Organizational Structure, Board Composition and Derivative Usage in the U.S. Property Casualty Insurance Industry

Abstract

This paper examines the impact of organizational structure and board composition on derivative usage in the U.S. property casualty insurance industry from 2000 to 2014. The results of this paper show that stock insurers are more likely to increase probability of participation and volume of derivatives activities for the within-year than mutual insurers. In terms of board composition, insurers with CEO/Chairperson duality tend to decrease the probability of derivative participation. The evidence also shows that insurers with large board size and big 4 auditor are more likely to decrease probability of derivative participation and engage in lower volume of derivatives activities. Examination of the impact of the Sarbanes-Oxley Act (SOX) on derivatives indicates that insurers with CEO/Chairperson duality and big 4 auditor are more likely to decrease derivatives usage after SOX. After financial crisis, insurers with high percentage of insider directors on the board and big 4 auditor tend to engage in lower volume of derivatives. Finally, we find that stock insurers with reinsurance are more likely to decrease probability of participation and volume of derivatives than mutual insurers with reinsurance. The overall results show that organizational structure and board composition have impact on insurers' derivatives usage.

Keywords: Organizational Structure, Board Composition, Derivative Usage, Reinsurance, Sarbanes-Oxley Act, Financial Crisis

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1. Introduction

The purpose of this paper is to examine the insurer's derivative usage in relation to organizational structure and board composition in the U.S. property casualty insurance industry. There has been a dramatic increase in insurer's derivative activities in the last decade. A survey of International Swaps and Derivatives Association (ISDA) reports that "approximately 90% states derivatives instruments are important risk management strategy" on April 2015.[1] According to a special report of NAIC (2015)[2], the U.S. insurance industry's use of derivatives continued to grow in 2014. The total notional value of insurance industry derivative position increased from $1.854 trillion to $2.015 trillion from 2013 to 2014. The report shows that life insurers accounted for approximately 94% of total industry notional value and property casualty insurers accounted for only 6%. The derivative instruments types include Swaps (49%), Options (45%), Futures (3%), and Forwards (3%) in 2014 (Appendix 1 and Figure 1). In general, the purposes of derivatives used for hedging include interest rate risk, equity market risk, foreign exchange risk and credit risk (Appendix 2 and Figure 2).

Different topics related to corporate derivative usages examined include: financial distress (e.g., Gunther and Siems, 1995[3] and Cummins et al., 1997, 2001), tax incentive (e.g., Colquitt and Hoyt, 1997; Cummins et al., 1997, 2001), economics scales hypotheses (e.g., Colquitt and Hoyt, 1997; Cummins et al., 1997, 2001; De Ceuster et al., 2003), and reinsurance (Shiu, 2011; Lantara and Takao, 2014; Shiu,

[1] http://www.naic.org/capital_markets_archive/150826.htm

[2] NAIC Capital Market Bureau provide some special reports that insurance companies use derivative instruments information since June 2011. http://www.naic.org/capital_markets_archive/150807.htm (published Nov. 18, 2015)

[3] Gunther and Siems (1995) discuss the relation between the derivatives usage and the capital structure in the U.S. banks.

2016).[4]

The property casualty insurance industry exists two vital organizational structures including mutual and stock forms. The agency conflicts of stakeholders are different for the different organizational structures. Stock insurers may be motivated to engage in riskier activities to use more derivatives than mutual insurers to maximize stakeholders' wealth (e.g., Colquitt and Hoyt, 1997[5]; Cummins et al., 2001[6]; Lantara and Takao, 2014). In contrast, mutual insurers may use more derivatives than stock insurers because managers of mutual firms are more likely to use derivatives to hedge their risk (Hardwick and Adams, 1999[7]; and Shiu, 2007[8]). This paper examines the impact of organizational structure on derivative usage to provide addition insight on which organizational structure form uses more derivatives.

Corporate governance mechanism plays an importantly role in all types of industries, especially, financial firms because they sell promises not fiscal products. There are two main categories of corporate governance: internal corporate governance (e.g., CEO/Chairperson duality, board size, independent directors on the board, managerial compensation, and insider ownership) and external corporate governance (e.g., takeover market, ratings, legal environment, and regulations).

[4] The use of derivatives are examined in the different countries, such as the U.S. and Canada (Doinne and Triki, 2013; Doinne et al., 2015), Germany (Bodnar and Gebhardt, 1998), U.K. (Hardwick and Adams, 1999; Shiu, 2007, 2011), New Zealand (Mallin et al., 2001), Australia (Nguyen et al., 2002; De Ceuster et al., 2003), Belgium (De Ceuster et al., 2000), Japan (Heaney et al., 1999) and Taiwan (Shiu et al., 2010).

[5] Colquitt and Hoyt (1997) indicate that stock insurers are more likely to use derivatives than mutual insurers when studying the determinants of life insurers' derivatives usage (futures and options) of the Georgia Commissioner of Insurance in Atlanta in 1992

[6] Cummins et al., (1997, 2001) extend the study of Colquitt and Hoyt (1997) including organization forms and use several types of derivatives (e.g., options, swaps and futures) to examine decisions of derivatives participation and volume in 1994.

[7] Hardwick and Adams (1998) investigate the relation among organizational form, some firms' characteristics and financial derivatives use in the U.K. life insurance companies in 1995.

[8] Shiu (2007) discusses the determinations of derivative usage including organization structure, reinsurance, and firm size in the U.K. general insurance industry from 1994 to 2002.

Corporate governance mechanism is designed to reduce the agency costs between ownership and management (Welker, 1995). A few studies examine the relation between corporate governance mechanism and derivative usage (Allayannis et al., 2003[9]; Borokhovich et al., 2004[10]; Marsden and Prevost, 2005; Dionne and Triki, 2013; Dionne et al., 2015[11]; and Kim and Kim, 2015[12]). The literature above examine the relation in the nonfinancial industries, the banking industry, and gold mining industry. But the literature does not examine the relation between corporate governance and derivative usage in the U.S. property casualty insurance industry.

Instead of looking at one single corporate governance measure (i.e., outside directors on the board), this study constructs more comprehensive corporate governance (especially for board composition) which includes CEO/Chairperson of the board duality, board size, percentage of insider directors on the board, and Big 4 auditor firms to investigate whether affect derivative usage. For example, Borokhovich et al., (2004) argue that outside directors take an active role in interest rate derivatives usage and firms adopt hedging behavior in the stakeholders' interests. Marsden and Prevost (2005) suggest that firms with higher proportion of outside directors are less likely to use financial derivatives after the new 1993 Companies Act in the listed New Zealand companies in 1994 and 1997. With respect to the issue

[9] Allayannis et al., (2003) examine the impact of currency derivatives on firm value (measured as Tobin's Q) when using sample of foreign firms that are cross-listed on a major U.S. exchange (e.g. level II and level III ADRs) between 1990 and 1999. They find that firms with strong corporate governance (both the firm-and country-level) are more likely to use currency derivatives to hedge. Corporate governance data are disclosed in two sections: Item 4 and Item 10.

[10] Borokhovich et al., (2004) find that a positive relation between outside directors and derivatives in 284 nonfinancial firms of the S&P 500 in 1995. They argue that outside directors take an active role in interest rate derivatives usage and firms adopt hedging behavior in the stakeholders' interests.

[11] Dionne and Triki (2015) discuss that independence and financial knowledge of directors on risk management and firm value in the gold mining industry. They suggest that the independence of directors matters in explaining the effect of financial knowledge on hedging activities.

[12] Kim and Kim (2015) show that firms with strong corporate governance mechanism are more likely to use more derivatives for hedging activities in Korea. Corporate governance score is measured by Korean Corporate Governance Index (KCGI) on a survey from the Corporate Governance Service (CGC).

between board composition and derivatives usage in the insurance industry, the literature focused on the U.S. insurance industry is very limited with one exception. Cummins et al., (2001) point out the future research suggestions such as board composition, compensation plans and distribution of stock ownership related to derivatives.[13] Following suggestion of Cummins et al., (2001), this paper expected to fill the gap in the literature in the U.S. property casualty insurance industry. In other words, we utilize the long sample period from 2000 to 2014 to drawn from the U.S. property casualty insurance industry rather than short period. For example, Cummins et al., (1997, 2001) focus on 1994 data while Colquitt and Hoyt (1997) use 1992 data in Atlanta.

Several large financial scandal (e.g., Enron, Worldcom, Tyco International) resulting from lack of rigorous board composition were found to have resulted in the regulatory reforms (e.g., SOX of 2002). Following the spirit of the SOX Act (2002), we expect that board composition provide monitoring and advisory functions with respect to the insurers' derivatives usage. We investigate whether SOX would have impact on the relation between board composition and derivative usage.

Moreover, derivatives have been blamed as one key factor of 2008 – 2009 Financial Crisis. According to the finding of Harrington (2009), derivatives trading had actively grown until the Financial Crisis, resulting in intensified financial regulations. Specifically, the rapid collapse of AIG [14] results from reckless derivatives positions. Dodd-Frank Wall Street Reform and Consumer Protect Act (Dodd-Frank Act) was signed into law in 2010. Among many regulations,

[13] Please see page 87.

[14] American International Group (AIG) had issued the huge amount of credit default swap contracts (CDS, a type of derivative) to public. AIG required to add collateral to satisfy requirement when rating becomes downgraded. However, AIG suffered a liquidity problem because it's not enough cash to satisfy collateral requirement. The U.S. government provide $85 billion to solve AIG problems in mid-September 2008.

Dodd-Frank Act enacts comprehensive regulation of financial markets including increased transparency of derivatives. Hence, this paper also investigates the relation between board composition and derivatives usage before and after Financial Crisis.

This paper examines the organizational structure, board composition and derivatives usage in the U.S. property casualty insurance industry using 15 years of longitudinal data (2000 to 2014). To our best knowledge, this paper is probably the first to consider board composition on derivative usage by using the U.S. insurance firm-year observations. The results of this paper show that stock insurers are more likely to increase probability of participation and volume of derivatives activities for the within-year than mutual insurers. In terms of board composition, insurers with CEO/Chairperson of the board duality tend to decrease probability of derivative participation. The evidence also shows that insurers with large board size and big 4 auditor are more likely to decrease probability of derivative participation and engage in lower volume of derivatives activities. Examination of the impact of the Sarbanes-Oxley Act (SOX) on derivatives indicates that insurers with CEO/Chairperson of the board duality and big 4 auditor are more likely to decrease derivatives usage after SOX. After financial crisis, insurers with high percentage of insider directors on the board and big 4 auditor tend to engage in lower volume of derivatives. Finally, we find that stock insurers with reinsurance are more likely to decrease probability of participation and volume of derivatives than mutual insurers with reinsurance. The overall results show that organizational structure and board composition have impact on insurers' derivatives usage.

