The Use of Credit Default Swaps in the Insurance Industry: Evidence from U.S. Life and Property-Casualty Insurance Companies

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Using a unique dataset of credit default swaps (CDS) users in the insurance industry for the sample period from 2001 to 2007, we systematically investigate the extent to which and why U.S. insurance companies utilize CDS in purchase and sell positions. We find that insurers participate in the CDS market as both sellers and buyers, with large banks as their primary counterparties. Their overall CDS transactions have increased in number and in value, but as a share of total transactions, sell positions have declined in recent years, likely due to "learning effects." In line with asset-liability management, life insurers tend to write more CDS contracts and hold the contracts for a longer period, compared to property-casualty (PC) insurers. Stock insurers engage in more CDS transactions than mutual insurers do, supporting the managerial risk aversion hypothesis. We also identify a number of other issuer characteristics (such as size and asset allocation) and the CDS market risk factors that affect the purchase and sell positions of insurers. Evidence shows that insurers participate in the CDS market for reasons beyond hedging.

Key words: Credit default swaps, hedging, income generation, life insurers, property and casualty insurers, and asset replication.

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1. Introduction

In the past decade, the credit derivatives market has grown in size and complexity at an explosive speed from a virtual non-entity to a notional outstanding value of over $60 trillion by the end of the first half of 2008 (BIS 2008). Banks account for a majority of trading activity in credit derivatives, in the hope of reaping profit opportunities in this asset class. Insurance companies have also reportedly been among the most active market participants in the credit derivatives market. The innovation of credit derivatives has provided insurance firms with an additional risk-management mechanism as well as another asset category. According to data from the British Bankers' Association (2006), insurers worldwide held 18 percent of the market in credit default swaps (CDS) sell positions and 6 percent of the CDS market in CDS purchase positions.

However, to the best of our knowledge, the use of credit derivatives by insurers has received limited research attention. This study tries to fill this important gap by examining the positions of their CDS transactions and the factors contributing to the degree of participation by insurers in the CDS market. It offers the first attempt to investigate systematically the use of CDS by U.S. life insurers and property and casualty (PC) insurance companies. In addition, the use of CDS in different organizational forms of the insurance industry, namely, stock insurers and mutual insurers, is also examined. Because only a very small percentage of insurers engage

in CDS transactions, we take an approach beyond examining insurers' participation decisions by focusing on the degree of their participation and their transaction positions.[1]

The bailout of AIG in September 2008 attracted heated attention to the use of credit derivatives by insurance companies in the United States and worldwide. The CDS was identified as the culprit behind the fall of AIG. Indeed, the nearly $62 trillion credit derivatives market is largely over-the-counter and has not been regulated by any state or federal authorities. Trading activities by major participants, such as banks and hedge funds, are private and so are not disclosed to the public.[2] Thus, little is known about trading counterparties, volume, holding positions, and holding periods in this market. The lack of transparency led to serious information asymmetry in the market, which presents challenges for policymakers in regulating the market. During the recent financial crisis, this lack of regulation was pointed to as contributing to systemic risk.

Unlike banks and hedge funds, insurance companies are closely regulated at the state level. The insurer's use of derivatives, including credit derivatives, is required to be reported to the National Association of Insurance Commissioners (NAIC). This information presents us a unique opportunity for examining CDS transactions by insurance companies and shedding light on the trading behavior and reasons for participation by a large financial institution group in the market. The transaction information is collected from the regulatory annual statements of life and PC insurance companies. The reported CDS trading data taken from Schedule DB includes transaction-level data on CDS, including the transaction type (buy or sell), position opening and

[1] There were 2,741 PC insurance companies and 1,128 life insurance companies in the United States in 2008. Source: http://www.iii.org/media/facts/statsbyissue/industry. 12 PC insurers and 60 life insurers participated in the CDS market as of 2007 according to the National Association of Insurance Commissioners (NAIC) data we used in our study.

[2] Minton et al. (2009) investigate the use of credit derivatives by banks. However, their data is taken from banks' annual report and is at the aggregate level. Detailed information on CDS transactions by banks is not publicly available.

closing dates, and counterparty names. The detailed nature of the data allows us to analyze the practices of CDS purchases and sales separately, to test a number of economic hypotheses, and to evaluate the determinants of CDS use by the insurance industry.

One market perception from AIG's debacle was that the insurance company, viewing CDS as an extension of the insurance business, participated in the CDS market only as a seller in order to collect premiums.[3] However, most insurance companies that engage in CDS transactions might act as both sellers and buyers. In addition, insurers might be involved in such transactions for different reasons, such as hedging, asset replication, and income generation.

Why do insurers sell CDS? Selling credit protection is an extension of taking on credit risk in insurance companies' investment activities to generate income.[4] Corporate credit risk has been viewed by insurance companies as uncorrelated to other underwritten risks and, therefore, offers an opportunity to create greater diversification (Fitch Rating 2003). Traditionally, insurance companies have invested in corporate bonds to manage the duration of their liabilities. However, prior studies have shown that CDS are a more sensitive indicator of the underlying reference entity's credit risk (Blanco et al. 2005). They can provide enormous flexibility, greater diversification, and higher returns because the CDS market has more liquidity (Goldfried, 2003). Moreover, existing bonds might not provide the insurers with adequate flexibility for asset-liability duration consideration. Selling CDS allows insurers to assume credit risk in an alternate format by replicating bond portfolios with more flexible maturities and interest rates.

[3] Adam Davidson, "How AIG fell apart," Reuters, September 18, 2008.

[4] In a CDS, the protection seller agrees to compensate the protection buyer for any losses. The buyer of protection makes periodic payments to the protection seller until a credit event occurs or the maturity date of the contract is reached, whichever is first. If there is no default event before maturity, the protection seller pays nothing. If a credit event occurs, the buyer is compensated for the loss incurred as a result. The payment on default is either repayment at par against physical delivery of a reference asset (physical settlement) or the notional amount minus the post default market value of the reference asset (cash settlement), which is equal to the difference between the par value of the bond or loan and its market value after default.

Nevertheless, for the purpose of asset diversification, insurers are not likely to "replace" all their bond holdings with CDS. Thus insurers also actively buy CDS in order to hedge the credit risk associated with their bond assets. As a financial intermediary, the insurance industry is subject to various sources of risk, including interest rate risk, market risk, credit risk, and liquidity risk. Insurers rely on a variety of derivatives to manage these risks.[5] Because insurers' investment portfolios comprise a large share of bonds,[6] they can apply single-name or basket CDS to hedge the credit risk associated with bond holdings. As a method of reducing credit risk, buying CDS is more efficient than reducing bond holdings through sales, which is sometimes impractical due to short-selling restrictions, illiquidity of the bond market, or tax and accounting considerations. In addition, buying CDS can help insurers to free up credit lines needed to support other businesses.

Insurance companies might also invest in CDS simply to enhance their investment income. Because they have greater market liquidity and are traded by large institutional participants with information advantages, CDS contracts are arguably the most efficient way to trade credit risk. Insurers purchase CDS in anticipation of widening CDS spreads and sell CDS if credit spreads are expected to narrow. Profit from these transactions can be incrementally better than that realized from outright sales of bonds on the bond market.

Using the unique dataset from NAIC over a seven-year period (2001–2007), we first examine whether the insurance companies have acted as net sellers and how the dynamics of

[5] Hedging transactions are to reduce price, quantity, currency, and other risks associated with their assets and liabilities. Income generation is defined as derivatives written or sold to generate additional income or return. Replication transactions replicate the performance of one or more assets that the insurers are allowed to acquire.

[6] Insurers hold bonds in order to manage the duration of their liabilities or assets. According to the NAIC SVO report (2007), for life insurers, bond holdings account for 76.1 percent of total invested assets in 2006 while PC insurers allocate 62.1 percent of their assets to bond holding. Karapiperis (2007), summarizing the data from the Federal Reserve's Flow of Funds Accounts, reported that life insurers held 20 percent of total outstanding bonds in 2006, as the largest bond investment sector. Property/casualty insurers were also among the top sectors with 3 percent of outstanding bonds in 2006.

their trading behavior have evolved over time. Our results show that, at the beginning, insurance companies participated in the CDS market primarily as net sellers. Large banks are their primary counterparties. But after incurring huge losses selling CDS and as they learned the nature and risk of the new asset class, they appeared to decrease the share of their net sales positions in CDS. We see this change as likely due to learning effects.

Next, we examine whether life insurers behave differently from PC insurers in terms of purchase and sell positions and holding periods. This is important to isolate the rationales for CDS use between the two insurance groups, which underwrite significantly different types of insurance policies and have risk/return profiles with substantial cross-sectional variation.

Life insurance policies have relatively more complicated features than do property-liability policies in terms of the payoff structure and the policy period. Life insurers' liabilities have longer maturity, and their duration mismatch risk is greater than that of PC insurers. The more flexible maturity structure of CDS contracts allows them to replicate the bond portfolios by selling CDS and therefore effectively implement their asset-liability duration management. Our results show that life insurers, on average, write more CDS contracts than PC insurers do. This finding is consistent with the practice that life insurers participate more in the bond market than PC insurers.

In contrast, PC insurers face greater uncertainty and liquidity constraints due to higher claim frequency. They are less capable of acting as protection sellers because writing CDS requires a lump-sum compensation of credit loss to protection buyers when a credit event occurs. Unlike life insurers that have long liability maturity that allows them to make fixed-income investment and earn interests on interests to increase surplus, PC insurers have shorter liability maturity. So they have to adopt more aggressive investment strategy to realize capital

appreciation and build their surplus base. This is revealed by a greater percentage of stock holdings by PC firms than life insurers.[7] In addition, regulatory considerations are less onerous for PC insurers than for life insurers. So they have more leeway in their investment choice. We find that PC insurers, on average, buy more CDS than life insurers. Moreover, both the mean and median holding period of CDS contracts by PC insurers are less than one year, which is shorter than that of life insurers. This is consistent with the notion that PC insurers are likely to trade CDS for speculation purpose in order to boost the growth of their surplus.

