and firm value (e.g., Cummins et al. 2001; Altuntas et al. 2017), we control for firm-specific characteristics such as insurer size, leverage, product line concentration, geographic concentration, proportion of long-tail line, and reinsurance demand in our regression analyses. Insurer size (*Size*) is defined as the natural log of net admitted assets. Leverage (*Leverage*) is computed as 1 minus the surplus-to-asset ratio. Product line concentration (*ProdHHI*) and geographic concentration (*GeoHHI*) are calculated by the sum of squares of value of net written premiums in line i or state i divided by total net written premiums, respectively. We compute the proportion of long-tail line (*Longtail*) as the premiums of long-tail lines divided by total net written premiums. For reinsurance demand (*Reinsurance*), we employ the ratio of reinsurance ceded

4) If notional amount is missing data from Schedule DB, notional amount for equity options is calculated by multiplying the number of contracts strike price by 100, and notional amount for bond options is estimated by multiplying the number of contracts by par value per contract(Cummins and Song 2008).

to total direct premium plus reinsurance assumed. As dependent variables, we utilize Tobin's Q as a market-based measure of firm value. Tobin's Q is a widely used measure in the literature on the impact of derivatives use on value of a firm (e.g., Jin and Jorion 2006; MacKay and Moeller 2007; Allayannis et al. 2012). We compute Tobin's Q by dividing market value of assets by the book value of assets, where market value of assets is estimated as the total assets plus market value of equity minus book value of equity. Market value of equity is calculated by multiplying the number of common shares outstanding by stock price at fiscal year-end. Following Daniel and Titman (1997), we estimate book value of equity as stockholder's equity + deferred taxes + investment tax credit - preferred stock. Table 1 summarizes the definition of all variables used in our regression models.

〈Table 1〉 Variable Definitions

Variable Description	Definition
Derivatives Participation	1= if an insurer reports any derivatives trading as measured by notional amounts in year t, and zero otherwise
Extent of Derivative Transaction	Volume of derivatives transactions in notional amounts of derivatives in year t scaled by insurer's total admitted assets in year t
Tobin's Q	(AT + ME - BE) / AT AT: total assets ME: market value of equity at year-end BE: book value of equity (stockholder's equity + deferred taxes + investment tax credit - preferred stock)
Return on Assets (ROA)	Earnings before interests and taxes (EBIT) divided by total admitted assets
Leverage	1 minus the surplus-to-asset ratio
Insurer Size	Natural log of net admitted assets
Product Concentration	Sum of squares of value of net written premiums in line i divided by total net written premiums

Geographic Concentration	Sum of squares of value of net written premiums in state i divided by total net written premiums
Long-tail Lines	Premiums of long-tail lines divided by total net written premiums
Reinsurance Demand	Ratio of reinsurance ceded to total direct premium plus reinsurance assumed

V. Result

1. Descriptive statistics

Table 2 reports descriptive statistics for the variables used in this study. The mean values of derivative participation and the volumes of derivatives transactions are 0.207 and 0.019 respectively. Cummins et al. (1997) shows that the participation rate of derivatives usage for US property-casualty insurers is about 7%. The reason for the difference in participation rate of derivatives use is that our sample includes only large publicly traded property-liability insurers that can afford large fixed starting up costs of hedging with derivatives, thereby utilizing more derivatives to hedge risks. The mean (median) value for Tobin's Q and ROA is 1.067 (1.035) and 0.023 (0.030), respectively. Leverage has a mean (median) of 0.631 (0.654). The mean of product and geographic concentration are 0.435 and 0.382, respectively, indicating that insurers in our sample hold more diversified product lines and are more geographically diversified. Finally, the majority of total net written premiums (67%) consists of longer tailed lines of business.