Our study stands out in several ways. First, this paper is the first to examine the impact of organizational structure including stock insurers and mutual insurers and board composition on participation (volume) of derivatives, respectively in the U.S.

property casualty insurance industry. Second, this paper provides more comprehensive board composition variables (i.e., CEO/Chairperson of the board duality, board size, insider directors on the board, and Big 4 auditor firms) in the U.S. property casualty insurance industry. Prior studies only examine one board composition variable, independent director on the board. Finally, no research has been done on the interaction terms of derivative usage related to board composition in the context of the SOX (2002) Act and Financial Crisis.

The paper is organized as follows: at first we present the hypothesis development and the data and methodology are described in next Sections.

Hypotheses Development

Based on the above discussions, we develop the following testable hypotheses to examine organizational structure and board composition in relation to derivative usage.

Organizational structure and derivative usage

Managers of stock organizational structure will engage in more complex activities, because stock insurers for controlling managers are more effective than mutual insurers. Previous studies have noted that stock insurers are more exposed to risk than mutual insurers (Colquitt and Hoyt, 1997; Cummins et al., 2001; and Cummins and Song, 2008). For example, Colquitt and Hoyt (1997) find that stock insurers are more likely to employ derivatives than mutual insurers based on managerial discretion hypothesis (Mayers and Smith, 1988). Cummins and Song (2008) suggest that stock insurers are more likely to use derivative participation and engage in higher volume of derivative. Lantara and Takao (2014) also find stock organization forms are positively and significantly related to derivative usage.

On the contrary, mutual organizational form merge the owner and policyholder

functions. Mutual insurers have limited management mechanisms for owners to control manager. Thus, mutual managers tend to have lower risk based on their job security, implying that managers of mutual insurers are more likely to use derivative than managers of stock insurers. Hardwick and Adams (1999) indicate that mutual insurers are more likely to use more derivatives than stock insurers. Shiu (2007) suggests stock insurers use less derivatives than mutual insurers. The literature about whether stock insurers are more likely to use derivatives than mutual insurers is not conclusive. We thus suggest:

Hypothesis 1: Organizational structure is not related to derivative usage in the U.S. property casualty insurance industry.

CEO/chairperson of the board duality and derivative usage

Belkhir (2006) indicates a manager may be more conservative behavior and want to protect his job. This expect that a CEO would be inherently cautious based on individual human capital in the company. Moreover, Bebchuk et al., (2009) suggest that CEOs playing the dominant roles and they tend to make more risk-averse decisions. Pathan (2009) provides that a CEO has more power to influence any decisions of board and take lower risk because managers have un-diversifiable wealth including human capital and comparatively fixed salary. This implies that insurers with CEO/chairperson of the board duality are more likely to decrease probability of participation of derivative than insurers without duality. However, Dionne and Triki (2013) argue that CEO/Chairperson duality is insignificant related to hedge decision when using the delta percentage as the hedge variable in the gold mining industry. The relation between CEO/chairperson of the board duality and derivative usage is not clear. This leads to the following null hypothesis:

Hypothesis 2: CEO/chairperson of the board duality is not related to derivative usage in the U.S. property casualty insurance industry.

Board size and derivative usage

Prior research suggests that larger boards are less effective in monitoring function because they have more coordination and communication problems when board sizes increase (e.g., Lipton and Lorsh, 1992; Yermack, 1996; Cheng, 2008). Derivative instruments are more complex transactions than other investment projects, implying that insurer with large board size are more likely to decrease probability of participation. Conversely, Xie et al., (2003) find that large board sizes may be more effective in monitoring financial reports because directors of the board with relevant and complementary knowledge and experiences. Tai et al., (2014) suggest that board size are significantly and positively related to firm's hedging activities in the S&P 500 non-financial firms. In others words, insurers with large board size are more likely to increase derivative usage. The relation between board size and derivative usage is not clear. This leads to the following null hypothesis:

Hypothesis 3: Board size is not related to derivative usage in the U.S. property casualty insurance industry.

Insider (executive director) director percentage and derivative usage

Whidbee and Wohar (1999) argue that firms with higher percentage of outside directors on the board are associated with higher derivative usage when insider holdings small equity stakes (below 10%) in the banking industry.[15] Borokhovich et al., (2004) find that firms with higher proportion of outside directors on the board are more likely to use interest rate derivatives in the U.S.[16] Tai et al., (2014) also note

[15] There are 175 publicly traded bank holding companies (BHCs) in the sample. Corporate governance data is obtained from 1991 proxy statements. They find that large BHCs are more likely to adopt derivatives.

[16] The final sample consists of the 284 nonfinancial firms in the S&P 500. The data from the Compustat and SEC proxy statements in 1994. Financial firms had to be excluded because financial firms adopt derivatives both to trade and to hedge.

that percentage of independent directors is significantly and positively related to firm's hedging activities when using S&P 500 non-financial firms. However, Marsden and Prevost (2005) suggest that firms with higher percentage of independent directors on the board tend to decrease derivative usage following the implementation of the 1993 Companies Act when using data of the listed New Zealand companies in 1994 and 1997.[17] They also emphasis derivatives usage as an internal corporate governance mechanisms can make firms' derivatives decision, and the legislative and regulatory may affect derivatives usage.

Some studies find that percentage of insider (independent) directors on the board insignificant related to derivative usage. For example, Shiu et al., (2010) argue that percentage of independent outsider directors on the board (as proxy of corporate governance) is insignificant related to derivative usage in the banking industry in Taiwan from 1998 to 2005.[18] Dionne and Triki (2013) point out that percentage of independent directors do not have impact on the decision to hedge when using the delta percentage as the hedge variable in the gold mining industry. The relation between the percentage of insider directors on the board and derivative usage is not clear. This leads to the following null hypothesis:

Hypothesis 4: The percentage of insider directors on the board is not related to derivative usage on the board in the U.S. property casualty insurance industry.

The Sarbanes-Oxley Act and derivative usage

The SOX Act (2000) requires directors on the boards to assume responsibility for the financial statements of insurance companies. The Financial Accounting Standards Board (FASB) has issued Statement of Financial Accounting Standards (SFAS) No. 133, Accounting for Derivative Instruments and Hedging Activities, to

[17] Authors introduce the Act which imposes directors' fiduciary responsibilities.
[18] The sample consists of 934 firm-quarter observations.

add transparency to a firm's use of derivatives and its risk management practices. Most firms adopting the new requirements on January 1, 2001.[19] Passage of the SOX, the SEC, NYSE, NASDAQ and AMEX have led to more rules and regulatory for monitoring directors on the board in an attempt to restore investor confidence. The complex derivative transactions will result in strict scrutiny for all financial reports after the launch SOX. Specially, boards of directors have become more cautious about their roles since the implementation of the law. This implies that insurers are more likely to decrease probability participation and volume of derivative after the implementation of the SOX Act. We therefore propose the following hypothesis:

Hypothesis 5: Insurers are more likely to decrease probability participation and volume of derivative after enactment of the Sarbanes-Oxley Act than before SOX.

The financial crisis and derivative usage

Derivative instruments' reporting is based on SAP[20]. SAP-based financial statements are prepared and reported in accordance with insurance regulatory purposes. Luan (2012) find that the property casualty insurance companies are more likely to decrease hedging derivatives after the global financial crisis in 2008 than before. It implies that insurers adopt more conserve decisions and then reducing derivative usage after financial crisis. We therefore propose the following hypothesis:

Hypothesis 6: Insurers are more likely to decrease probability participation and volume of derivative after financial crisis than before financial crisis.

3. Data and Methodology

[19] Prior to Statement of Financial Accounting Standards (SFAS) 133, Accounting for Derivative Instruments and Hedging Activities is accounting standard for derivatives instruments that incomplete and inconsistent accounting guidance.

[20] SSAP No. 86, Accounting for Derivative Instruments and Hedging, Income Generation, and Replication (Synthetic Asset) Transactions.

Data

There are 640 insurance companies (137 mutual insurers and 503 stock insurers) in 2000 in our sample, representing over 83% of the total assets of all property casualty insurers. Our sample consists of U.S. property casualty insurance companies with net admitted assets of more than US$100 million[21]. We hand collected detailed information on insurers board composition including CEO and chairperson of the board whether or not are the same person (i.e., CEO/Chairperson duality), numbers of directors on the board, the percentage of insider directors on the board, firm age (i.e., number of years since the firm was established), auditor whether selecting Big 4 auditors (i.e., PricewaterhouseCoopers LLP, Ernst & Young, Deloitte, and KPMG) from A.M. Best's Insurance Report (Property Casualty). Organizational structure (i.e., mutual and stock insurers) and other financial data obtained from the National Association of Insurance Commissioners (NAIC) for the period 2000 to 2014. Derivative instruments are reported in Schedule DB data filed with the NAIC annual financial statements[22] from 2000 to 2014. Before 2010, Parts A through E of Schedule DB report five categories of derivatives including (A) all options, Caps, Floors and Insurance Futures options owned; (B) all options, Caps, Floors and Insurance Futures options written; (C) all Collar, Swap, and Forward Agreement open; (D) all Futures Contracts and Insurance Futures Contracts open; (E) Counterparty Exposure for Derivative Instruments open. In 2010, some parts are combined or modified. There are new four categories of derivatives: (A) all Options,

[21] There are 791 initial insurance companies' net admitted assets more than US$100 million in 2000. When we use balance panel data and drop unreasonable data (e.g., negative net admitted assets or negative net written premiums), the final sample includes 640 insurers.