Next, we investigate how an insurer's ownership structure affects the use of CDS. Based on the specific organizational form, an insurance company can also be categorized as a stock or a mutual insurer. Stock insurers separate the functions of managers, stockholders, and policyholders, whereas mutual insurers merge the owner and customer functions; that is, policyholders both supply capital and are residual risk bearers.

The managerial risk aversion hypothesis suggests that stock firms are less likely than mutual insurance firms to participate in hedging activity because the interests of the latter are more aligned with owners (Colquitt and Hoyt 1997). Thus, mutual insurers can be expected to buy more CDS for hedging purposes than are stock insurers. The managerial discretion hypothesis (Mayers and Smith, 1988) states, by contrast, that stock firms are likely to engage in higher risk or more complex activity than mutual firms because the former can reduce agency costs through increased monitoring of management behavior. The complex features of CDS contracts require that those dealing with them have sophisticated experience. Thus, stock insurers are expected to be more likely than mutual insurers to utilize CDS, whether as buyer or seller. Overall, our results show that stock insurers are more actively involved in the CDS

[7] As shown in the Insurance Fact Book (Washington, DC American Council of Life Insurers 2003), asset allocations for Life insurers include: 73% on bond, 11% on mortgage and real estate, and 4% on stocks. In contrast, PC insurers hold 67% of assets on bond and 16% on stocks.

market than the mutuals on both purchase and sell positions. In particular, the finding that stock insurers engage in more buy positions supports the managerial discretion hypothesis.

Finally, we explore which other factors affect the insurers' participation level in purchase and sell positions within a multivariate regression framework. We find that larger firms undertake more CDS transactions, supporting the economy-of-scale hypothesis. We also examine the relevance of insurers' asset allocation, which might convey information about the insurers' risk preference and liquidity condition. The regression results show that insurers with more liquid assets, as measured by a higher cash ratio, tend to have a higher CDS purchase position, but a lower CDS sell position. However, insurers with a higher real estate allocation ratio are more conservative with respect to taking CDS sell positions, due to the liquidity risks inherent in real estate investment. In addition, the more profitable insurers are significantly associated with CDS sell positions. Moreover, we include a market CDS index and show that higher CDS index levels create a disincentive for taking a purchase position, but a motivation for a sell position. We also find evidence that the insurers are involved in the CDS market for the purpose of speculation.

This study contributes to the literature in two major ways. First, we add to the literature on derivative use by insurers (Colquitt and Hoyt 1997; Cummins, Phillips, and Smith 1997, 2001). We present the dynamic use of CDS by both life and PC insurers and test hypotheses regarding the factors driving their purchase and sell CDS positions. This study sheds light on the extent to which CDS is used by different types of insurance companies and adds to our understanding of economic rationales behind CDS use. Second, employing the insurance industry as our research sample, we complement the study by Minton et al. (2009), which systematically examines the use of credit derivatives by U.S. bank holding companies from 1999

to 2003. They find that the use of credit derivatives is clustered among large banks and that a majority of the banks using credit derivatives are net buyers of credit protection. The use of credit derivatives by insurance companies could be fundamentally different from that by banks due to the nature of the insurance industry. As such, we investigate how insurance companies, as another major participant in the credit derivatives market, utilize CDS for hedging, replication, and income enhancement purposes.

The rest of the paper is organized as follows. Section 2 gives some background and develops research hypotheses. Section 3 describes the data and descriptive statistics. Section 4 presents the empirical findings. The conclusions are summarized in Section 5.

2. Background and Development of Hypotheses

In an effort to manage their financial risks, insurers use many existing financial derivatives, such as options, futures, swaps, and forward contracts. The extant literature has provided theoretical predictions and empirical evidence on derivatives activity in the insurance industry. Specifically, insurance literature finds evidence that insurers are motivated to use financial derivatives by consideration of the expected costs arising from financial distress, asset volatility, liquidity, taxes, and organizational forms. For example, Cummins, Phillips, and Smith (1997) present extensive descriptive statistics on the use of derivatives by U.S. life and property-liability insurers. Colquitt and Hoyt (1997) analyze the use of derivatives by life insurers licensed in Georgia. Cummins, Phillips, and Smith (2001) investigate the economic rationale for their use and develop and test specific economic hypotheses related to the use of derivatives in property-liability insurers as well as life insurers. In view of the current focus on the role of credit derivatives by financial institutions as one contributing cause of the current financial crisis,

we investigate how the insurance industry, as the major player in the CDS market other than banks, uses CDS. This study, to the best of our knowledge, is the first to provide a thorough examination of the use of credit derivatives, specifically CDS, by life insurers and PC insurance companies.

Credit derivatives allow insurers to enhance investment income, implement their risk management strategy, and replicate their existing asset portfolios. Insurers can create loan or bond substitutes for entities that have not been issued in those markets at chosen maturities. For example, life insurers accumulate long-term-policy liabilities, so they are challenged to find enough long-term bond and loan assets to match their liabilities. While there is ample supply of shorter-term bond and loan assets, the supply of longer-term assets can be limited. Because they can have a maturity of up to 30 years, long-term CDS allow life insurers to match their long-term liabilities. Selling CDS contracts enables an insurer to take the credit risks in exchange for receiving premiums and replicate the revenue structure of the coupon payments from holding bonds. For years, insurance companies have invested in corporate bonds in the cash market corresponding to their liability position to implement effective asset-liability duration management. However, existing bonds might not meet the insurers' need for duration flexibility, while the CDS market provides enormous flexibility. Goldfried (2003) argues that CDS offer access to new credit not offered for a specific firm or at a specific term and in addition, CDS helps to separate the credit and interest rate decision and CDS indices enable greater diversification for insurers. Therefore, by selling CDS tailored exactly to their needs, insurers can increase the diversification of their exposure to credit.

On the other hand, buying CDS protection allows an insurer to mitigate exposure to credit risk and retain the benefit of a wide credit spread as well as long-term interest rates. In

terms of reducing credit risk, it is more efficient to buy CDS than to sell bonds because of restrictions on short-selling bonds, lower liquidity in the cash market, and tax considerations, among other things.

Alternatively, insurance companies participate in the CDS market in order to increase their investment income. They simply take a view on the future trend of the credit quality of the underlying reference entities. For speculative purpose, insurers may buy CDS when they expect CDS spreads to widen and sell CDS when they expect the spreads to narrow. Trading CDS is perhaps the easiest and most liquid and efficient way to trade credit risk because it is a more sensitive indicator of the underlying reference entity's credit risk, owing to its greater market liquidity and informed market participants (such as commercial or investment banks) with privileged information.[8]

In sum, as one of the largest holders of credit risk, insurers can use credit derivatives to alter their exposure to credit risk, to replicate asset portfolios, or to enhance their investment income.

2.1. The Dynamics of Long-Term Trading Behaviors of Insurers

First, we examine whether insurers' use of CDS has evolved over time as they learned the nature and risk of CDS contracts. When the CDS market first began in 2001–2003, bank lenders rushed to protect themselves by buying CDS as the quality of their assets deteriorated amid the credit crisis and waves of corporate defaults. Commercial and investment banks became big buyers of CDS protection for their loan and bond portfolios, while insurance companies were among the big sellers. According to the British Bankers' Association, insurance companies

[8] There is a great deal of anecdotal evidence that the CDS market leads the bond and equity market in reflecting changes in a firm's creditworthiness. For example, see D. Berman, "Secrets to keep: Insider trading hits golden age," *Wall Street Journal,* June 19, 2007; B. Drummond, "Insider traders concealed by swaps, options Boesky never used," Bloomberg.com, June 20, 2007. This anecdotal evidence is further confirmed by academic studies of Acharya and Johnson (2007), Blanco et al. (2001), and Fung et al. (2007).

accounted for 7% of the purchases and 23% of the sales in 1999.[9] Fitch Rating (2003) reported that globally the insurance industry was the largest seller in 2003, with a net position of $283 billion; excluding the financial guarantors, insurance companies had a net position of $117.3 billion. However, insurance companies, as sellers, had incurred huge losses in the spectacular defaults by Enron and WorldCom.

Insurers absorbed a massive amount of risk in a relatively short period because they entered the new market without knowing enough about the potential risks they were taking on. Clark (2002) stresses the inability of insurance companies to measure sufficiently the risk that they are selling, mainly because they lack the sophisticated technology required for appropriate pricing. Nevertheless, the surge of credit events increased awareness among insurers of the risk inherent in CDS contracts, thereby leading them to become more cautious about these instruments.

For example, our data show that the Connecticut General Life Insurance Company incurred heavy losses selling CDS on behalf of Enron. This experience persuaded it not to engage in any other CDS deals later. It was reported that some big sellers of CDS—Ambac Financial Group, Financial Security Assurance, MBIA, General Re, and Zurich Financial Services Group—retrenched on their involvement with CDS dramatically in 2003.[10] Fitch Rating (2003) also documents pullbacks by insurance companies on CDS.

In 2004, default rates fell to historically low levels. Overall market participants became more complacent about credit risks. Counterparties of insurers on CDS transactions, such as large banks, used CDS to obtain exposure to credit risk rather than hedge it. During this period,

[9] The swaps emperor's new clothes, *Economist*, February 8, 2001.
[10] Pass the parcel, *Economist*, January 18, 2003.

we would expect insurers to increase their purchases, resulting in a decline in their net sell position.

Insurers also learned to reduce their credit risk exposure by simultaneously selling and buying CDS with different maturities on the same reference entity. For example, during the bankruptcy of Delta Airlines in 2005, the loss of insurance companies in our sample was limited, because their selling positions are largely covered by an opposite buying position with slightly shorter maturities.[11] This allows insurers to take a net long credit position, but limit their credit risk exposure. The dynamics of insurers' trading behaviors may arise as a result of greater familiarity with the features of the new asset class and changing credit risk conditions over time. We refer to this as the "learning-by-doing" effect. In light of our discussion, the first hypothesis is as follows:

H1: Over time, CDS transactions by insurance companies are expected to increase, and the percentage of CDS sales transactions by insurers is expected to decline.