〈Table 2〉 Descriptive Statistics

Variables	N	Mean	Median	SD	Min	Max
Derivative Participation	527	0.207	0.000	0.405	0.000	1.000
Extent of Derivative Transaction	527	0.019	0.000	0.094	0.000	0.515
Tobin's Q	527	1.067	1.035	0.161	0.635	2.228
ROA	527	0.023	0.030	0.072	-0.832	0.328
Leverage	527	0.631	0.654	0.154	0.010	0.983
Size	527	20.900	20.912	2.027	15.648	24.587
Product Concentration	527	0.435	0.312	0.323	0.094	1.000
Geographic Concentration	527	0.382	0.150	0.485	0.034	1.000
Long Tail	527	0.674	0.765	0.299	0.000	1.000
Reinsurance	527	0.211	0.288	0.746	0.000	0.998

Note: This table reports the descriptive statistics of variables used in his study. See Table 1 for variable definitions.

Table 3 presents the results of univariate tests of the differences in mean and median values of variables between derivatives hedgers and non-hedgers. The results show that derivatives hedgers have a significant higher Tobin's Q and ROA than non-hedgers based on both mean and median values, implying that insurers using derivatives for hedging purposes tend to have greater firm value and financial profitability relative to non-hedging insurers. Derivative hedgers have higher level of leverage as compared to the non-hedgers, implying that firms having high debt ratios are more engaged in hedging activities. Lastly, derivatives hedgers are significantly larger and use less reinsurance than non-hedgers counterparts.

〈Table 3〉 Univariate Comparison of Derivatives Users and Non-users

Variables	Hedgers (N=109)		Non-hedgers (N=418)		Difference Tests	
	Mean	Median	Mean	Median	Mean T-test	Median Wilcoxon test
Tobin's Q	1.073	1.042	1.037	1.023	0.036***	0.019**
ROA	0.038	0.036	0.019	0.020	0.019***	0.016***
Leverage	0.641	0.651	0.587	0.595	0.054***	0.056***
Size	23.143	23.480	20.271	20.569	2.872***	2.911***
Product Concentration	0.287	0.282	0.254	0.253	0.033	0.029
Geographic Concentration	0.225	0.165	0.219	0.158	0.006	0.007
Long Tail	0.746	0.802	0.655	0.751	0.091	0.051
Reinsurance	0.242	0.249	0.312	0.314	-0.070***	-0.065***

Note: This table provides the results of univariate tests of the differences in mean and median values for derivatives users and non-users. Derivatives users are firm-year observations when Derivatives Participation =1, and non-users are firm-year observations when Derivatives Participation =0. See Table 1 for variable definitions.

2. Empirical Results

This section presents the results of the effect of derivative hedging on firm value. The estimates of the parameters from our two-way fixed effects regression of the relationship between derivatives hedging and firm value are presented in Table 4. Previous studies argue that the relationship between hedging and firm value could suffer from the problems of endogeneity. To check this possibility, we test for endogeneity by conducting a regression-based Hausman test.[5] In untabulated results, we do not reject the null hypothesis of exogeneity. Therefore, hedging variable is treated as exogenous in our fixed effects regressions. We use robust standard errors

5) Following Cummins and Song (2008) and Altuntas et al. (2017), we use determinants of insurer hedging, such as the percentage of total assets invested in stock and the percentage of total assets invested in bond as instrumental variables and perform the regression-based Hausman Test.

clustered by firm. Model 1 in Table 4 provides the estimations of parameters for the effect of participation decision of derivatives on firm value, as measured by Tobin's Q. The estimated coefficient on derivatives indicator variable is statistically significant and positive in Tobin's Q at the 10 percent level in Model 1. In model 2, in which volume of derivatives is an independent variable, we also find a significant positive relationship between derivatives hedging and Tobin's Q at the 5 percent level. These results suggest that derivatives hedging enhances shareholder value for public property-liability insurers. These results also indicate that investors value insurer's hedging with derivatives, and as a result, hedging activities improve the value of a firm, consistent with the findings of Adam and Fernando (2006). The hedging premium may be due to the fact that increased debt capacity and tax benefit from derivatives hedging lead to a higher firm value (Graham and Rogers, 2002). Another possible explanation is that insurers' hedging decisions are mainly motivated by maximizing shareholder value rather than by managerial risk-aversion,[6] and, thus derivatives hedging is beneficial to shareholders in property-liability insurance firms.