[22] http://www.naic.org/capital_markets_archive/110610.htm
In 2010, Schedule DB was revised to be more streamlined and yet provide more detailed and useful information regarding an insurance company's derivatives exposure and activity. Part A provides positions and activity in options, caps, floors, collars, swaps and forwards. Exposure to, and activity in, futures contracts are reported in Part B. Part C provides positions and activity in replication (synthetic asset) transactions. Finally, counterparty exposure is reported in Part D. By contrast, the purpose of derivative use only had two possibilities: hedging and other before 2010.

Caps, Floors, Collars, Swaps and Forwards; (B) Futures Contracts open; (C) Replicated (Synthetic) Assets; (D) Counterparty Exposure for Derivative Instruments open. In particular, Parts A and B provide the different objective of derivative instruments including (1) Hedging Effective; (2) Hedging Other; (3) Replication; (4) Income Generation; (5) Other.[23]

To examine the effectiveness of SOX, we separate the entire sample into two subsamples: one prior to its implementation (2000 to 2004) and one following its implementation (2005 to 2014). In addition, we also examine the effect of financial crisis (Q3 of 2007 to Q4 of 2008). Two subsamples that attempt to capture effects for the period before and after global financial crisis will be used. One subsample is prior to the financial crisis (2000-2008) and the other is following the crisis (2009 and 2014).

Methodology

The first stage is to investigate the insurance company whether using derivative and the second stage is that if an insurance company uses derivative then it needs to employ how much of derivative. We follow Cummins et al., (2001) and use Probit regression analysis to examine the participation decision.[24] We also use the Tobit regression to investigate the volume of derivatives. The Pobit regression model used to examine the relation among derivative usage, organizational structure and board composition variables. The dependent variable is derivative usage and the independent variable including organizational structure, board composition variables and control variables in the regression.

[23] By contrast, the purpose of derivative use only had two possibilities: hedging and other before 2010.
[24] Colquitt and Hoyt (1997), Cummins et al. (1997, 2001), Shiu (2011), Lantara and Takao (2014). In addition, Shiu (2007, 2011) adopts the Probit regression model and different dependent variables to examine the participation decision. For example, dependent variables include participation, multinomial participation and futures participation in the study of Shiu (2007). Shiu (2011) also uses three dependent variables: participating, futures and contracts for differences and options to test participation of derivatives.

The empirical models are as follow:

$$y^* = \alpha_0 + \alpha_1 Stock_{it} + \alpha_2 Duality_{it} + \alpha_3 Boardsize_{it} + \alpha_4 Insider\_directors_{it} +$$
$$+ \alpha_5 Big4Auditor_{it} + \alpha_6 Lnna_{it} + \alpha_7 Leverage_{it} + \alpha_8 Bu\sin esslineHerfindahl_{it} +$$
$$+ \alpha_9 GeographicHerfindahl_{it} + \alpha_{10} \Re insurance_{it} + \alpha_{11} Longtail_{it} + \alpha_{12} Perstock_{it} +$$
$$+ \alpha_{13} Perrealstate_{it} + \alpha_{14} CMO_{it} + \alpha_{15} Foreign\_assets_{it} + \alpha_{16} Foreign\_liability_{it} +$$
$$+ \alpha_{17} Tax_{it} + \alpha_{18} Group_{it} + u_{it}$$

The Probit regression model is used to test the participation of derivative decision. Where $y^* = P(y = 1 \mid X)$ is binary variable, 1= if an insurer had derivatives transitions, 0= otherwise.

The Tobit regression model is used to test the volume of derivative decision. Where $y^* = P(y > 0 \mid X)$ is the observed variable, y = the volume of derivatives transitions divided by the total assets if an insurer had derivatives transitions, 0 = if an insurer did not use derivatives.

Dependent Variable

Participation of derivative decision is measured as a binary variable in this paper. We follow Cummins et al., (2001), there are two criteria to measure derivatives participation and derivatives volume: derivatives usage during the year and derivatives positions at year-end. Using data of during the year, the main reason is to avoid insurers manipulating derivatives positions for window-dressing, regulatory or tax consideration (e.g., Shiu, 2007, 2011[25]; Cummins et al., 2001). The dependent variables: $Derivative\_participat ion\_within-year_{it}$ (Derivative participation within-year) and $Derivative\_participat ion\_end-of-year_{it}$ (Derivative participation end-of-year): 1 = if the insurer had any of its derivatives owned during the year or any of its derivative transactions at the end of the year (notional amount), respectively; 0 = otherwise (Colquitt and Hoyt, 1997; Cummins et

[25] Shiu (2007, 2011) cannot examine what factors influence in amounts of within-year derivative transactions because data limitations, such as Hardwick and Adams (1999).

al., 2001; Shiu, 2011; Lantara and Takao, 2014). $Derivative\_participation\_marketvalue_{it}$ (Derivative participation market value): 1 = if the insurer had any of its derivatives owned by measured market value at the end of the year, respectively; 0 = otherwise (Cummins and Song, 2008).

The volume of derivative by measured notional amounts[26] and market value have been used in the literature to indicate the amount of insurers derivative divided by total assets ($Derivative\_volume\_within-year_{it}$, $Derivative\_volume\_end-of-year_{it}$ and $Derivative\_volume\_marketvalue_{it}$) (e.g., Tufano, 1996; Graham and Rogers, 2000, 2002; Colquitt and Hoyt, 1997; Cummins et al., 2001; Kim, Mathur and Nam, 2006; Cummins and Song, 2008; Bartram, Brown and Fehle, 2009; Lantara and Takao, 2014).

Independent Variable

The independent variables include organizational structure, board composition variables and control variables. $Stock_{it}$ is organizational structure variable, which is a binary variable: 1 = stock organizational structure, 0 = mutual organizational structure (Colquitt and Hoyt, 1997; Hardwick and Adams, 1999; Cummins et al., 2001; Shiu, 2011; Lantara and Takao, 2014).

Board composition variables include CEO/Chairperson duality, board size, the percentage of insider directors on the board, and Big 4 auditor. $Duality_{it}$, the same entity functioning as CEO and Chairperson of the board, is a binary variable; 1 = CEO and chairperson of the board are the same person, 0 = otherwise (e.g., Dionne and Triki, 2013). $Boardsize_{it}$ (board size), which is defined as the total number of

[26] If the notional amount is missing data from Schedule DB, we follow Cummins and Song (2008) that notional amount for equity options are approximated as number of contracts strike price ×100 and notional amount for bond options are approximated as number of contracts ×par value per contract.

directors on the board (e.g., Tai et al. 2014). $Insider\_directors_{it}$, defined as the percentage of insider directors on the board (e.g., Whidbee and Wohar, 1999; Borokhovich et al., 2004; Marsden and Prevost, 2005; Tai et al., 2014). Audit quality is proxied by the auditor variables. $Big4Auditor_{it}$ is a binary variable: 1 = the four largest accounting companies in the U.S. (PricewaterhouseCoopers LLP, Ernst & Young, Deloitte and KPMG), 0 = otherwise (Ho, Lai and Lee, 2013).

Control Variables

There are a number of papers examining the links between derivatives usage and firm-specific characteristics (e.g., firm size, leverage, insurer's asset portfolio, long-tail premium written, and reinsurance demand). For example, Colquitt and Hoyt (1997) find that large insurers[27] are more likely to use derivatives than small insurers.[28] Hardwick and Adams (1999) also find that derivatives usage are positively related to firm size, leverage and international links, but negatively related to reinsurance in the U.K. life insurance companies. De Ceuster et al. (2003) indicate that determinants of derivatives usage includes: firm size, leverage and reinsurance for the life insurers, firm size and long-tail lines for the general insurers in Australia. Shiu (2007) provide evidence that firm size, liquidity, interest rate risk exposure, and business concentration are vital factors to affect derivative usage in the U.K. general insurance industry. González et al. (2011) also show that decision of derivative with hedging and volume are positively relative to firm size, leverage and interest rate exposure.[29] Lantara and Takao (2014) provide empirical evidence that the positive relation between derivative usage and firm size, leverage, and proportion of assets invested in stocks and bonds, but negative relation between derivative usage and

[27] Insurers' natural logarithm of net premiums written is used as firm size.
[28] Many studies conduct that large firms are more likely to use derivatives (e.g., Carter and Sinkey, 1998; Whidbee and Wohar, 1999).
[29] The sample includes 28 Spanish Life insurance companies in 2002.

reinsurance in Japan insurance industry.

Following previous literature, the control variables include firm size in terms of net admitted assets, leverage, lines of business Herfindahl index, geographic Herfindahl index, reinsurance ratio, ratio of preferred stock to total assets, foreign assets dummy, foreign liability dummy, tax, and group. $Lnna_{it}$ (firm size), which is natural logarithm of net admitted assets (e.g., Cummins et al., 1997; Hardwick and Adams, 1999; Cummins et al., 2001; Lantara and Takao, 2014). Colquitt and Hoyt (1997) also use the natural logarithm of net premiums written as the proxy of firm size. $Leverage_{it}$ (leverage) is measured as one minus surplus/liability (Colquitt and Hoyt, 1997; Hardwick and Adams, 1999; Cummins et al. 1997; Cummins et al., 2001, De Ceuster et al., 2001; González et al., 2011). $Business\ Line\ Herfindahl\ Index_{it}$ (lines of business Herfindahl index) is defined as $\sum(PW_i/TPW)^2$ where PW_i is the value of net written premiums in line i and TPW is the insurer's total net written premiums. $Business\ Line\ Herfindahl\ Index_{it}$ measures the line concentration and indicates the levels of risk taking (Hill et al., 1992; Ho, Lai and Lee, 2013). $Geographic\ Herfindahl\ Index_{it}$ is a measure of geographic concentration (e.g., Cole and McCullough, 2006; Ho, Lai and Lee, 2013). The Geographic Herfindahl index is defined as $\sum(PW_i/TPW)^2$ where PW_i is the value of net written premiums in state i, and TPW is the insurer's total net written premiums. $Reinsurance_{it}$ (reinsurance ratio) is measured as the ratio of reinsurance ceded divided by the sum of direct premiums written plus reinsurance assumed (e.g., De Ceuster et al., 2001; Shiu, 2011). $Longtail_{it}$ (Percentage of long-tail lines) is the premiums of long-tail lines divided by total net written premiums (for property casualty insurers). The percentage of lines of business is from Schedule P of the NAIC annual statement.