2.2. Life Insurers vs. PC Insurers

Life and PC insurers are similar in that both are highly regulated in the conditions under which they underwrite insurance policies and invest in a variety of assets. The significant difference in their business specialization leads to a difference in their underwriting behavior, investment activities, and regulatory requirements.

In general, the insurance industry receives premiums before it pays pre-specified benefits, namely, insurance liabilities. Between the time that premiums are received and the time that benefits are paid, insurance companies use the premiums to engage in investment

[11] We find 362 covered net sales positions in our sample, in which insurers hedge the credit risks from selling CDS by simultaneously purchasing CDS protection with different maturities. Such trades occur frequently during times of greater uncertainty, for example, before the bankruptcy of Delta Airlines and rumored leveraged buyout (LBO) deals like that of HCA.

activities under the scrutiny of regulation. Life insurance companies underwrite life insurance, annuities, and guaranteed investment contracts (GICs), and they invest the funds primarily in publicly traded bonds. They are also major participants in the market for privately placed bonds, real estate, and mortgages, which are subject to liquidity risk and often contain embedded options. PC insurers issue debt to cover different types of risks, such as automobile accidents, fire, work accidents, weather-related catastrophes, and lawsuits arising from malpractice or defective products. PC insurance companies invest a large proportion of their funds in traded stocks and bonds. Both life and PC insurers face significant interest rate risk and duration gap risk, because a large proportion of their investments are in rate-sensitive, long-term, fixed-income obligations, and they tend to have positive equity duration gaps, with the duration of assets exceeding the duration of liabilities (Staking and Babbel, 1995).

PC insurers are expected to buy more CDS than life insurers for several reasons. First, the return objectives for PC insurance companies are different from life insurance companies since PC insurers face greater uncertainty due to the possibility of higher claims frequency. Traditionally, they hold a greater percentage of equity-type investments in their portfolios than life insurers hold. [12] Large stock holdings are designed to provide high levels of current income and capital appreciation to build the surplus base and provide growth to the surplus, whereas bond portfolios are maintained to fund insurance reserve requirements. PC insurers, viewing CDS as a new investment class, may buy and sell CDS within a short period to realize capital appreciation and boost their surplus. Second, regulatory considerations are less onerous for PC insurers than for life insurers. For life insurers, the ability to pay death benefits when due is a critical concern, so NAIC directs life insurers to maintain an asset valuation reserve (AVR) as

[12] As shown in the *Insurance Fact Book* (Washington, DC American Council of Life Insurers 2003), life insurers assets are allocated as follows: 73% in bonds, 11% in mortgages and real estate, and 4% in stocks. By contrast, the allocations for PC insurers were: 67% in bonds and 16% in stocks.

a cushion against substantial losses of portfolio value. This is not required for PC firms. So they are given considerable leeway in choosing investments, including CDS. Third, the motivation to purchase more CDS to hedge bond portfolios by life insurers may be tempered by their greater expertise in analyzing credit risk. Compared to PC insurers, life insurance companies tend to hold a larger proportion of bonds as the major asset category. So they are motivated to purchase CDS protection to manage the credit risks embedded in their bond holdings. On the other hand, credit quality of investment assets is associated with the ability of life insurers to pay income and principal when due. Controlling credit risk is a major concern for life insurance companies and is often managed through a broadly diversified portfolio. As a result, the investment activities enable life insurers to develop in-house expertise in analyzing credit. This will reduce the motivation to hedge the underlying risks of their investment by purchasing CDS.

As CDS sellers, insurance companies can write CDS contracts for the purpose of asset replication to create a variety of "quasi-bonds" that offer more flexibility in terms of maturities and underlying entities. Life insurers are hypothesized to sell more CDS than PC firms for the following reasons. First, life insurance companies are more sensitive to interest rate because their policies pay periodic returns. They hold a larger proportion of bonds than PC insurers. Writing CDS contracts, which is parallel to buying bonds, allows life insurers to collect a fixed insurance premium periodically over a specified period. Second, due to the long duration of liability requirements, life insurance companies, as CDS protection sellers, can afford to compensate the protection buyer for any losses when a credit event occurs. In contrast, the high uncertainty of claims and high claims frequency make liquidity requirements for PC insurers relatively high.

Their ability as CDS sellers to compensate protection sellers is tempered by their liquidity requirements. So we expect PC insurers to sell less CDS than life insurance companies.

Moreover, the portfolios of PC and life insurers vary in terms of the characteristics of the contracts, such as maturity. Life insurers' liabilities have a longer maturity, and their duration mismatch risk is greater than that of PC insurers. For example, individual life insurance policies and annuities are contracts with a relatively long maturity and contain numerous embedded options, whereas PC insurers generally have liabilities with shorter maturities. Therefore, we predict life insurance companies are less likely to trade their CDS positions frequently and tend to hold CDS for a longer period. If the incentives of hedging and replication of using CDS dominate that of speculation, life insurers are less likely to trade their CDS positions frequently and tend to hold CDS for a longer period. Moreover, due to greater motivation to boost surplus growth and less stringent regulatory requirements, PC insurers may invest in CDS simply for speculation purpose. So they may hold CDS for a shorter period than life insurers. Collectively, the hypotheses on life and PC insurers can be formulated as follows:

H2-1: Life insurers tend to buy less and sell more CDS contracts than PC Insurers do.

H2-2: Life insurers tend to hold CDS contracts for a longer period than PC insurers do.

2.3. Stock Insurers Versus Mutual Insurers

An insurance company faces a broad array of strategic choices. It must choose its lines of business as well as its geographic reach, its organizational form, the composition of its board of directors, and the structure of its executive compensation plan, distribution system, risk management policy, and so on. Stock insurers separate the functions of managers, stockholders, and policyholders. Mutual insurers merge the owner and customer functions; that

is, policyholders play a role as suppliers of capital as well as bearers of residual risk. Mutual and stock insurers are the primary ownership structures of the insurance industry. Because CDS can be utilized as a risk management mechanism or a risk-taking instrument, it is interesting to examine how an insurer's ownership structure affects the use of CDS. To explicitly examine the relationship between ownership structure and the use of CDS, we evaluate two competing hypotheses, namely, those relating to managerial discretion and managerial risk aversion that have been developed and empirically tested in the extant literature.[13]

According to the managerial discretion hypothesis (Mayers and Smith, 1988), stock insurers are more likely than mutual firms to engage in higher-risk or more-complex activity because stock owners can reduce agency costs through increased monitoring of management behavior. For a stock insurer, there exist conflicts of interest between stockholders and policyholders over dividend policy, financing policy, and investment policy. In a mutual insurance company, merging the two parties naturally controls this conflict. However, this merger results in less-effective control of the conflict between owners and executives over effort, payout policy, and risk-management activities.[14] As suggested in Mayers and Smith (1988, 1994) and Marx, Mayers, and Smith (2001), stock companies have several control mechanisms that limit the dysfunctional exercise of managerial discretion. Some of these mechanisms are: (1) monitoring by capital markets (specifically by stock analysts, institutional investors, and other blockholders); (2) the threat of a takeover; and (3) the use of stock-based

[13] For example, the studies by Colquitt and Hoyt (1997) and Cummins et al (2001) provide a link between insurers' ownership structure and their hedging policies. They provide evidence supporting the managerial discretion hypothesis that mutual managers are less likely than stock managers to engage in a large, complex derivatives business.

[14] This conflict is partially controlled through outsider participation by the board of directors, who monitor the executives (Mayers, Shivdasani, and Smith, 1997). Outside directors can adopt the lower level of compensation and compensation sensitivity appropriate for control of owner–manager conflicts in a mutual.

incentive compensation. These potentially important control mechanisms are infeasible in mutuals because they do not have alienable ownership claims. Thus, stock insurers should have a comparative advantage over mutuals in strategic choices that require higher discretion (Marx, Mayers, and Smith 2001). In terms of underwriting behavior, within a given market segment, mutuals can underwrite less-complex and less-risky policies than stock insurers can (Mayers and Smith 2000). As suggested in Cummins et al. (1997), "*the tendency of stock insurers to conduct more-complex or -risky types of businesses implies that they have more reasons to use derivatives for hedging than mutuals do and also are likely to have a comparative advantage in acting as derivatives dealers*". Selling or buying CDS protection is in fact a complex activity that requires a high level of managerial discretion. The applications of CDS require a better understanding of this innovative financial instrument and greater managerial discretion to include it in the company's policy. Insurance companies face a great deal of scrutiny and need to satisfy the regulations on derivatives that apply to the insurance industry. For example, insurance companies are required to build a robust compliance system for documenting, executing, and measuring CDS trades.[15] Insurers also need to have more resources and technology to satisfy regulations and trading requirements. Therefore, based on the managerial discretion hypothesis, we expect that stock insurers will be more likely than mutuals to actively engage in CDS transactions in terms of trading volume, whether as a buyer or a seller.

Yet the managerial risk aversion hypothesis suggests that stock insurers are less likely than mutuals to participate in hedging activity (Colquitt and Hoyt 1997). In a public firm, stockholders have voting control, and management's activity is monitored by the party averse to firm-specific risk transfer. Well-diversified stockholders of a public insurance company

[15] "Special Report: Credit Default Swaps—Flexibility, but with a volatile edge," *Financial Times*, November 1, 2005.

prefer that the firm not transfer risk at a cost greater than that of the risk itself. In addition, stock insurers can access capital markets more easily than mutual firms can and, therefore, they are more inclined than mutuals to accept portfolio risk rather than to hedge it away. Conversely, in a mutual firm, the interests of the owners and the fixed claimants are more closely aligned because the policyholders "own" the company. Management has substantial amounts of capital (primarily human capital) invested in the firm. As poorly diversified stakeholders, management and other fixed claimants, such as policyholders, have reason to support various forms of corporate risk reduction. The managers of mutual firms may exhibit risk aversion and place a high priority on avoiding or hedging risks. Buying CDS protection is commonly viewed as reducing credit risk. Consequently, mutuals are expected to purchase more CDS protection to hedge credit risk and sell less CDS protection in order to carry less risk. By comparison, stock insurers are more likely to sell CDS protection rather than purchase it.