With regard to control variables in Table 4, leverage is significantly and negatively related to firm value, suggesting that insurers with a high level of leverage tend to have a lower firm value (Rajan and Zingales, 1995). Insurer size is positively associated with Tobin's Q, consistent with (Berger and Ofek, 1995). The coefficients on long-tail line of business are negative and significant at the 1 percent level, indicating that investors assign negative value to insurers having more long-tail lines of business because these business lines are related

6) Risk-averse, under-diversified managers have incentives to minimize their exposure to firm-specific risk (Stulz, 1984). Thus, if managers' risk aversion leads to hedging activities, it may reduce value of a firm.

to higher levels of uncertainty (Pottier and Sommer, 1999).

〈Table 4〉 Derivatives Hedging and Firm Value (Tobin's Q)

Model 1: Participation Decision		Model 2: Extent of Derivative Transaction
Dependent Variable: Tobin's Q		
Intercept	1.472*** (0.090)	1.407*** (0.076)
Hedging	0.038* (0.021)	0.341** (0.169)
Leverage	-0.150*** (0.049)	-0.130*** (0.048)
Size	0.021*** (0.005)	0.016*** (0.004)
ProdHHI	-0.029 (0.031)	-0.030 (0.031)
GeoHHI	-0.048 (0.132)	-0.070 (0.152)
Longtail	-0.091*** (0.023)	-0.101*** (0.024)
Reinsurance	-0.022 (0.179)	-0.017 (0.185)
Year-fixed Effects	Yes	Yes
Firm-fixed Effects	Yes	Yes
Observations	527	527
Adjusted R-squared	0.067	0.068

Note: The table reports the results of the effect of derivatives hedging on firm value (Tobin's Q). Robust standard errors clustered by firm are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively. See Table 1 for variable definitions.

Prior studies (e.g., Chernenko and Faulkender 2011) point out that the effect of derivatives use on firm value could be different for hedging vs non-hedging activities. Thus, we repeat our analysis for non-hedging activities to explore whether non-hedging activities have an impact on firm value. We use the volume of derivatives transactions as a dependent variable where an insurer reports that the purpose of derivatives use is not hedging.[7] The results in

Table 5 show that the coefficients of derivatives usage are not statistically significant in Tobin's Q for non-hedging activities. The lack of significance implies that investors consider the amounts of derivatives for non-hedging purposes as unimportant.

〈Table 5〉 Non-Hedging Derivatives Use and Firm Value (Tobin's Q)

Extent of Derivative Transaction	
Dependent Variable: Tobin's Q	
Intercept	1.381*** (0.077)
Derivatives Use	0.073 (0.180)
Leverage	-0.126** (0.050)
Size	0.002 (0.018)
ProdHHI	-0.016*** (0.004)
GeoHHI	-0.030 (0.031)
Longtail	-0.005 (0.012)
Reinsurance	-0.084*** (0.023)
Year-fixed Effects	Yes
Firm-fixed Effects	Yes
Observations	527
Adjusted R-squared	0.147

Note: The table reports the results of the effect of non-hedging derivatives use on firm value (Tobin's Q). Derivatives use is defined as the volume of derivatives transactions where the insurer reports that the purpose is not hedging. Robust standard errors clustered by firm are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively. See Table 1 for variable definitions.

7) Non-hedging activities means using derivatives for purposes other than hedging. The non-hedging activities are reported as Replication, Income Generation, Other in the Schedule DB of annual statement.