$Asset\_portfolio_{it}$ is separate variables that measure the proportion of assets invested in different types[30] includes the proportion of asset portfolio in stocks ($Perstock_{it}$), proportion of asset portfolio in real estate ($Perrealstate_{it}$), proportion of asset portfolio in publicly traded collateralized mortgage obligations ($PerCMO_{it}$). Foreign assets ($Foreign\_assets_{it}$) is a binary variable, 1= insurers with foreign assets, 0=otherwise. Foreign liability ($Foreign\_liability_{it}$) is binary variable, 1= insures with foreign liability, 0=otherwise. Tax_{it} is binary variable, 1 = if an insurer paid no federal income or capital gains taxes in the current year, 0 = otherwise; $Group_{it}$ is a binary variable, 1 = if an insurer is a member of a group, 0 = otherwise. u_{it} is an error term. The rest of independent variables include organizational structure, board composition variables and all control variables are same as those variables of the first Probit regression. The description of all variables presents in Table 1.

[Insert Table 1 here]

4. Summary Statistics and Empirical Results

This section presents summary statistics and then empirical results.

Summary statistics

The summary statistics for all variables are presented in Table 2. The average derivative participation (volume) end-of-year, within-year and market value end-of-year are 8.9%, 10% and 8.5% (0.3%, 0.6% and 0.04%), respectively. This similar with prior literature, For example, Lantara and Takao (2014) find that the participation rate of derivatives usage (73.2%) in Japan is higher than the U.S.[31]

[30] It is will be considered that insurers manage the default, liquidity and volatility risk arising from investment in these types of risky assets portfolios based on value maximizing hypothesis of Cummins et al., (2001).

[31] Cummins et al. (1997).

(11.93% for life and health and 6.88% for property casualty insurers) and the U.K.[32] (57% for life and health insurers) when evidence the life and property casualty insurance companies in Japan from 2001 to 2011. The mean of stock insurers (79.2%) is similar to findings in previous literature (e.g., Cummins et al., 2001). The mean of CEO/Chairperson duality is 52.1%. On average, the board size is about 9 (8.898). This supports the notion that eight and nine directors on the boards are the most effective (Lipton and Lorsch, 1992). The average percentage of insider directors on the boards represents 46.3% of directors. The mean Big 4 auditor is 87.1%. The average firm size is 20.213. This is similar to the results of previous studies (e.g., Cummins et al., 2001).

[Insert Table 2 here]

We provide descriptive statistics for derivative participation *vs.* non derivative participation in the Table 3. On average, stock insurers with derivative participation within-year (79.8%) are higher than derivative participation end-of-year (77.4% is measured by national amount or 78.4% is measured by market value). Mean of CEO/Chairperson of the board duality in derivative participation within-year (55.8%) is higher than derivative participation end-of-year and nonusers. The average of board size in derivative participation end-of-year as measured by notional amount (9.304) is higher than others derivative participation and nonusers. Mean of percentage of insider directors on the board in derivative participation end-of-year as measured by market value (50.9%) is higher than others derivative participation and nonusers. The average of Big 4 auditors in derivative participation end-of-year (89.6%) is higher than others derivative participation and nonusers.

We also provide descriptive statistics for derivative participation *vs.* non

[32] Hardwick and Adams (1999).

derivative participation in the Table 3. On average, stock insurers with derivative participation within-year (79.8%) are higher than derivative participation end-of-year (77.4% is measured by national amount or 78.4% is measured by market value). Mean of CEO/Chairperson of the board duality in derivative participation within-year (55.8%) is higher than derivative participation end-of-year and nonusers. The average of board size in derivative participation end-of-year as measured by notional amount (9.304) is higher than others derivative participation and nonusers. Mean of percentage of insider directors on the board in derivative participation end-of-year as measured by market value (50.9%) is higher than others derivative participation and nonusers. The average of Big 4 auditors in derivative participation end-of-year (89.6%) is higher than others derivative participation and nonusers.

[Insert Table 3 here]

Table 4 indicates that Pearson correlation coefficients. We find the percentage of insider directors on the board is positively related to stock insurers (41.3% at the one percent level). The variance-inflation factors (VIFs) used to test for multicollinearity among independent variables in our regressions (Neter et al., 1985). The VIFs of all independent variables in our regressions are lower than 2. It shows that there is no multicollinearity issue among results.

[Insert Table 4 here]

Empirical results

Table 5 shows the results of Probit regression of organizational structure and board composition on derivative participation decision. There are three methods for calculating derivative participation: end-of-year as measured by notional amount, within-year as measured by notional amount, and end-of-year as measured by market value in Models A, B and C, respectively. The stock insurers are significantly and

positively related to within-year derivative participation in Model B, but insignificantly in Models A and C. This result implies that stock insurers are more likely to increase derivative participation within-year transactions than mutual insurers. Stock insurers tend to increase derivative participation within-year based on managerial discretion hypothesis rather than end-of-year when compared to mutual insurers. This is consistent with finding of Cummins and Song (2008) that stock insurers are more likely to use derivative participation. In other words, stock insurers are more likely to use derivatives within-year to manage their investment activities. This result partially supports our hypothesis 1. The evidence shows that CEO/Chairperson duality is significantly and negatively related to derivative participation in Model C, supporting insurers with CEO/Chairperson duality are more likely to decrease derivative participation as measured by market value. This finding rejects our hypothesis 2. The coefficient of board size is significant and negative, indicating that insurers with large board size tend to decrease derivative participation. This result rejects our hypothesis 3. The percentage of insider directors on the board is insignificantly related to derivative participation. We also find insurers with Big 4 auditors are significantly and negatively related to derivative participation in all Models.

For all control variables, firm size is significantly and positively related to derivatives participation in all Models. This result is consistent with the findings of previous studies (Hardwick and Adams, 1999; Cummins et al., 2001; De Ceuster et al., 2003; González et al., 2011; Lantara and Takao, 2014). For example, Cummins et al. (2001) find that large insurers are more likely to employ more participating of derivatives than small insurers. The coefficients of leverage is significant and negative in Model B, indicating the insurers with higher leverage are more likely to decrease

derivative participation within-year transaction. The business line Herfindahl index is significantly related to derivative participation in all Models. This is consistent with the findings of Shiu (2016). The coefficient of geographic Herfindahl index is significant and positive in all Models, supporting the insurers are more geographically concentrated resulting in higher derivative participation. Reinsurance is significantly and negatively related to derivative participation within-year in Model B. This substitution effect is similar to the findings of previous derivative usage studies (Hardwick and Adams, 1999; De Ceuster et al., 2003; Shiu, 2016). For example, Hardwick and Adams (1999) suggest that an inverse relation between reinsurance and derivatives participation. Proportion of stocks and proportion of real estate on the assets are significantly and positively related to derivative participation, suggesting that insurers with higher proportion of stocks and real estate on the assets are more likely to use derivative participation (Cummins et al. 2001). The coefficients on foreign assets dummy variable and foreign liability dummy variable are significant and positive in all Models, supporting that insurers with foreign assets or foreign liability tend to use derivatives (Cummins et al., 2001). Tax is positively related to derivative participation end-of-year and within-year in Models A and B, implying an insurer with a higher level of tax are more likely to use derivative. Our finding is consistent with that of Shiu (2011). The group variable is significantly and negatively related to derivative participation in Models A and C, suggesting that insurers at the group level are more likely to decrease probability participation end-of-year when compared to individual insurer level. This result is similar to the finding of Cummins et al., (2001), who argue that unaffiliated insurers tend to use derivative more than groups, because they cannot protect their capital to against certain risks.

[Insert Table 5 here]

We examine the impact of organizational structure and board composition on derivative usage when considering SOX Act. Table 6 includes the interaction terms of the SOX Act between organizational structure and board composition variables. The interaction term between SOX and stock insurers (SOX × Stock) are significantly and negatively related to derivative participation within-year in Model B, implying that stock insurers are more likely to decrease probability of participation within-year post-SOX than before. In other words, stock insurers tend to decrease derivative transaction within-year after SOX. The coefficient of interaction term between SOX and CEO/Chairperson duality (SOX × Duality) is significant and negative in all Models, implying that insurers with CEO/Chairperson duality are more likely to decrease probability of participation post-SOX than before SOX. One possible reason is that an insurer with a duality role of CEO and chairperson on the board will adopts conserve strategy to reduce risk and then decreasing derivative usage after SOX. This result is similar to Wang et al. (2010), who suggest that CEOs have become significantly more risk averse following the passage of SOX[33]. Finally, the interaction term between SOX and Big 4 auditors (SOX × Big 4 auditors) is significantly and negatively related to derivative usage in all Models. This is consistent with the spirit of SOX. Insurers adopt Big 4 auditors are more likely to decrease probability of participation post-SOX than before. As a mentioned above, those findings are consistent with the essence of the SOX Act. Our results support Hypothesis 5. The other control variables are similar to the previous results of Table 5.

[Insert Table 6 here]

[33] Wang (2008) examine risk-taking behavior in relation to CEO turnover prior to and following the implementation of SOX.

To investigate the effect of financial crisis, the results present the interaction terms of organizational structure and board composition variables in Table 7. Evidence shows that the coefficient of the interaction term between financial crisis and percentage of insider directors on the board (FC × Insider Directors) is significantly and negatively related to derivative participation in Model A. This finding indicates that insurers with higher percentage of insider directors on the board are more likely to decrease probability of participation after financial crisis. The coefficient of the interaction term between financial crisis and Big 4 auditors (FC × Big 4 auditors) is significantly and negatively related to derivative participation in all Models, supporting that insurers use Big 4 auditors tend to decrease derivative usage after financial crisis. Our results are consistent with Hypothesis 6. The other control variables are similar to the previous results of Table 5.