Both the managerial discretion hypothesis and the managerial risk aversion hypothesis predict that stock insurers will be involved in more CDS *sales*. As for mutuals, the managerial discretion hypothesis suggests that they would buy less in CDS because of the complex feature of the derivatives contract, whereas the managerial risk aversion hypothesis predicts that they would sell more CDS.

So our third hypothesis is:

H3-1Sstock insurers would be expected to engage in more CDS sales transactions than mutual insurers, according to both managerial risk aversion and managerial discretion hypotheses.

H3-2: Stock insurers are expected to engage in more (less) CDS purchases transactions than mutual insurers if the managerial discretion (risk aversion) hypothesis dominates.

3. Data

The data on CDS positions are taken from Schedule DB of the annual regulatory statements filed by insurers with state regulators. Because insurers are closely regulated at the state level, a report of the insurer's use of derivatives, including CDS transactions, is required by National Association of Insurance Commissioners (NAIC), and this information is presented in the statutory annual statements of life and PC insurance companies. The detailed nature of the reported CDS trading data allows us to thoroughly analyze their CDS trading and evaluate the determinants behind their use of CDS.

We compiled the data for this study from regulatory annual statements filed by insurers with NAIC for the period from 2001 to 2007. We collected the notional amount, date of opening position, date of termination date, date of maturity, consideration received or paid, and gain (loss) on termination. In addition, we manually identified each transaction to gather information on the CDS position (purchase or sale), underlying reference entity, counterparty of the CDS, and rate paid (received) for holding a CDS. Our analyses are based on Schedule DB, which lists individual CDS transactions and reveal within-year and year-end transactions volume. We conduct the analysis based on individual firm-level data.[16]

Our sample covers 72 insurance companies, including 12 PC insurers and 60 life insurers, among which 44 are stock insurers and 28 are mutual insurers. In terms of individual CDS transactions, there are 6,829 CDS sell/buy transactions from 2001 to 2007, of which 3,864 transactions are in sell positions and 2,965 are in buy positions.

[16] Many insurers are members of groups that operate under common ownership. Cummins, Phillips, and Smith (1997, 2001) found that the group level analysis provided virtually no information concerning the derivative participation decision and thus may lack important information.

In the wake of the near-collapse of AIG, counterparty risk and chain reactions arising from CDS transactions between the insurance companies and other financial institutions are of particular interest to investors and regulators. Table 1 indicates that during this period insurance companies dealt with 29 counterparties, of which the large banks Deutsche Bank, Citigroup, Goldman Sachs, JPMorgan, Lehman Brothers, Merrill Lynch, Morgan Stanley, Barclays, UBS, CSFB, Bank of America, and Bear Stearns account for 89% of the total notional amount of CDS transactions. Three insurers and reinsurers—AIG, Aegon, and Swiss Re—were in the list of counterparties. The only two financial services companies on the counterparty list were Trilon Financial and KBC Financial, but their trading is rather limited. The fact that insurance companies are engaged in CDS transactions mainly with large banks helps to minimize the counterparty risk inherent in those transactions. However, the intricate web of transaction relationships between insurance companies and banks can lead to systemic shocks to the economy, which was precisely why AIG was bailed out by the government.

[Insert Table 1]

4. Empirical Analysis

To empirically test the hypotheses articulated above, we first conduct univariate analysis to provide a thorough examination of CDS utilization over time, CDS utilization by both stock and mutual insurers, and utilization by life and PC insurance companies. Following the results of univariate comparisons, we further investigate the hypotheses by conducting a multivariate regression analysis in which we control insurer characteristics as well as CDS characteristics.

4.1. Results of the Dynamics of Trading Behavior by Insurers

As a starting point, we present the breakdown of the notional CDS trading amount by insurers by year and buying or selling positions shown in Table 2. As shown in Panel A, the

aggregate notional amount is $104.6 billion from 72 insurers between 2001 and 2007. The mean and median of the CDS trading amount for an insurer within a year are $407.1 million and $94.3 million, respectively, with a maximum amount of $5.6 billion and a minimum of $0.2 million.

[Insert Table 2]

In addition, the average proportion of sell positions is 56.6% over the whole sample period. Except in 2006, the proportion of sell positions among insurance companies exceeds 50%. More formally, we test the null hypothesis that the proportion of sell positions for the whole sample is 50%, i.e., a sell position is equal to a purchase position. The chi-square test rejects the null hypothesis at the 1% level, supporting the conclusion that the percentage of sell transactions exceeded the percentage of buy positions. In the early period (2001–2003) 35 distinct insurers participated in the CDS market, whereas in the late period (2004–2007), 69 participated, for a total of 72 insurers during the entire sample period. While an increasing number of insurers has participated in the CDS market over time, and the total transaction amount has increased with the development of the market, the average proportion of sell positions declined from 69.9% in 2001–2003 to 54.9% in 2004–2007. The test of equality of sell positions between the two periods rejects the null hypothesis at the 1% level. The declining sell positions are consistent with H1, that insurers have reduced sell positions over time perhaps due to "learning effects."

Panels B and C report the distribution of CDS notional amount by type of transaction, indicating that during the sample period 59 insurance companies write CDS contracts, and 62 insurers purchase CDS contracts.[17] Although a majority of insurers act as both CDS buyers and sellers, some engage only in one-sided transactions. As shown in the rightmost column in Panel

[17] An insurer can take purchase and sell positions at the same time. This is why the total number of insurers taking sell (59) and buy positions (62) is higher than the number of sample firms, 72.

B, sell positions of insurance companies total 3,864, more than the 2,965 buy positions shown in Panel C. However, the aggregate notional amount of sell positions is $46.4 billion, compared to $58.2 billion for buy positions. Such a difference can be attributed to the lower average level of sell positions, $240.6 million, compared with the average of purchase position level, $295.3 million. Both panels show that the aggregate amount of sell and buy positions has increased over time with the exception of 2006, when insurers decreased their sell positions by about 1% (from 10,577 in 2005 to 10,522 in 2006), shown in Panel B, and increased their purchase positions by about 68% (from 9,844 in 2005 to 16,550 in 2006), shown in Panel C. In addition, the amount of the increase in purchase positions is greater than that in sell positions, especially in later years, in line with the finding in Panel A that insurers increased the percentage of their purchase positions gradually.

4.2. Life Insurers vs. PC Insurers

4.2.1 Comparisons of Transaction Positions

We present the results of CDS comparisons between life and PC insurers in Table 3, testing H3, which our results support. Our sample comprises seventy-two insurers: sixty life insurers and twelve PC insurers. Between 2001 and 2007 the number of life insurers using CDS increases from eleven to forty-nine, whereas the number for PC insurers remains stable and small, ranging from five to twelve. The aggregate CDS notional amount is $77.1 billion for life insurers, compared with $27.5 billion for PC insurers; the number of transactions is 5,374 for life insurers and 1,455 for PC insurers. However, as shown in Panel C the average notional amount of the CDS used by PC insurers at $491.5 million (largely from the purchases) is higher than that by life insurers ($383.6 million), though the difference is not significant. The percentage of sell

positions is 64.1% for life insurers versus 28.7% for PC insurers. According to chi-square tests, both percentages are shown to be significantly different from 50% at the 1% level, suggesting that life insurers acted as net sellers, while PC insurers acted as net buyers. There is also a difference between life and PC insurers in terms of the trend of CDS sell transactions over time. Specifically, the sell percentage of life insurers seems to be lower in the later period (e.g., 61.3% in 2007) than in the earlier period (e.g., 82.9% in 2002), in line with results of the entire sample. It indicates that life insurers gradually increase their purchase positions of CDS contracts over time, but are still net sellers. As for PC insurers, in the first year (2002) of initiating CDS transactions, all five PC insurers took sell positions. However, from 2003 to 2007, PC insurers rapidly adjust their CDS transactions and act as buyers, with the percentage of sell transactions overall below 50% of all transactions.

Panel C specifically shows comparisons between life and PC insurers with respect to overall CDS transactions, purchase positions, and sell positions. It indicates that the average purchase amount of life insurers is $178.87 million, which is significantly less than that of PC insurers, at $396.92 million. By contrast, the average sales amount of life insurers is $204.68 million, significantly more than that for PC insurers, at $94.56 million. Such results support H2-1.

[Insert Table 3]

4.2.2 Comparison of CDS Holding Period

The analysis of the holding periods of CDS transactions for both groups of insurers sheds more light on the purpose of CDS holdings by the insurance companies. We divide the sample into two groups. One subsample consists of CDS transactions terminated on or before their maturity dates, comprising 2,875 positions. The other subsample includes CDS that were active as of December 31, 2007, numbering 3,954 positions. For terminated positions, we calculate the

CDS holding period as the difference in terms of the number of days between the date of the open position and the date of the termination position over 365 days. For active positions, the holding period is defined as the number of days' difference between the position opening date and the last day of our sample period, divided by 365 days. As shown in Panel A of Table 4, the average and median CDS holding periods for the terminated subsample is 1.68 and 1.01 years, respectively. The holding period ranges from a minimum of 1 day to a maximum of 6.32 years, indicating that CDS can provide insurers with opportunities for long-term hedging or revenue generation, as well as short-term speculation. As shown in the upper-left panel of Panel B, life insurers have an average holding period of 1.85 years, about 0.91 year longer than that for PC insurers. The mean and median holding periods for PC insurers are 0.94 and 0.40 years, respectively, both shorter than one year, implying that PC insurers engage in CDS transactions for the purpose of short-term speculation. The mean and median differences between life and PC insurers are statistically significant at the 1% level. This is consistent with H2-2. When we break down the sample by sell and purchase position, as shown in the upper-right panel, we find that insurers on average hold CDS contracts for 2.13 years if they are sellers and 1.01 years if they are buyers. The mean and median differences are also significant at the 1% level.