Next, our main question concerns how derivatives hedging is associated with firm value in relation to a variety of factors. To answer this question, we rerun our regressions by incorporating interaction terms between derivatives hedging and several factors, including leverage, insurer size, product line concentration and geographic concentration, a portion of long-tail line, and reinsurance demand. Table 6 reports the results. First, For the effect of derivatives hedging and capital structure on firm value, we add interaction term of derivatives hedging and leverage (*Hedging* × *Leverage*) to the regression models. Given the positive coefficient of derivatives hedging, a positive sign on the interaction term indicates that derivatives hedging increases firm value as insurers choose higher levels of leverage. In model 1 and 2 of Table 6, the coefficients of the interaction term *Hedging* × *Leverage* are significant and positive in Tobin's Q for participation decision at the 10 percent level and the volume of derivatives transactions at the 5 percent level, respectively. These results imply that firm value of hedging firms are higher when they have more leverage, suggesting that insurers with higher levels of leverage may benefit from derivatives hedging through the reduction of the financial distress costs and the increased net present value of the tax shield (Smith and Stulz 1985; Froot et al. 1993; Hahnenstein and Röder 2006). The results also indicate that investors tend to value hedging decision for firms with higher leverage in US property-liability insurance firms.

We find that the coefficient on the interaction term *Hedging* × *Size* in Tobin's Q is positive and significant at the 10 percent level for volume of derivatives transactions, implying that the positive relationship between derivatives hedging and firm value is stronger when firm size increases. This suggests that derivatives hedging is more beneficial for large insurance companies because larger insurance firms are more exposed to various risks,[8)] and thus derivatives hedging can help large insurers hedge their risks efficiently. The interaction terms of *Hedging* × *GeoHHI* is negatively associated with Tobin's Q for participation decision. This indicates that as the degree of geographic concentration (diversification) increases, the positive effect of derivatives hedging on firm value is less (more) prevalent in property-liability insurance firms.

We find that the interaction terms of *Hedging* × *Longtail* are significantly and negatively related to Tobin's Q for both participation decision and extent of derivatives, implying that high uncertainty associated with long-tail line of business may weaken the positive effect of derivatives hedging on firm value. Lastly, the coefficient on the interaction term *Hedging* × *Reinsurance* is significantly positive in Tobin's Q for the volume of derivatives hedging at the 5 percent level. This suggests that the positive impact of derivatives hedging on firm value is more pronounced for insurers using more reinsurance. A possible explanation of this result is that both derivatives and reinsurance help insurers to hedge risk, thus reducing the variance of the firm's value. This is consistent with the complementarity hypothesis by Colquitt and Hoyt (1997) and Shiu (2011).

Smith and Stulz (1985) report that hedging can impact the pre-tax financial profitability of the firm. Following this study, we employ the return on asset (ROA) as a dependent variable.[9] We repeat the same analysis in Table 4 using ROA as a measure of firm performance. The sample includes 26,121 firm-year observations for all US property-liability over the period 2000-2015. The results in Table 7 are very similar to those in Table 4. In Table 7, we find that both of derivatives hedging variables are significantly and positively related to

8) For example, large insurers doing business globally tend to have more exposure to foreign exchange risk than small domestic insurers.
9) We find qualitatively similar results with return on equity (ROE).

insurer's financial performance. These results suggest that insurers regard firm's pre-tax firm profits as a concern for hedging, and the potential benefits from derivatives hedging outweigh the costs associated with hedging activities.

〈Table 6〉 Interaction Effects of Derivatives Hedging and Various Factors on Firm Value (Tobin's Q)

Model 1: Participation Decision		Model 2: Extent of Derivative Transaction
Dependent Variable: Tobin's Q		
Intercept	1.481*** (0.086)	1.560*** (0.085)
Hedging	0.039* (0.020)	0.433** (0.164)
Hedging × Leverage	0.046* (0.026)	0.244*** (0.062)
Leverage	-0.143*** (0.051)	-0.134*** (0.045)
Hedging × Size	0.013 (0.011)	0.035* (0.019)
Size	0.018*** (0.005)	0.017*** (0.004)
Hedging × ProdHHI	-0.043 (0.035)	-0.034 (0.033)
ProdHHI	-0.030 (0.057)	-0.036 (0.031)
Hedging × GeoHHI	-0.059* (0.031)	-0.055 (0.047)
GeoHHI	-0.041 (0.123)	-0.056 (0.148)
Hedging × Longtail	-0.084** (0.041)	-0.307*** (0.088)
Longtail	-0.107*** (0.030)	-0.139*** (0.041)
Hedging × Reinsurance	0.038 (0.226)	0.091** (0.038)
Reinsurance	-0.022 (0.016)	-0.024 (0.070)
Year-fixed Effects	Yes	Yes