[Insert Table 7 here]

Reinsurance appears to be a substitute for the use of derivative to reduce insurers' risk. The negative relation between reinsurance and derivatives exists in the previous studies, such as Hardwick and Adams (1999), De Ceuster et al. (2003), Shiu (2007), Lantara and Takao (2014), and Shiu (2016). To investigate the substitute effect of reinsurance on participation of derivative, the result presents the interaction terms between reinsurance and organizational structure and board composition variables in Table 8. Evidence shows that the coefficient of the interaction term between reinsurance and organizational structure (Reinsurance × Stock) is significantly and negatively related to derivative participation in all Models. This result implies that stock insurers with reinsurance are more likely to decrease probability of participation of derivatives than mutual insurers. The interaction term between reinsurance and board size (Reinsurance × Boardsize) is significantly and

positively related to derivative participation in all Models. Insurers with reinsurance and large board size are more likely to increase probability of participation of derivatives than insurers with reinsurance and small board size. The interaction term between reinsurance and percentage of insider directors on the board (Reinsurance ×Insider Directors) is significantly and positively related to derivative participation in all Models. This result shows that insurers with reinsurance and higher percentage of insider directors on the board are more likely to increase probability of participation of derivatives than insurers with reinsurance and lower percentage of insider directors on the board. The other control variables are similar to the previous results of Table 5.

[Insert Table 8 here]

Table 9 notes that results of Tobit regression of organizational structure and board composition variables on derivative volume. Models A, B and C show that three measures for derivative volume: end-of-year as measured by notional amount, within-year as measured by notional amount, and end-of-year as measured by market value, respectively. The evidence indicates that stock insurers are significantly and negatively related to derivative volume end-of-year in Model A, but significantly and positively related to derivative volume within-year in Model B. This finding is suggesting that stock insurers are more likely to engage in higher volume of derivative within-year transactions, but more likely to engage in lower volume of derivative end-of-year. In other words, stock insurers tend to use large volume within-year derivative transactions to manage investment decisions than mutual insurers, since stock insurers are more exposed to risk than mutual insurers (Colquitt and Hoyt, 1997; Cummins et al., 2001; and Cummins and Song, 2008). Insurers with large board size are more likely to engage in lower volume of derivative within-year and end-of-year transactions as measured by notional amount, but more likely to

engage in higher volume of derivative end-of-year as measured by market value. The coefficient of the percentage of insider on the board is significant and positive, indicating insurers with higher percentage of insider on the board are more likely to engage in higher volume of derivative within-year. Finally, the Big 4 auditors is significantly and negatively related to volume of derivative, suggesting the insurers adopt Big 4 auditors are more likely to engage in lower volume of derivative within-year transactions. The other control variables are similar to the previous results of Table 5 with one exception. The coefficient of group is not statistically significant.

[Insert Table 9 here]

We also investigate the impact of organizational structure and board composition on derivative extent post-SOX Act. Table 10 shows that the interaction term between SOX and stock insurers (SOX × Stock) are significantly and negatively related to derivative volume within-year in Model B. This result implies that stock insurers are more likely to engage in lower volume of derivative within-year post-SOX than before. The interaction term between SOX and CEO/Chairperson duality (SOX × Duality) is significant and negative, implying that insurers with CEO/Chairperson duality are more likely to engage in lower volume of derivative within-year post-SOX than before SOX. Finally, the interaction term between SOX and Big 4 auditors (SOX × Big 4 auditors) is significantly and negatively related to derivative volume, suggesting insurers adopt Big 4 auditors are more likely to engage in lower volume of derivative after SOX. The other control variables are similar to the previous results of Table 6.

[Insert Table 10 here]

Table 11 also presents the Tobit regression results of derivative volume when considering financial crisis issue. The findings are similar to the results of Table 7.

Evidence shows that the coefficient of the interaction term between financial crisis and percentage of insider directors on the board (FC × Insider Directors) is significantly and negatively related to derivative volume in Models A and C, but insignificantly in Model B. This finding indicates that insurers with higher percentage of insider directors on the board are more likely to engage in lower volume of derivative end-of-year rather than within-year after financial crisis. The coefficient of the interaction term between financial crisis and Big 4 auditors (FC × Big 4 auditors) is significantly and negatively related to derivative participation in all Models. This result supports that insurers with Big 4 auditors tend to decrease derivative volume after financial crisis. The other control variables are similar to the previous results of Table 7.

[Insert Table 11 here]

To investigate the substitute effect of reinsurance on volume of derivative, the result presents the interaction terms between reinsurance and organizational structure and board composition variables. Evidence shows that the coefficient of the interaction term between reinsurance and organizational structure (Reinsurance × Stock) is significantly and negatively related to volume of derivative in all Models. This result implies that stock insurers with reinsurance are more likely to engage in lower volume of derivatives than mutual insurers with reinsurance. The other control variables are similar to the previous results of Table 7.

[Insert Table 12 here]

5. Conclusion

This study examines the impact of organizational structure and board composition on derivative usage in the U.S. property casualty insurance industry from 2000 through 2014. The first purpose is to investigate the insurance company whether

using derivative when considering organizational structure and board composition. The second purpose in this paper is that if an insurance company uses derivative then it needs to employ how much of derivative. Finally, we examine the interaction effect of enactment among SOX Act, financial crisis and derivatives activities. We also investigate the substitute effect of reinsurance between organizational structure and board composition (i.e., the interaction terms of reinsurance between organizational structure and board composition variables) on participation and volume of derivative.

The results of this paper show that stock insurers are more likely to increase probability of participation and volume of derivatives activities for the within-year than mutual insurers. In terms of board composition, insurers with CEO/Chairperson duality tend to decrease the probability of derivative participation. The evidence also shows that insurers with large board size and big 4 auditor are more likely to decrease probability of derivative participation and engage in lower volume of derivatives activities. Examination of the impact of the Sarbanes-Oxley Act (SOX) on derivatives indicates that insurers with CEO/Chairperson duality and big 4 auditor are more likely to decrease derivatives usage after SOX. After financial crisis, insurers with high percentage of insider directors on the board and big 4 auditor tend to engage in lower volume of derivatives. Finally, we find that stock insurers with reinsurance are more likely to decrease probability of participation and volume of derivatives than mutual insurers with reinsurance. The overall results show that organizational structure and board composition have impact on insurers' derivatives usage.

Table 1. Description of variables

Variable Description	Definition
Dependent variables	
Derivative participation end-of-year	1= if an insurer had any of its derivative owned at the end of year (notional amount), 0= otherwise.
Derivative participation within-year	1= if an insurer had any of its derivative transaction during the year (notional amount), 0= otherwise.
Derivative participation market value	1= if an insurer had any of its derivative owned at the end of year (market value), 0= otherwise.
Derivative volume end-of-year	National amount of derivatives owned by an insurer at the end of year dividend by total admitted assets.
Derivative volume within-year	National amount of derivatives by an insurer during a year dividend by total admitted assets.
Derivative volume market value	Market value of derivatives owned by an insurer at the end of year dividend by total admitted assets.
Independent variables *Organizational structure and board composition variables*	
Stock	1= stock organizational structure, 0 = mutual organizational structure.
Duality	1= CEO and chairperson of the board are the same person, 0 = otherwise.
Board size	Total number of directors on the board.
Insider directors	The percentage of insider directors on the board.
Big 4 auditor	1 = the four largest accounting companies in the U.S. (i.e., PricewaterhouseCoopers LLP, Ernst & Young, Deloitte and KPMG), 0 = otherwise.
Control variables	
Lnna	Natural logarithm of net admitted assets.
Leverage	One minus surplus/liability.
Business Line Herfindahl Index	This is defined as $\sum(PW_i/TPW)^2$ where PW_i is the value of net written premiums in line i and TPW is the insurer's total net written premiums.
Geographic Herfindahl Index	This is defined as $\sum(PW_i/TPW)^2$ where PW_i is the value of net written premiums in state i, and TPW is the insurer's total net written premiums.
Reinsurance	The ratio of reinsurance ceded divided by the sum of direct premiums written plus reinsurance assumed.
Longtail	The premiums of long-tail lines divided by total net written premiums
Prostock	The proportion of asset portfolio in stocks.
Prorealestate	The proportion of asset portfolio in real estate.
ProCMO	The proportion of asset portfolio in publicly traded collateralized mortgage obligations.
Foreign assets	1 = insurers with foreign assets, 0=otherwise.
Foreign liability	1 = insures with foreign liability, 0=otherwise.
Tax	1 = if an insurer paid no federal income or capital gains taxes in the current year, 0 =otherwise.
Group	1 = if an insurer is a member of a group, 0 otherwise.
SOX	1 = if year is 2005 to 2011, 0 = otherwise.
FC	1 = if year is 2009 to 2014, 0 = otherwise.

Table 2 Descriptive Statistics

Variables	Mean	Standard Deviation	Min	Max
Derivative participation end-of-year	0.089	0.285	0.000	1.000
Derivative participation within-year	0.100	0.300	0.000	1.000
Derivative participation market value	0.085	0.279	0.000	1.000
Derivative volume end-of-year	0.003	0.033	0.000	0.881
Derivative volume within-year	0.006	0.045	0.000	0.985
Derivative volume market value	0.000	0.005	0.000	0.287
Stock	0.792	0.406	0.000	1.000
Duality	0.521	0.500	0.000	1.000
Boardsize	8.898	3.878	0.000	39.000
Insider directors	0.463	0.307	0.000	1.000
Big 4 auditor	0.871	0.335	0.000	1.000
Lnna	20.213	1.391	15.349	25.841
Leverage	0.589	0.184	0.000	0.995
Business Line Herfindahl Index	0.386	0.285	0.077	1.000
Geographic Herfindahl Index	0.377	0.357	0.032	1.000
Reinsurance	0.389	0.312	0.000	1.000
Longtail	0.699	0.287	0.000	1.000
Prostock	0.165	0.176	0.000	0.973
Prorealestate	0.007	0.022	0.000	0.490
ProCMO	0.066	0.083	0.000	0.747
Foreign_assets	0.456	0.498	0.000	1.000
Foreign_liability	0.376	0.484	0.000	1.000
Tax	0.247	0.431	0.000	1.000
Group	0.907	0.291	0.000	1.000