More interestingly, we break down the sample first by sell/purchase position and then by type of insurer. The lower-left panel shows that the average holding periods of purchase positions for life and PC insurers are 1.11 and 0.75 years, respectively. The median holding periods are 0.60 and 0.30 years for life and PC insurers, respectively. This result suggests that, with respect to terminated positions, life insurers and PC insurers terminate 35.7% (= 838/2,346) and 61.1% (=323/529) of their buy positions within a year. This type of short-term trading is likely due to speculation. The holding period of sell positions for life insurers is 2.26 years,

significantly longer than that for PC insurers (1.24 years). The median holding period of sell positions for PC insurers is 0.49 years, suggesting that PC may also sell CDS for speculation purposes.

Panel C and D present the holding period for CDS positions active as of the end of 2007. Life insurers also have a longer holding period than PC insurers, as shown in the upper-left panel in Panel D. But the main difference in the holding period between two types of insurers is with respect to the sell side (see the lower-right panel). This is consistent with the expectation that PC insurers, compared to life insurers, have a shorter holding period of CDS sell positions due to the nature of their short-term liabilities.

[Insert Table 4]

4.3. Public Insurers Versus Mutual Insurers

4.3.1. Comparisons of CDS Positions

Table 5 reports CDS usage by distinguishing between stock insurers and mutual insurers. Our sample includes 44 stock insurers and 28 mutuals that engaged in CDS transactions between 2001 and 2007. Consistent with H3-1 and H3-2, we find that stock insurers are more actively involved in the CDS market than the mutuals, in terms of both the aggregate notional amount and the number of transactions. As shown in Panel A of Table 5, stock insurers engaged in 5,662 CDS trades, with a total notional amount of $91.4 billion. This is in sharp contrast to mutuals, which had 1,167 transactions, with a total notional amount of $13.3 billion. The use of CDS by stock insurers has grown enormously over time, whereas the trend among mutuals remained stable. For example, from 2004 to 20007, the notional amount for stock insurers rose from $6,920 million in 2004 to $37,673 million in 2007, while for the mutual insurers it increased from $1,217 million in 2004 to $5,010 million in 2007. The average and median CDS

trading amounts are $531.2 million and $115.3 million, respectively, for stock insurers, compared with $156.0 million and $39.5 million for mutual insurers. Panel C shows the results based on the *t*-test and Wilcoxon test for the mean difference and median difference, respectively, in the CDS trading amounts between stock and mutual insurers. Results suggest that stock insurers use more CDS than the mutuals do, which is significant at the 1% level.

To test H3, we further break down the sample by the transaction type. The comparisons of the purchase (and sell) positions between stock and mutual insurers also show significant differences. Stock insurers engaged in an average level of $303.51 million in purchase positions and $227.63 million in sell positions. Both levels are significantly higher at the 1% level than the corresponding average amounts of $70.32 million and $85.68 million in purchase and sell positions for mutual insurers. Such a finding supports H3-1, consistent with both the managerial risk aversion hypothesis and the managerial discretion hypothesis. However, the finding that stock insurers also have greater purchase positions than do mutuals supports H3-2, which is consistent with the managerial discretion explanation only.

[Insert Table 5]

4.3.2. Comparison of CDS Holding Periods

An analysis of holding periods sheds more light on the trading behaviors of stock and mutual insurers. Several points are worth mentioning. First, for positions terminated, as shown in Panel A of Table 6, stock insurers hold buy positions for an average of 0.93 year and a median of 0.50 year, both significantly shorter than for CDS held by mutual insurers. The short investment horizon suggests that these buy positions are likely for speculation purposes. It seems that stock insurers buy CDS for reasons other than hedging. This result provides further support for the managerial discretion hypothesis. Second, for the sell positions, the mean and median of holding

periods for both groups are longer than one year. This suggests that insurers sell CDS for the purposes other than speculation, which can be either hedging or asset replication. Third, for positions not terminated, as displayed in Panel B, stock insurers hold purchase positions for a shorter period than do mutual insurers, implying that stock insurers trade more frequently than mutuals do and act more like derivative dealers.

[Insert Table 6]

4.4. Cross-Sectional Analysis of Factors Explaining the Use of CDS

The hypotheses stated in Section 2 are supported, based on the univariate analyses examining the behaviors of stock insurers and mutual insurers and of life and PC insurers. In addition to the characteristics of insurers discussed in the univariate analyses, it is important to understand other characteristics of insurance companies that explain the use of CDS as buyers or sellers. Cummins et al. (2001) examine the participation decision and the volume decision on the use of derivatives by insurers. Our study focuses on volume decisions, but not the participation decision, by insurance companies because only a limited number (72 out of a total exceeding 3,000) of life and PC insurance companies engage in CDS transactions due to the high cost of entry. Based on the sample, we use a multivariate regression analysis as follows:

$$Position = \alpha + \beta_1 Stock + \beta_2 Life + \beta_3 Size + \beta_4 Life\_Size + \beta_5 CashRatio + \beta_6 BdRatio + \beta_7 StkRatio + \beta_8 \mathrm{Re}Ratio + \beta_9 ROA + \beta_{10} PW\_GW + \beta_{11} RBC\_\mathrm{Re}g + \beta_{12} SUP\_TA + \beta_{13} SpeDM + \beta_{14} Index + \varepsilon$$

The dependent variables that describe the degree of CDS participation by insurers are the buy, sell, and total CDS positions. That is, LBuyAmt, LSellAmt, and LAmt represent the natural logarithm of aggregate notional amounts over a year of CDS purchase, sell, and total positions, respectively. Using this approach, we can test factors affecting the use of CDS in both buy and

sell positions along with other related hypotheses. Insurers using CDS are basically large insurers and thus are homogeneous in size. Within this group it would be interesting to know whether firm size plays a role in the use of CDS.

Several independent variables are included in the regression analysis. Below we discuss the definition of these variables and predictions of their relationship to use of CDS.

Stock is a dummy variable equal to 1 if the firm is a stock insurer and 0 if the firm is a mutual insurer. *Life* is a dummy variable that equals 1 if the firm is a life insurer and 0 if the firm is a PC insurer. These two variables (*Stock*, *Life*) are used to differentiate the effect of stock and mutual insurers and life and PC insurers with respect to determination of the CDS position, to test H2 and H3 under a multivariate framework.

Size is defined as the natural logarithm of total assets of the insurer. Presumably setting up CDS derivatives activities and obtaining expertise to manage them have fixed costs. Larger firms tend to have the infrastructure in place that allows economies of scale in the information and transactions costs entailed in setting up CDS operations. They should also have more resources, including human capital, to execute and monitor CDS transactions and manage counterparty risk. Yet large insurers may be more diversified and therefore engage in CDS less for hedging purposes. Thus larger firms are expected to undertake more CDS transactions if the economies-of-scale explanation dominates diversification benefits. In addition, we use an interaction variable, Life_Size (Life × Size), to examine possible interaction effects.

The next set of control variables is associated with insurers' asset allocation to examine the effects of the investment decisions on insurers' CDS transaction volume (Cummins et al., 2001). The proportion of various assets may convey different information about the insurers' risk preference and liquidity conditions. The variables are defined as follows:

CashRatio is defined as the proportion of cash and short-term investment to investment assets. CashRatio is expected to be positively related to LAmtBuy because firms with more liquid assets can buy more CDS. Conversely, CashRatio is expected to be negatively related to LAmtSell because they have fewer incentives to sell CDS for revenue enhancement due to having fewer financial constraints.

NBdRatio is defined as the bond investment ratio. If CDS are purchased to hedge the credit risk embedded in their bond holdings, insurers with higher BdRatio should buy more CDS. So BdRatio will be positively correlated with LAmtBuy. But if insurers have lower bond holdings, they are likely to take more CDS sell positions either to replicate a bond portfolio for asset-liability duration management or to increase the credit risk in exchange for the fixed and regular income from buyers. Consequently, BdRatio would be negatively correlated with LAmtSell. However, if CDS are used for short-term speculation purposes, the bond investment ratio may be unrelated to either LAmtBuy or LAmtSell.

StkRatio is defined as the stock investment ratio. This variable measures investment activity as a share of the asset allocation of the insurance company.

ReRatio is defined as the real estate investment ratio. Investments in stock and real estate may expose insurers to more market and liquidity risk. To limit their risk exposure, insurers with higher StkRatio and ReRatio are more likely to engage in CDS buy positions rather than in sell positions. In other words, we expect StkRatio and ReRatio to be negatively (positively) associated with LAmtSell (LAmtBuy).

ROA is the return on assets. Firms with higher profitability, as measured by ROA, are expected to be financially stronger and thus can invest in the new market and assume higher risks. Thus, ROA is expected to have a positive effect on CDS sell positions.

PW_GW, a proxy for growth opportunities, is defined as the growth rate of insurance premiums. A higher premium rate implies that insurers underwrite more insurance business, thereby carrying more liability, which can motivate insurers to use more bonds for asset-liability management and thereby to buy more CDS protection from credit risks. Thus, a positive correlation is expected between PW_GW and LAmtBuy. At the same time, because of their need to manage asset-liability duration, insurers might be motivated to use CDS to replicate the bond portfolio, which has a more flexible duration. Based on this, we expect PW_GW to be positively related to the CDS sell positions.