Firm-fixed Effects	Yes	Yes
Observations	527	527
Adjusted R-squared	0.425	0.497

Note: The table reports the results of the effect of derivatives hedging on firm value (Tobin's Q). Robust standard errors clustered by firm are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively. See Table 1 for variable definitions.

〈Table 7〉 Effects of Derivatives Hedging and Firm Performance (ROA)

Model 1: Participation Decision		Model 2: Extent of Derivative Transaction
Dependent Variable: ROA		
Intercept	-0.071*** (0.009)	-0.062*** (0.009)
Hedging	0.012*** (0.004)	0.113*** (0.031)
Leverage	-0.094*** (0.005)	-0.092*** (0.005)
Size	0.009*** (0.002)	0.007*** (0.002)
ProdHHI	-0.008*** (0.002)	-0.007*** (0.001)
GeoHHI	-0.012 (0.031)	-0.014 (0.026)
Longtail	-0.015 (0.014)	-0.013 (0.012)
Reinsurance	-0.005 (0.006)	-0.002 (0.009)
Year-fixed Effects	Yes	Yes
Firm-fixed Effects	Yes	Yes
Observations	26,121	26,121
Adjusted R-squared	0.017	0.016

Note: The table reports the results of the effect of derivatives hedging on firm performance (ROA). Robust standard errors clustered by firm are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively. See Table 1 for variable definitions.

Ⅵ. Conclusion

Using a sample of US publicly traded property-liability insurers over the period 2000-2015, we examine the effect of derivatives hedging on firm value. Our evidence shows that derivatives hedging enhances a value of firm value, but we find no significant relationship between derivatives usage and firm value for non-hedging activities. More importantly, we explore how derivatives hedging affects firm value in relation to a variety of factors. Specifically, our evidence suggests that firm value of hedging firms are higher when insurers have more leverage. Also, we find that the positive effect of derivatives on firm value is more pronounced for firms utilizing more reinsurance, and firms that are larger, but the positive impact is weakened for the firms that have more geographic concentration and a larger portion of long-tail lines. These results indicate that the impact of derivatives hedging on firm value vary depending on various factors in US property-liability insurance firms. Taken together, our findings provide new insight into the potential mechanisms for the effect of derivatives hedging on firm value in the insurance sector. Therefore, our findings have important implications for regulators, various stakeholders, and insurers themselves as they consider derivatives hedging strategies to reduce or prevent insurer insolvency.

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요 약

본 논문은 미국 손해보험회사에서 파생상품을 이용한 헤지가 기업가치에 미치는 영향을 분석하였다. 분석결과 파생상품 헤지는 보험회사의 기업가치와 통계적으로 유의한 양(+)의 상관관계가 나타난 반면, 헤지 목적이 아닌 파생상품의 거래에 대해서는 기업가치와 유의한 상관관계가 나타나지 않았다. 또한 파생상품을 이용한 헤지와 기업가치 간의 양(+)의 관계는 규모가 크고 높은 레버리지를 가지며 재보험을 더 많이 이용하는 보험회사일수록 크게 나타났으며, 지리적으로 사업이 집중되어 있고 보험 사고의 발생시점과 보험금 지급시점 간의 시차가 긴 롱테일 종목(Long tail line)의 비중이 높은 회사일수록 약하게 나타난다는 사실을 발견하였다.

※ **국문 색인어**: 파생상품 헤지, 기업가치, 총자산이익률(ROA)