Table 3 Descriptive Statistics for Derivative Participation

Models	Derivative end-of-year				Derivative within-year				Derivative market value			
Participation	Users		Nonusers		Users		Nonusers		Users		Nonusers	
Variables	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Stock	0.774	0.418	0.793	0.405	0.798	0.402	0.791	0.407	0.784	0.412	0.792	0.406
Duality	0.553	0.497	0.518	0.500	0.558	0.497	0.517	0.500	0.549	0.498	0.519	0.500
Boardsize	9.304	4.236	8.857	3.839	9.295	4.192	8.852	3.839	9.175	4.225	8.871	3.843
Insider directors	0.500	0.333	0.460	0.304	0.502	0.335	0.459	0.304	0.509	0.334	0.459	0.304
Big 4 auditor	0.896	0.306	0.869	0.338	0.891	0.312	0.869	0.337	0.896	0.305	0.869	0.338
Lnna	21.591	1.447	20.077	1.310	21.545	1.522	20.064	1.294	21.637	1.458	20.080	1.308
Leverage	0.618	0.140	0.587	0.188	0.612	0.146	0.587	0.188	0.615	0.142	0.587	0.188
Business Line Herfindahl Index	0.307	0.243	0.394	0.288	0.296	0.233	0.396	0.289	0.310	0.245	0.393	0.288
Geographic Herfindahl Index	0.315	0.344	0.383	0.358	0.338	0.351	0.382	0.357	0.314	0.345	0.383	0.357
Reinsurance	0.317	0.264	0.397	0.315	0.318	0.261	0.397	0.316	0.313	0.264	0.397	0.315
Longtail	0.703	0.253	0.699	0.290	0.706	0.233	0.699	0.292	0.703	0.256	0.699	0.289
Prostock	0.247	0.170	0.157	0.175	0.250	0.169	0.156	0.174	0.246	0.168	0.157	0.175
Prorealestate	0.008	0.016	0.007	0.022	0.009	0.018	0.007	0.022	0.009	0.018	0.007	0.022
ProCMO	0.057	0.064	0.067	0.085	0.058	0.066	0.067	0.085	0.057	0.063	0.067	0.085
Foreign_assets	0.757	0.429	0.426	0.495	0.763	0.425	0.421	0.494	0.764	0.425	0.427	0.495
Foreign_liability	0.285	0.452	0.385	0.487	0.284	0.451	0.387	0.487	0.289	0.454	0.384	0.486
Tax	0.296	0.457	0.242	0.428	0.294	0.456	0.242	0.428	0.292	0.455	0.243	0.429
Group	0.931	0.253	0.904	0.294	0.935	0.247	0.904	0.295	0.930	0.255	0.905	0.294
Number of Observations	871		8,914		979		8,806		830		8,955	

Table 4 Correlation Coefficients of Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Stock	1.000																	
2 Duality	0.087	1.000																
	0.000																	
3 Boardsize	-0.309	-0.100	1.000															
	0.000	0.000																
4 Insider directors	0.413	0.223	-0.445	1.000														
	0.000	0.000	0.000															
5 Big 4 auditors	0.262	0.031	-0.068	0.192	1.000													
	0.000	0.002	0.000	0.000														
6 LN(NA)	0.024	0.044	0.140	0.059	0.190	1.000												
	0.018	0.000	0.000	0.000	0.000													
7 leverage	0.036	-0.030	0.045	-0.021	0.004	0.270	1											
	0.000	0.003	0.000	0.043	0.731	0.000												
8 Business Line Herfindahl Index	-0.050	-0.136	0.006	-0.128	-0.110	-0.134	-0.052	1.000										
	0.000	0.000	0.562	0.000	0.000	0.000	0.000											
9 Geographic Herfindahl Index	-0.220	-0.155	0.162	-0.250	-0.181	-0.199	-0.013	0.235	1.000									
	0.000	0.000	0.000	0.000	0.000	0.000	0.223	0.000										
10 Reinsurance	0.225	0.119	-0.111	0.166	0.141	-0.208	-0.159	-0.274	-0.280	1.000								
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000									
11 Longtail	-0.163	-0.061	0.041	-0.061	-0.084	-0.023	0.1044	-0.092	0.130	0.016	1.000							
	0.000	0.000	0.000	0.000	0.000	0.030	0.000	0.000	0.000	0.121								
12 Prostocks	-0.191	-0.007	0.090	-0.128	-0.056	0.244	-0.249	-0.033	-0.088	-0.081	0.019	1.000						
	0.000	0.498	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.069							
13 Prorealestate	-0.232	-0.029	0.055	-0.136	-0.146	-0.040	0.012	-0.032	0.074	-0.081	-0.007	0.129	1.000					
	0.000	0.004	0.000	0.000	0.000	0.000	0.250	0.002	0.000	0.000	0.493	0.000						
14 ProCMO	0.012	-0.040	-0.004	0.035	0.073	0.006	0.1465	-0.095	0.010	0.053	0.086	-0.210	-0.078	1				
	0.245	0.000	0.685	0.001	0.000	0.577	0.000	0.000	0.359	0.000	0.000	0.000	0.000					
15 Foreign assets	-0.122	0.032	0.080	0.001	-0.016	0.406	0.097	-0.097	-0.066	-0.131	0.036	0.203	0.020	0.031	1			
	0.000	0.002	0.000	0.950	0.112	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.051	0.003				
16 Foreign liability	-0.065	-0.044	0.030	-0.126	-0.070	-0.283	-0.156	0.143	0.139	-0.026	-0.032	0.102	0.068	-0.152	-0.333	1.000		
	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.004	0.000	0.000	0.000	0.000			
17 Tax	-0.027	-0.003	0.053	-0.039	-0.002	0.013	0.0396	-0.022	-0.004	0.038	-0.007	0.087	0.023	-0.048	0.027	-0.019	1.000	
	0.008	0.761	0.000	0.000	0.836	0.205	0.000	0.033	0.713	0.000	0.515	0.000	0.025	0.000	0.0086	0.075		
18 Group	0.231	0.086	-0.161	0.193	0.239	0.119	-0.04	-0.226	-0.210	0.197	-0.101	0.071	-0.053	0.0762	-0.020	-0.079	0.044	1.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0449	0.000	0.000	

Table 5 Probit Regression Results of Derivative Usage on Organizational Structure and Board Composition

Models	Model A		Model B		Model C	
Participation	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
Stock	-0.055	0.387	0.206	0.001 ***	-0.033	0.606
Duality	-0.062	0.183	-0.047	0.305	-0.084	0.078 *
Boardsize	-0.010	0.108	-0.009	0.140	-0.016	0.016 **
Insider directors	0.096	0.286	0.089	0.304	0.137	0.136
Big 4 auditors	-0.137	0.070 *	-0.211	0.004 ***	-0.129	0.096 *
Lnna	0.355	0.000 ***	0.360	0.000 ***	0.372	0.000 ***
Leverage	0.058	0.771	-0.440	0.019 **	-0.160	0.426
Business Line Herfindahl Index	-0.398	0.000 ***	-0.608	0.000 ***	-0.342	0.000 ***
Geographic Herfindahl Index	0.145	0.048 **	0.324	0.000 ***	0.155	0.038 **
Reinsurance	-0.141	0.131	-0.177	0.050 **	-0.148	0.118
Longtail	0.032	0.720	0.025	0.773	0.057	0.535
Prostock	0.621	0.000 ***	0.556	0.000 ***	0.507	0.001 ***
Prorealestate	1.275	0.288	3.900	0.000 ***	2.545	0.028 **
ProCMO	-0.353	0.279	-0.194	0.530	-0.213	0.521
Foreign_assets	0.319	0.000 ***	0.416	0.000 ***	0.337	0.000 ***
Foreign_liability	0.203	0.000 ***	0.183	0.001 ***	0.251	0.000 ***
Tax	0.089	0.094 *	0.106	0.041 **	0.078	0.152
Group	-0.251	0.036 **	-0.182	0.135	-0.242	0.049 **
Intercept	-8.468	0.000 ***	-8.440	0.000 ***	-8.808	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-1,970.531		-2,097.260		-1,884.88	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 6 Probit Regression Results of Derivative Usage on Organizational Structure and Board Composition with the SOX Act

Models	Model A		Model B		Model C	
Participation	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
SOX	0.315	0.265	0.714	0.011 **	0.436	0.156
Stock	-0.092	0.418	0.410	0.000 ***	-0.035	0.770
SOX×Stock	0.048	0.714	-0.283	0.032 **	0.000	0.999
Duality	0.088	0.296	0.064	0.425	0.110	0.212
SOX×Duality	-0.212	0.034 **	-0.166	0.085 *	-0.270	0.009 ***
Boardsize	-0.014	0.241	-0.006	0.616	-0.025	0.057 *
SOX×Boardsize	0.005	0.711	-0.006	0.665	0.012	0.432
Insider directors	0.200	0.224	-0.052	0.734	0.215	0.206
SOX× Insider directors	-0.135	0.486	0.221	0.228	-0.097	0.627
Big 4 auditors	0.168	0.387	0.270	0.173	0.298	0.182
SOX× Big 4 auditors	-0.357	0.088 *	-0.554	0.009 ***	-0.486	0.039 **
Lnna	0.354	0.000 ***	0.358	0.000 ***	0.371	0.000 ***
Leverage	0.092	0.644	-0.416	0.028 **	-0.124	0.539
Business Line Herfindahl Index	-0.401	0.000 ***	-0.608	0.000 ***	-0.346	0.000 ***
Geographic Herfindahl Index	0.144	0.050 **	0.325	0.000 ***	0.154	0.040 **
Reinsurance	-0.140	0.133	-0.184	0.043 **	-0.147	0.123
Longtail	0.029	0.748	0.021	0.810	0.052	0.569
Prostock	0.639	0.000 ***	0.564	0.000 ***	0.530	0.001 ***
Prorealestate	1.403	0.254	4.319	0.000 ***	2.728	0.023 **
ProCMO	-0.368	0.261	-0.201	0.516	-0.227	0.496
Foreign_assets	0.324	0.000 ***	0.423	0.000 ***	0.344	0.000 ***
Foreign_liability	0.208	0.000 ***	0.188	0.000 ***	0.258	0.000 ***
Tax	0.080	0.133	0.104	0.045 **	0.066	0.224
Group	-0.260	0.031 **	-0.189	0.124	-0.251	0.043 **
Intercept	-8.809	0.000 ***	-9.060	0.000 ***	-9.262	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-1,965.411		-2,088.147		-1,877.017	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 7 Probit Regression Results of Derivative Usage on Organizational Structure and Board Composition with the Financial Crisis