RBC_Reg is defined as the ratio of risk-based capital (RBC) to RBC required by regulations. *SUP_TA* is the ratio of surplus equity to total assets. These two variables, *RBC_Reg* and *SUP_TA*, are used as proxies for a lower financial distress cost. Insurers are subject to risk-based capital regulations, which outline the actions that regulators may take when the ratio of the insurer's actual capital to its RBC falls below a certain threshold. Insurers with higher RBC_Reg and SUP_TA are less likely to experience financial distress and are more inclined to comply with regulatory requirement; they are therefore less likely to engage in CDS transactions, whether in buy or sell positions. So these two variables should be negatively related to LAmtBuy as well as with LAmtSell. However, using CDS to hedge bond positions requires additional RBC, which creates a disincentive for insurers with less capital to buy CDS, even though they are motivated to hedge due to their higher financial distress costs. Thus, RBC_Reg and SUP_TA are expected to be positively related to LAmtBuy as well as LAmtSell. So the expected signs of RBC_Reg and SUP_TA are ambiguous.

To test whether the insurer also uses CDS for speculation, we construct two variables, SPE_Buy and SPE_Sell.

SPE_Buy is a variable that indicates the insurer engaged in a purchase transaction that closed within a year. *SPE_Sell* indicates a sale transaction that closed within a year. If insurers close a transaction within a year, that is, before the maturity (the average maturity of CDS in our sample is five years), the transaction is more likely to be for speculation than for hedging or asset replication. We expect SPE_Buy to be positively associated with LAmtBuy if an insurer is likely to buy CDS for speculation. Similarly, SPE_Sell is expected to be positively associated with LAmtSell if an insurer is likely to sell CDS for speculation.

Index is a variable that indicates the impact of external market factors. We use *Index* to measure the price of credit risk. This CDS index is the average of investment-grade North America CDS index levels over a year. Higher index levels are associated with higher premiums, leading to lower demand for CDS and greater supply of CDS by insurers. So Index is expected to be negatively related to LAmtBuy and positively related to LAmtSell.

Our data is a pooled time-series and cross-sectional unbalanced panel data. CDS trading volumes for a given insurer is likely to be correlated over time, hence we must correct for the insurer-clustering effect. Moreover, CDS trading volumes may also be correlated across insurers for a given year, therefore, we need to correct for the time effect. Given this, we adjust for insurer-clustering effects while controlling for time effects, following Petersen (2009).

4.5 Results of Multivariate Regression

Table 7 reports descriptive statistics of the variables employed in the multivariate regression model for the whole sample of insurers using CDS collected from the NAIC database. The year-insurer panel data has 257 observations; 66% of which are stock insurers and 79% of which are life insurers. The average assets of insurers are total $30,269 million, ranging from $213 million to $219,050 million, confirming that large insurers are major participants in the

CDS market. The average investment ratio in cash and short-term investment is 3.8%, in bonds 71.4%, in stocks 10.7%, and in real estate assets 0.6%. The average return on asset (ROA) is 1.7%, ranging from -19.7% to 29.8%. The average premium growth rate is 1.08%, while the highest is 5.33%. For insurers that engage in CDS, transactions have an average RBC_Reg as high as 8.16, suggesting that they are financially solid insurers. The average ratio of surplus equity to total assets is 0.18. On average, 30.4% (26.1%) of insurers that purchase (sell) CDS protection terminate the contracts within a year, suggesting that they did so for speculation rather than hedging. Finally, the annual average CDS index level ranges from 39.8 basis points to 141.8 basis points, with a median of 50.4 basis points.

[Insert Table 7]

Table 8 reports the cross-sectional regression results. The dependent variable of Model 1 is LAmtBuy, that of Model 2 is LAmtSell, and that of Model 3 is LAmt. The coefficients on the Stock variable in three models are positive and significant in Model 2 and Model 3. This finding suggests that, compared to a mutual insurer, a stock insurer tends to engage more in CDS transactions as a seller, consistent with H2-1 and supporting the managerial discretion hypothesis. However, there is no significant difference between stock and mutual insurers with respect to the amount of CDS purchases. This may be due to the offsetting effects of the managerial risk aversion and managerial discretion hypotheses. The coefficient on Life is negative and significant in Model 1, but positive and significant in Model 2. Results suggest that, compared to PC insurers, life insurers buy fewer CDS, but sell more CDS, consistent with H3-1. Overall, these results provide evidence supporting the hypotheses that stock insurers and mutual insurers behave differently in CDS transactions due to their organizational forms; life insurers behave differently from PC insurers due to their specialization in line-of-insurance business.

[Insert Table 8]

Size is positive and highly significant in all three regressions, supporting the hypothesis that insurers' usage of CDS is subject to economies of scale. This can also be attributable to their financial soundness and lower counterparty risk. Although an average life insurer tends to buy fewer CDS than a PC insurer, a larger life insurer is likely to buy more than a small life insurer due to economies of scale, resulting in the positive sign for Life_Size in Model 1. Regarding the sell position, an average life insurer tends to sell more CDS than a PC insurer, but a larger life insurer is likely to sell less than a small life insurer perhaps because they are more diversified and do not need to use CDS as a way of increasing their revenue.

Next, a positive (negative) coefficient is found for CashRatio in Model 1(Model 2), confirming our hypothesis that more liquid insurers buy more CDS and sell fewer CDS. Interestingly, the coefficient on BdRatio, the bond investment ratio, is negative and significant in Model 3, indicating that insurers may engage in CDS less when they hold more bonds. In addition, the coefficient for BdRatio is positive but not significant in Model 1. Taken together, the results in Models 1 and 3 indicate that insurers may use CDS for purposes other than hedging the credit risk embedded in their bond portfolios. In other words, insurers whose assets include less in bond holdings are likely to engage in more CDS use, either as an alternative asset to assume credit risk or to replicate their bond portfolios. The negative and significant correlation between BdRatio and LAmtSell in Model 2 further confirms expectations.

The StkRatio variable is not a significant variable in determining the extent of using CDS. The coefficients for ReRatio (the real estate investment ratio) are negative and significant in Models 2 and 3, but insignificant in Model 1, providing evidence that insurers with more risky

and illiquid assets tend to be more conservative in utilizing CDS. In addition, large banks may avoid dealing with insurers as counterparties if their existing assets carry greater liquidity risk.

The coefficients for ROA are positive and significant in Models 2 and 3, but insignificant in Model 1. This indicates that firms with higher profitability are more capable of engaging in more CDS sales transactions, perhaps due to their financial soundness. The PW_GW variable, a proxy for insurance business growth opportunities, and RBC_Reg are not statistically significant in all three models. The coefficient for the Sup_TA ratio is negative and significant in Model 2, suggesting that well-capitalized firms might be more risk-averse and thus sell fewer CDS.

Consistent with our hypothesis, SPE_Buy is positively related to LAmtBuy and SPE_Sell is positively associated with LAmtSell. This result supports that transaction volumes of CDS transactions are higher when CDS are bought or sold for speculation. Our findings suggest that insurers participate in the CDS market not only for hedging, but also for other purposes.

The coefficient for CDS Index is negative in Model 1, but positive in Model 2, suggesting that the CDS premium plays a role in the supply and demand of an insurer's decisions on CDS trading volume. A higher CDS premium reflects the degree of credit risk assumed in the CDS contracts. Results show that a higher CDS premium creates a disincentive for insurers to purchase CDS protection, but encourages insurers to engage in more CDS sales. Results also suggest that insurers tend to sell more CDS protection when banks and other market participants have a higher demand for the protection as overall credit risk is higher, as reflected in a higher CDS premium. For example, since the subprime crisis in the summer of 2007, banks have significantly increased their net CDS protection in order to hedge more conservatively their credit risk exposure. That same year (as shown in Panels A and B of Table 3) both life and PC insurers increased their sell transactions by about 5% (from 56.3% to 61.3%) and 8% (from

25.9% to 33.1%), respectively. Insurance companies are willing to take on more credit risk in exchange for receiving higher CDS premiums.

5. Conclusions

The fledging CDS market presents insurance companies with new opportunities for managing their credit risk, enhancing their revenue, and replicating assets to achieve a better duration match. However, this market comes with a cost if it is not properly used, as the turmoil of AIG in the recent financial crisis has shown. Moreover, this over-the-counter market has not been regulated, leading to great opacity with respect to market participants and their trading behavior. The requirement for insurers to report their derivative use to NAIC offers us a unique opportunity to peek behind the curtains.

Using the detailed transaction data reported by insurers, this study systematically examines the use of CDS by U.S. life and property and casualty (PC) insurance companies from 2001 to 2007. Contrary to the common belief that insurance companies are largely engaging on the sell side of the CDS market, insurers actually participate in both purchase and sell credit protection, with large banks as major counterparties. The percentage of sell positions has declined in recent years due to "learning effects." Consistent with asset-liability duration management, life insurers are more active participants in the CDS market than PC insurers are, and they are more likely to write CDS contracts to replicate their bond portfolio. In addition, life insurers tend to hold CDS contracts for a longer period than PC insurers do, in an attempt to match their liability duration. In contrast, PC insurers, with the average CDS holding period less than one year, are more likely to buy CDS contracts to realize capital appreciation and boost the growth of their surplus. When we break down the sample according to the organization form,

stock insurers tend to engage in more CDS transactions than mutual insurers do. Stock insurers hold their buy positions for less than a year, most likely for the purpose of speculation, and the holding period is significantly shorter than it is for mutual insurers. The comparison between stock and mutual insurers provides support for the managerial discretion hypothesis.

The regression analysis indicates that the purchase and sell amounts of CDS by insurers are reliably associated with a number of insurer-specific characteristics. Several interesting results are noted. First, larger insurers appear to use more CDS, consistent with the economies-of-scale explanation. Second, insurers with more liquid assets tend to buy more CDS. In addition, insurers with a higher liquid assets ratio and real estate allocation ratio tend to sell fewer CDS. Insurers with lower bond investment and greater profitability are likely to sell more CDS. Our evidence suggests that insurers engage in CDS transactions not only for the purpose of hedging but also for speculation. In general, the CDS trading amount is greater if trading is for speculation. Finally, a higher CDS price motivates insurers to sell CDS and discourages insurers from buying CDS. In sum, our results suggest that insurance companies participate in the CDS market for a variety of reasons, including hedging, asset replication, and revenue enhancement.

Our study contributes to the literature in two major ways. First, we extend a series of studies on derivative usage in insurance companies by focusing on credit derivatives. We document the extent of CDS use by different type of insurers and explore various reasons for insurance companies to take different positions in the CDS market. We also identify insurer characteristics that explain the use of CDS. Second, our paper complements the study on bank use of credit derivatives by focusing on the insurance industry. Using a unique data set, we are able to shed light on the trading behavior of insurance companies, another group of financial institutions that are actively involved in the CDS market and have contributed to the market

turmoil in the recent financial crisis. The results help to increase the transparency of the largely unregulated CDS market and should be useful for market participants and regulators.

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Table 1: Insurer's Amount by Counterparty

	All				Sell		Buy	
Counterparty	N.	Sum (mn)	Mean (mn)	% of Sale Positions for Insurers	Sum (mn)	Mean (mn)	Sum (mn)	Mean (mn)
Deutsche Bank	687	15,991	23.3	43.67	3,595	12.0	12,395	32.0
Citigroup	517	10,732	20.8	57.83	3,528	11.8	7,204	33.1
Merrill Lynch	763	9,175	12.0	76.54	6,476	11.1	2,699	15.1
Goldman Sachs	635	8,974	14.1	37.48	3,055	12.8	5,919	14.9
JP Morgan	574	8,292	14.5	53.83	4,210	13.6	4,082	15.4
Lehman Brothers	486	7,266	15.0	43.42	2,874	13.6	4,392	16.0
Morgan Stanley	582	6,971	12.0	61.34	4,977	13.9	1,994	8.9
PRU Global	789	6,777	8.6	78.33	5,998	9.7	779	4.6
UBS	523	6,016	11.5	56.02	3,788	12.9	2,228	9.7
Barclays	226	5,982	26.5	43.36	1,876	19.1	4,106	32.1
Credit Sucsse	375	4,991	13.3	58.93	1,946	8.8	3,045	19.8
Bank of America	294	4,455	15.2	48.98	1,759	12.2	2,696	18.0
Bear Stearns	145	3,912	27.0	42.76	682	11.0	3,231	38.9
Bank of Montreal	16	1,077	67.3	6.25	10	10.0	1,067	71.1
BNP Paribas	18	1,000	55.6	38.89	125	17.9	875	79.6
HSBC	32	647	20.2	46.88	325	21.7	322	18.9
Royal Bank of Scotland	53	631	11.9	37.74	163	8.1	469	14.2
Wachovia	26	554	21.3	73.08	450	23.7	104	14.8
Trilon Financial Corp	5	425	85.0	0.00	0	0.0	425	85.0
KBC Financial	23	165	7.2	100.00	165	7.2	0	0.0
ABN AMRO	8	145	18.1	100.00	145	18.1	0	0.0
AIG Financial	10	140	14.0	100.00	140	14.0	0	0.0
Bank One	28	140	5.0	92.86	130	5.0	10	5.0
Aegon	12	136	11.3	0.00	0	0.0	136	11.3
Royal Bank of Canada	1	20	20.0	100.00	20	20.0	0	0.0
Swiss Re	1	3	2.5	0.00	0	0.0	3	2.5
Total	6,829	104,617	15.3	56.58	46,436	12.0	58,181	19.6

Table 2. CDS Notional Amounts (in Millions) by Year and Buy/Sell Positions

Panel A: All

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions	% of Sales Transactions
2001	11	409	37.2	30.0	120.0	2.0	31.6	58	75.9
2002	20	1,507	75.3	41.5	393.0	2.0	105.9	220	84.1
2003	31	4,389	141.6	78.0	724.9	1.1	186.4	482	62.7
2004	33	8,137	246.6	138.5	973.9	1.1	275.5	734	56.3
2005	49	20,420	416.7	90.0	5118.7	1.0	905.3	1,163	62.9
2006	52	27,072	520.6	120.3	4284.3	1.0	901.0	1,511	48.9
2007	61	42,683	699.7	127.7	5599.5	0.2	1250.5	2,661	54.5
Early Period (2001-2003)	35	6,305	101.7	46.4	724.9	1.1	150.1	760	69.9
Late Period (2004-2007)	69	98,313	504.1	115.0	5599.5	0.2	968.3	6,069	54.9
Total	72	104,617	407.1	94.3	5599.5	0.2	863.5	6,829	56.6

Panel B: Insurance Company as Protection Seller

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions
2001	6	240	40.0	25.0	120.0	10.0	42.0	44
2002	17	1,213	71.3	45.0	378.0	2.0	90.7	185
2003	20	2,532	126.6	42.5	701.0	0.6	179.3	302
2004	23	4,396	191.1	106.0	900.5	0.6	245.3	413
2005	35	10,577	302.2	100.0	2498.0	2.0	526.2	731
2006	40	10,522	263.1	107.5	1512.3	1.0	376.8	739
2007	52	16,957	326.1	64.5	2091.5	2.0	508.5	1,450
Total	59	46,436	240.6	75.0	2498.0	0.6	406.9	3,864

Panel C: Insurance Company as Protection Buyer

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions
2001	7	169	24.1	28.0	50.0	2.0	17.7	14
2002	7	294	42.0	28.0	170.0	2.0	58.0	35
2003	23	1,857	80.7	19.5	367.5	0.6	110.4	180
2004	27	3,741	138.6	49.8	613.1	0.6	188.9	321
2005	40	9,844	246.1	52.5	3270.3	0.7	655.3	432
2006	44	16,550	376.1	83.6	3717.9	2.3	827.8	772
2007	49	25,726	525.0	103.4	5154.3	0.2	1048.3	1,211
Total	62	58,181	295.3	54.3	5154.3	0.2	734.9	2,965

Note: ***, ** and* denote significance of the chi-square test at the 1%, 5%, and 10% level, respectively.

Test 1: The percentage of sell positions for the whole sample is 50%.
Result: Chi-square test statistic is 118.34***
Test 2: The percentage of sell positions for the early period is equal to that of the late period.
Result: Chi-square test statistic is 61.45***

Table 3. CDS Notional Amounts (in Millions) by Life and PC Insurers

Panel A: Life Insurers (N=60)

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions	% of Sales Transactions
2001	11	409	37.2	30.0	120.0	2.0	31.6	58	75.9
2002	15	1,349	89.9	47.8	393.0	2.0	117.4	205	82.9
2003	22	3,551	161.4	76.5	724.9	1.1	214.4	414	69.8
2004	24	5,855	244.0	123.0	973.9	1.1	300.9	604	63.9
2005	38	15,642	411.6	75.6	5118.7	1.0	904.7	928	72.6
2006	42	20,328	484.0	109.5	4284.3	1.0	890.5	1,144	56.3
2007	49	29,962	611.5	127.7	5599.5	0.2	1178.2	2,021	61.3
Total	60	77,095	383.6	81.0	5599.5	0.2	836.2	5,374	64.1

Panel B: Property and Casualty Insurers (N=12)

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions	% of Sales Transactions
2002	5	158	31.6	10.0	106.0	2.0	43.1	15	100.0
2003	9	838	93.1	82.9	190.3	4.0	76.4	68	19.1
2004	9	2282	253.5	222.0	613.1	4.0	208.0	130	20.8
2005	11	4,779	434.4	103.4	3270.3	2.7	951.0	235	24.3
2006	10	6,745	674.5	402.4	3260.3	6.2	977.3	367	25.9
2007	12	12,721	1060.1	382.0	5154.3	6.1	1515.2	640	33.1
Total	12	27,523	491.5	104.7	5154.3	2.0	958.6	1,455	28.7

Panel C: Comparison of Life and PC Insurers

Total Amount	Mean	Median	Purchase Amount	Mean	Median	Sales Amount	Mean	Median
Life	383.56	81.00	Life	178.87	15.00	Life	204.68	29.50
PC	491.48	104.71	PC	396.92	62.75	PC	94.56	10.00
Dif.	-107.92	-23.71	Dif.	-218.05	-47.75	Dif.	110.12	19.50
Test Stat.	0.83	0.56	Test Stat.	2.22**	2.94***	Test Stat.	2.92***	2.16**

Note: The *t*-test statistic is to test for mean difference and Wilcoxon statistic for median difference.