Models	Model A		Model B		Model C	
Participation	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
FC	0.374	0.120	0.284	0.218	0.539	0.031 **
Stock	-0.129	0.124	0.217	0.009 ***	-0.077	0.371
FC×Stock	0.153	0.202	-0.029	0.807	0.087	0.481
Duality	-0.072	0.242	-0.050	0.393	-0.071	0.261
FC×Duality	0.023	0.808	0.003	0.971	-0.034	0.719
Boardsize	-0.016	0.070 *	-0.012	0.141	-0.022	0.018 **
FC×Boardsize	0.010	0.408	0.005	0.661	0.010	0.431
Insider directors	0.246	0.039 **	0.045	0.695	0.267	0.028 **
FC× Insider directors	-0.346	0.051 *	0.116	0.494	-0.288	0.110
Big 4 auditors	0.255	0.049 **	0.080	0.498	0.348	0.014 **
FC× Big 4 auditors	-0.616	0.000 ***	-0.492	0.001 ***	-0.728	0.000 ***
Lnna	0.358	0.000 ***	0.360	0.000 ***	0.375	0.000 ***
Leverage	0.090	0.654	-0.424	0.025 **	-0.119	0.558
Business Line Herfindahl Index	-0.406	0.000 ***	-0.609	0.000 ***	-0.352	0.000 ***
Geographic Herfindahl Index	0.150	0.042 **	0.324	0.000 ***	0.159	0.035 **
Reinsurance	-0.139	0.138	-0.177	0.050 **	-0.148	0.119
Longtail	0.024	0.788	0.019	0.831	0.047	0.610
Prostock	0.618	0.000 ***	0.545	0.000 ***	0.511	0.001 ***
Prorealestate	1.463	0.236	4.262	0.000 ***	2.791	0.020 **
ProCMO	-0.368	0.262	-0.202	0.514	-0.210	0.528
Foreign_assets	0.334	0.000 ***	0.421	0.000 ***	0.354	0.000 ***
Foreign_liability	0.220	0.000 ***	0.189	0.000 ***	0.273	0.000 ***
Tax	0.072	0.175	0.100	0.053 *	0.059	0.281
Group	-0.314	0.010 ***	-0.224	0.069 *	-0.319	0.011 **
Intercept	-8.809	0.000 ***	-8.644	0.000 ***	-9.239	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-1958.190		-2090.874		-1870.168	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 8 Probit Regression Results of Derivative Usage on Organizational Structure and Board Composition with Reinsurance

Models	Model A		Model B		Model C	
Participation	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
Stock	0.087	0.236	0.343	0.000 ***	0.119	0.113
Reinsurance	-0.356	0.001 ***	-0.375	0.000 ***	-0.371	0.001 ***
Reinsurance×Stock	-0.488	0.000 ***	-0.478	0.000 ***	-0.522	0.000 ***
Duality	-0.079	0.126	-0.062	0.206	-0.094	0.088 *
Reinsurance×Duality	0.068	0.277	0.066	0.237	0.050	0.539
Boardsize	-0.019	0.007 ***	-0.018	0.009 ***	-0.026	0.001 ***
Reinsurance×Boardsize	0.037	0.003 ***	0.036	0.003 ***	0.041	0.002 ***
Insider directors	0.002	0.983	-0.009	0.927	0.028	0.785
Reinsurance× Insider directors	0.300	0.015 **	0.295	0.011 **	0.342	0.011 **
Big 4 auditors	-0.165	0.034 **	-0.237	0.002 ***	-0.152	0.061 *
Reinsurance× Big 4 auditors	0.091	0.184	0.086	0.177	0.078	0.344
Lnna	0.354	0.000 ***	0.359	0.000 ***	0.372	0.000 ***
Leverage	0.048	0.810	-0.459	0.015 **	-0.173	0.392
Business Line Herfindahl Index	-0.396	0.000 ***	-0.608	0.000 ***	-0.340	0.000 ***
Geographic Herfindahl Index	0.141	0.056 *	0.318	0.000 ***	0.149	0.047 **
Longtail	0.041	0.650	0.034	0.700	0.066	0.473
Prostock	0.588	0.000 ***	0.526	0.001 ***	0.469	0.004 ***
Prorealestate	1.204	0.313	3.809	0.000 ***	2.473	0.031 **
ProCMO	-0.382	0.243	-0.212	0.493	-0.244	0.463
Foreign_assets	0.320	0.000 ***	0.416	0.000 ***	0.339	0.000 ***
Foreign_liability	0.207	0.000 ***	0.184	0.001 ***	0.255	0.000 ***
Tax	0.087	0.102	0.104	0.045 **	0.076	0.163
Group	-0.260	0.031 **	-0.194	0.113	-0.253	0.041 **
Intercept	-8.380	0.000 ***	-8.337	0.000 ***	-8.710	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-1962.968		-2089.843		-1876.396	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 9 Tobit Regression Results of Derivative Volume on Organizational Structure and Board Composition

Models	Model A		Model B		Model C	
Volume	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
Stock	-0.018	0.028 **	0.025	0.014 **	-0.001	0.484
Duality	-0.007	0.226	-0.006	0.422	-0.001	0.138
Boardsize	-0.002	0.004 ***	-0.002	0.025 **	0.000	0.008 ***
Insider directors	0.017	0.154	0.045	0.001 ***	0.003	0.105
Big 4 auditors	-0.010	0.294	-0.031	0.009 ***	-0.001	0.618
Lnna	0.042	0.000 ***	0.057	0.000 ***	0.007	0.000 ***
Leverage	0.024	0.355	-0.017	0.578	-0.002	0.646
Business Line Herfindahl Index	-0.058	0.000 ***	-0.109	0.000 ***	-0.008	0.000 ***
Geographic Herfindahl Index	0.014	0.139	0.053	0.000 ***	0.003	0.067 *
Reinsurance	-0.016	0.181	-0.032	0.025 **	-0.003	0.157
Longtail	0.000	0.971	-0.007	0.621	0.000	0.887
Prostock	0.072	0.000 ***	0.082	0.001 ***	0.010	0.004 ***
Prorealestate	0.075	0.642	0.507	0.004 ***	0.030	0.236
ProCMO	-0.064	0.135	-0.053	0.287	-0.012	0.082 *
Foreign_assets	0.033	0.000 ***	0.056	0.000 ***	0.006	0.000 ***
Foreign_liability	0.029	0.000 ***	0.032	0.000 ***	0.006	0.000 ***
Tax	0.004	0.523	0.019	0.018 **	0.002	0.050 **
Group	-0.024	0.132	-0.021	0.295	-0.004	0.125
Intercept	-1.035	0.000 ***	-1.389	0.000 ***	-0.164	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-659.171		-832.509		580.973	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 10 Tobit Regression Results of Derivative Volume on Organizational Structure and Board Composition with the SOX Act

Models	Model A		Model B		Model C	
Volume	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
SOX	0.040	0.273	0.099	0.028 **	0.006	0.331
Stock	-0.022	0.148	0.048	0.009 ***	-0.003	0.241
SOX×Stock	0.004	0.801	-0.032	0.128	0.003	0.372
Duality	0.007	0.514	0.011	0.393	0.002	0.275
SOX×Duality	-0.020	0.124	-0.025	0.102	-0.005	0.030 **
Boardsize	-0.003	0.090 *	-0.002	0.343	-0.001	0.013 **
SOX×Boardsize	0.001	0.782	-0.001	0.711	0.000	0.182
Insider directors	0.031	0.144	0.032	0.184	0.006	0.111
SOX× Insider directors	-0.020	0.426	0.021	0.472	-0.003	0.398
Big 4 auditors	0.017	0.503	0.033	0.301	0.008	0.092 *
SOX× Big 4 auditors	-0.031	0.249	-0.074	0.032 **	-0.010	0.046 **
Lnna	0.042	0.000 ***	0.057	0.000 ***	0.007	0.000 ***
Leverage	0.028	0.292	-0.013	0.681	-0.001	0.769
Business Line Herfindahl Index	-0.059	0.000 ***	-0.109	0.000 ***	-0.008	0.000 ***
Geographic Herfindahl Index	0.014	0.140	0.053	0.000 ***	0.003	0.066 *
Reinsurance	-0.016	0.181	-0.033	0.021 **	-0.003	0.165
Longtail	-0.001	0.933	-0.008	0.597	0.000	0.853
Prostock	0.075	0.000 ***	0.084	0.001 ***	0.010	0.003 ***
Prorealestate	0.079	0.631	0.555	0.002 ***	0.032	0.224
ProCMO	-0.065	0.130	-0.054	0.281	-0.013	0.075 *
Foreign_assets	0.033	0.000 ***	0.057	0.000 ***	0.007	0.000 ***
Foreign_liability	0.030	0.000 ***	0.033	0.000 ***	0.006	0.000 ***
Tax	0.003	0.660	0.019	0.023 **	0.002	0.093 *
Group	-0.025	0.116	-0.022	0.272	-0.004	0.110
Intercept	-1.068	0.000 ***	-1.472	0.000 ***	-0.171	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-656.079		-826.465		588.455	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 11 Tobit Regression Results of Derivative Volume on Organizational Structure and Board Composition with the Financial Crisis

Models	Model A		Model B		Model C	
Volume	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
FC	0.059	0.058 *	0.058	0.118	0.012	0.026 **
Stock	-0.028	0.010 **	0.021	0.120	-0.002	0.290
FC×Stock	0.020	0.190	0.009	0.632	0.002	0.482
Duality	-0.011	0.151	-0.006	0.531	-0.001	0.384
FC×Duality	0.010	0.412	0.000	0.984	-0.001	0.692
Boardsize	-0.003	0.008 ***	-0.003	0.050 **	-0.001	0.005 ***
FC×Boardsize	0.001	0.399	0.001	0.689	0.000	0.211
Insider directors	0.046	0.003 ***	0.056	0.002 ***	0.007	0.007 ***
FC× Insider directors	-0.071	0.002 ***	-0.024	0.380	-0.009	0.021 **
Big 4 auditors	0.036	0.038 **	0.016	0.392	0.009	0.002 ***
FC× Big 4 auditors	-0.069	0.001 ***	-0.078	0.001 ***	-0.015	0.000 ***
Lnna	0.043	0.000 ***	0.057	0.000 ***	0.007	0.000 ***
Leverage	0.027	0.303	-0.014	0.662	-0.001	0.809
Business Line Herfindahl Index	-0.060	0.000 ***	-0.109	0.000 ***	-0.008	0.000 ***
Geographic Herfindahl Index	0.015	0.109	0.053	0.000 ***	0.003	0.058 *
Reinsurance	-0.015	0.210	-0.032	0.026 **	-0.003	0.164
Longtail	-0.002	0.878	-0.008	0.588	0.000	0.801
Prostock	0.072	0.000 ***	0.080	0.001 ***	0.010	0.003 ***
Prorealestate	0.080	0.629	0.553	0.002 ***	0.031	0.232
ProCMO	-0.065	0.127	-0.055	0.268	-0.012	0.086 *
Foreign_assets	0.035	0.000 ***	0.057	0.000 ***	0.007	0.000 ***
Foreign_liability	0.032	0.000 ***	0.034	0.000 ***	0.006	0.000 ***
Tax	0.001	0.890	0.017	0.034 **	0.002	0.134
Group	-0.032	0.046 **	-0.029	0.154	-0.006	0.032 **
Intercept	-1.076	0.000 ***	-1.424	0.000 ***	-0.172	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-644.730		-825.653		598.931	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 12 Tobit Regression Results of Derivative Volume on Organizational Structure and Board Composition with Reinsurance

Models	Model A		Model B		Model C	
Volume	End-of-year		Within-year		Market Value	
Variables	Estimate	P value	Estimate	P value	Estimate	P value
Stock	-0.008	0.401	0.038	0.002 ***	0.001	0.615
Reinsurance	-0.030	0.037 **	-0.050	0.003 ***	-0.005	0.036 **
Reinsurance×Stock	-0.033	0.049 **	-0.043	0.034 **	-0.006	0.030 **
Duality	-0.009	0.205	-0.009	0.238	-0.002	0.193
Reinsurance×Duality	0.005	0.566	0.011	0.125	0.000	0.858
Boardsize	-0.003	0.002 ***	-0.003	0.009 ***	0.000	0.003 ***
Reinsurance×Boardsize	0.002	0.159	0.003	0.143	0.000	0.137
Insider directors	0.009	0.497	0.037	0.016 **	0.001	0.515
Reinsurance× Insider directors	0.023	0.212	0.025	0.162	0.005	0.111
Big 4 auditors	-0.013	0.211	-0.035	0.004 ***	-0.001	0.526
Reinsurance× Big 4 auditors	0.007	0.394	0.013	0.107	0.001	0.571
Lnna	0.042	0.000 ***	0.057	0.000 ***	0.007	0.000 ***
Leverage	0.024	0.370	-0.018	0.550	-0.002	0.618
Business Line Herfindahl Index	-0.058	0.000 ***	-0.109	0.000 ***	-0.008	0.000 ***
Geographic Herfindahl Index	0.014	0.149	0.052	0.000 ***	0.003	0.076 *
Longtail	0.000	0.994	-0.007	0.643	0.000	0.914
Prostock	0.070	0.001 ***	0.080	0.001 ***	0.009	0.006 ***
Prorealestate	0.071	0.656	0.499	0.004 ***	0.030	0.245
ProCMO	-0.066	0.125	-0.054	0.278	-0.013	0.076 *
Foreign_assets	0.033	0.000 ***	0.056	0.000 ***	0.006	0.000 ***
Foreign_liability	0.030	0.000 ***	0.032	0.000 ***	0.006	0.000 ***
Tax	0.004	0.536	0.019	0.020 **	0.002	0.051 *
Group	-0.025	0.124	-0.022	0.274	-0.004	0.116
Intercept	-1.031	0.000 ***	-1.383	0.000 ***	-0.163	0.000 ***
Number of observations	9,786		9,786		9,786	
Log likelihood	-657.144		-829.897		-667.980	

Notes: ***, **, and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

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Appendix 1 Insurance Industry Derivatives Exposure by Derivative Type on Dec. 31, 2014

Industry	Swaps	Options	Futures	Forwards	Total Notional Value ($ Millions)	%
Life	957,598	807,041	64,862	60,517	1,890,018	94%
Property casualty	22,856	98,010	-	3,081	123,947	6%
Health	76	-	-	360	436	0%
Fraternal	125	518	-	-	643	0%
Total	980,655	905,569	64,862	63,958	2,015,043	100%
%	49%	45%	3%	3%	100%	

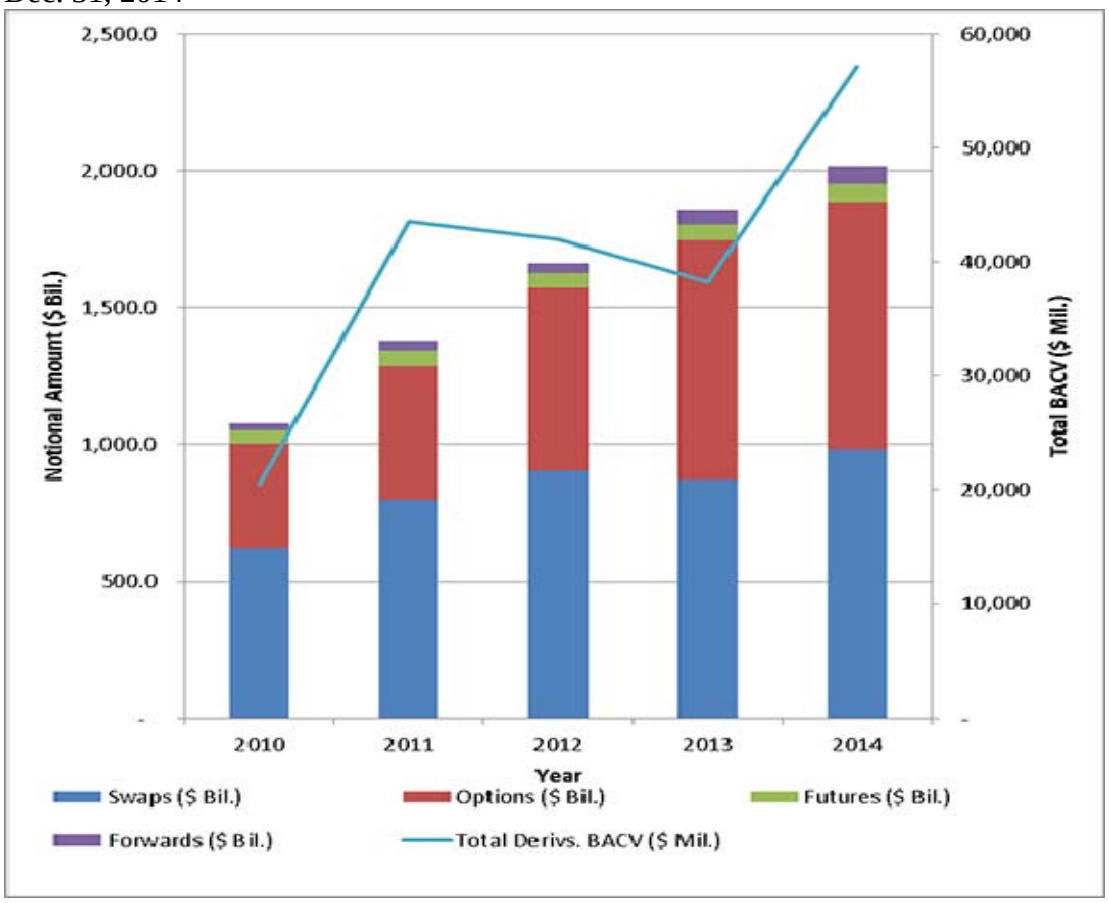
Source: NAIC Capital Market Bureau (2015)

Appendix 2 Insurance Industry Derivatives Used for Hedging Purposes by Risk Type on Dec. 31, 2014

Industry	Interest Rate risk	Equity risk	Foreign exchange risk	Credit risk	Other	Hedging Total Notional Value ($ Millions)	%
Life	1,217,693	422,176	105,925	8,475	57,313	1,811,583	96%
Property casualty	12,642	3,153	1,854	3,658	51,723	73,031	4%
Health	76	-	360	-	-	436	0%
Fraternal	50	93	125	-	-	269	0%
Total	1,230,462	425,422	108,264	12,134	109,036	1,885,318	100%
%	65%	23%	6%	1%	6%	100%	

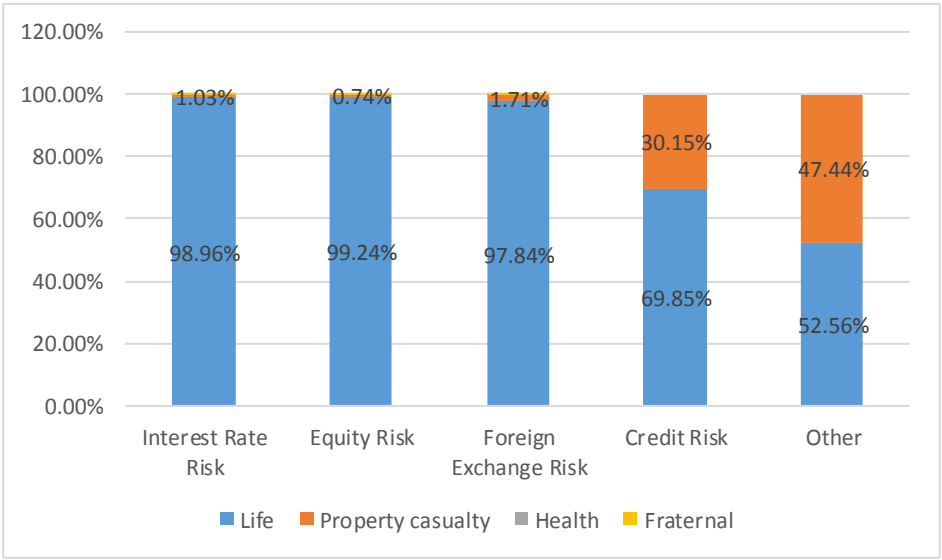
Source: NAIC Capital Market Bureau (2015)

Figure 1 Insurance Industry Derivatives Exposure Percentage by Derivative Type on Dec. 31, 2014



Source: NAIC Capital Market Bureau (2015)

Figure 2 Insurance Industry Derivatives Used for Hedging Purposes Percentage by Risk Type on Dec. 31, 2014



Source: NAIC Capital Market Bureau (2015)