***,** and* denotes significance of the chi-square test at the 1%, 5%, and 10% level, respectively.

Test 1: H0: the percentage of sell positions for the life insurers is 50%

Chi-square test statistic is 428.79***

Test 2: H0: the percentage of sell positions for the PC insurers is 50%

Chi-square test statistic is 263.34***

Test 3: H0: the percentage of sell positions for life and PC insurers is equal

Chi-square test statistic is 583.91***

Table 4. CDS Holding Period (in Years) by Life and PC Insurers

Panel A: Positions Terminated

	N.	Mean	Median	Max	Min	Std. Dev.
Total	2875	1.68	1.01	6.32	0.00	1.67

Panel B: Pairwise Comparison for Positions Terminated

Life/PC	N.	Mean	Median
Life	2346	1.85	1.19
PC	529	0.94	0.40
Dif.		0.91	0.79
Test Stat.		13.78***	12.52***

Buy/Sell	N.	Mean	Median
Buy	1,161	1.01	0.52
Sell	1,714	2.13	1.81
Dif.		-1.12	-1.29
Test Stat.		-20.47***	-15.07***

Buy	N.	Mean	Median
Life	838	1.11	0.60
PC	323	0.75	0.35
Dif.		0.36	0.25
Test Stat.		5.53***	6.15***

Sell	N.	Mean	Median
Life	1,508	2.26	2.02
PC	206	1.24	0.49
Dif.		1.02	1.53
Test Stat.		8.19***	8.18***

Panel C: Positions Not Terminated

	N.	Mean	Median	Max	Min	Std. Dev.
Total	3954	2.21	2.13	8.49	0.01	1.51

Panel D: Pairwise Comparison for Positions Not Terminated

Life/PC	N.	Mean	Median
Life	3028	2.28	2.16
PC	926	1.98	1.62
Dif.		0.30	0.54
Test Stat.		5.47***	4.61***

Buy/Sell	N.	Mean	Median
Buy	1,804	2.04	1.46
Sell	2,150	2.35	2.35
Dif.		-0.31	-0.89
Test Stat.		-6.62***	-6.20***

Buy	N.	Mean	Median
Life	1090	2.00	1.34
PC	714	2.10	2.03
Dif.		-0.10	-0.69
Test Stat.		-1.48	-2.89***

Sell	N.	Mean	Median
Life	1,938	2.43	2.39
PC	212	1.60	1.14
Dif.		0.83	1.25
Test Stat.		7.62***	8.83***

Note: For terminated positions, the holding period is defined as the day difference between date of position opening and date of position termination divided by 365 days. For positions not yet terminated, the holding period is defined as the day difference between date of position opening and the last day of 2007, divided by 365. Dif. is the mean and median difference in holding period between two sub-samples. Test Stat. reports the *t*-test statistic for mean difference and Wilcoxon statistic for median difference. *** denotes significance at the 1% level.

Table 5. CDS Notional Amounts (in Millions) by Stock/Mutual Insurers

Panel A: Stock Insurance Company (N=44)

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions	% of Sales Transactions
2001	4	138	34.5	34.0	50.0	20.0	13.2	11	9.1
2002	13	1,280	98.5	50.0	393.0	2.0	125.6	167	81.4
2003	20	3,481	174.1	111.0	724.9	4.0	210.4	388	64.9
2004	23	6,920	300.9	215.0	973.9	4.0	294.2	620	57.9
2005	36	17,304	480.7	107.7	5118.7	2.7	1009.4	970	66.0
2006	36	24,562	682.3	271.5	4284.3	6.2	1038.4	1,278	49.6
2007	40	37,673	941.8	264.0	5599.5	0.2	1453.7	2,228	53.1
Total	44	91,357	531.2	115.3	5599.5	0.2	1007.6	5,662	56.6

Panel B: Mutual Insurance Company (N=28)

Year	N. of Insurers	Sum	Mean	Median	Max	Min	Std. Dev.	N. of Transactions	% of Sales Transactions
2001	7	271	38.7	30.0	120.0	2.0	39.6	47	91.5
2002	7	227	32.4	38.0	75.0	2.0	26.5	53	92.5
2003	11	908	82.5	13.0	362.4	1.1	118.9	94	53.2
2004	10	1,217	121.7	19.9	529.1	1.1	182.8	114	47.4
2005	13	3,117	239.8	26.8	1863.3	1.0	510.0	193	47.2
2006	16	2,511	156.9	44.7	642.0	1.0	200.8	233	45.1
2007	21	5,010	238.6	77.0	2191.7	2.5	479.5	433	61.4
Total	28	13,260	156.0	39.5	2191.7	1.0	332.5	1,167	56.4

Panel C: Comparison of Stock and Mutual Insurers

Total Amount	Mean	Median	Purchase Amount	Mean	Median	Sales Amount	Mean	Median
Stock	531.14	115.30	Stock	303.51	45.00	Stock	227.63	32.50
Mutual	156.00	39.50	Mutual	70.32	9.00	Mutual	85.68	15.00
Dif.	375.14	75.80	Dif.	233.19	36.00	Dif.	141.95	17.50
Test Stat.	4.42***	4.77***	Test Stat.	3.77***	3.07***	Test Stat.	3.52***	3.25***

Note: Test Stat. reports the *t*-test statistic for mean difference and Wilcoxon statistic for median difference.

***,** and* denote significance of the chi-square test at the 1%, 5%, and 10% level, respectively.

Table 6. CDS Holding Period (in Years) by Stock and Mutual Insurers

Panel A: Pairwise Comparison for Positions Terminated

Stock/Mutual	N.	Mean	Median
Stock	2417	1.67	0.95
Mutual	458	1.71	1.25
Dif.		-0.04	-0.30
Test Stat.		0.59	2.57**

Buy	N.	Mean	Median
Stock	986	0.93	0.50
Mutual	175	1.45	1.01
Dif.		-0.52	-0.51
Test Stat.		5.19***	5.78***

Sell	N.	Mean	Median
Stock	1431	2.18	1.83
Mutual	283	1.88	1.78
Dif.		0.30	0.05
Test Stat.		2.51**	1.64

Panel B: Pairwise Comparison for Positions Not Terminated

Stock/Mutual	N.	Mean	Median
Stock	3245	2.13	2.12
Mutual	709	2.56	2.16
Dif.		-0.43	-0.04
Test Stat.		6.23***	5.96***

Buy	N.	Mean	Median
Stock	1470	1.85	1.30
Mutual	334	2.87	3.08
Dif.		-1.02	-1.78
Test Stat.		-10.45***	-10.09***

Sell	N.	Mean	Median
Stock	1775	2.37	2.39
Mutual	375	2.28	1.64
Dif.		0.09	0.75
Test Stat.		0.89	1.74*

Note: For terminated positions, the holding period is defined as the day difference between date of position opening and date of position termination divided by 365. For positions not terminated, the holding period is defined as the day difference between date of position opening and the last day of 2007, divided by 365. Dif. Measure = the mean and median difference in holding period between two sub-samples. Test Stat. reports the *t*-test statistic for mean difference and Wilcoxon statistic for median difference. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 7. Descriptive Cross-Sectional Statistics (N = 257)

Variable	Mean	Std. Dev	Min	Max	Median
Public	0.66	0.47	0.00	1.00	1.0
Life	0.79	0.41	0.00	1.00	1.0
TA (mn)	30,269	44,288	213	219,050	10,739
CashRatio (%)	3.8	6.2	0.0	64.6	2.1
BdRatio (%)	71.4	13.4	14.7	95.3	73.6
StkRatio (%)	10.7	13.0	0.0	60.9	4.6
ReRatio (%)	0.6	1.7	0.0	18.7	0.1
ROA (%)	1.7	3.7	-19.7	29.8	1.1
Inv_Opp (%)	1.08	0.59	0.14	5.33	1.01
RBC_Reg	8.16	3.73	2.13	32.90	7.66
SUP_TA	0.18	0.14	0.03	0.77	0.11
Spe_Buy	0.30	0.46	0.00	1.00	0.00
Spe_Sell	0.26	0.44	0.00	1.00	0.00
Index	0.62	0.28	0.40	1.42	0.50

Variable definitions:
Stock is a dummy variable that is equal to 1 if the firm is a stock insurer and 0 otherwise; Life is a dummy variable that is equal to 1 if the firm is a life insurer and 0 otherwise; TA is total assets of an insurer in millions of dollars; CashRatio, BdRatio, StkRatio, CashRatio, ReRatio are defined as cash and short-term investment ratio, bond investment ratio, stock investment ratio, cash and short-term investment ratio, and real estate investment ratio, respectively; PW_GW is the growth rate of insurance premium; RBC_Reg is the ratio of risk-based capital (RBC) to regulatory required RBC; SUP_TA is the ratio of equity surplus to total assets; Spe_Buy is a dummy variable if the insurer has a purchase transaction closed within a year, and Spe_Sell is a dummy variable if the insurer has a sell transaction closed within a year; Index is the average of investment-grade North America CDX index level over a year.

Table 8. Cross-Sectional Analysis of the Use of CDS by Insurers

This table presents coefficient estimates of the cross-sectional regression:

$$Position = \alpha + \beta_1 Stock + \beta_2 Life + \beta_3 Size + \beta_4 Life\_Size + \beta_5 CashRatio + \beta_6 BdRatio + \beta_7 StkRatio + \beta_8 \mathrm{Re}Ratio + \beta_9 ROA + \beta_{10} PW\_GW + \beta_{11} RBC\_\mathrm{Re}g + \beta_{12} SUP\_TA + \beta_{13} SpeDM + \beta_{14} Index + \varepsilon$$

Dependent variables Position are LAmtBuy, LAmtSell, and LAmt in Model 1-3, , which are the natural logarithm of aggregate notional amount of CDS purchase positions, sales positions, and total positions for an insurer over a year, respectively. Size is the natural logarithm of total assets of the insurer; Life_Size is the interaction term between Life and Size. Other variables are defined in Table VI. The estimates are from an OLS regression for 257 observations with 70 clusters of insurers. Year dummies are also included in the regression. Reported in parentheses are t-statistics based on clustered standard errors, which are robust standard errors adjusted for clustering by insurance companies. The superscripts ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Model	**Model 1**		**Model 2**		**Model 3**	
Dependent Variables	**LAmtBuy**		**LAmtSell**		**LAmt**	
Constant	-12.19		-13.83		3.48	
	(-1.67)		(-2.05)		(0.90)	
Stock	0.33		0.80		0.78	
	(0.67)		(1.92)	*	(2.91)	***
Life	-4.13		3.06		-1.15	
	(-2.51)	***	(1.98)	**	(-0.81)	
Size	0.51		0.59		0.58	
	(2.81)	***	(3.34)	***	(5.99)	***
Life_Size	0.14		-0.09		0.04	
	(2.80)	***	(-1.72)	*	(0.89)	
CashRatio	9.66		-9.49		2.78	
	(2.55)	***	(-2.72)	***	(1.18)	
BdRatio	1.16		-4.71		-3.58	
	(0.38)		(-1.92)	*	(-2.08)	**
StkRatio	-1.65		-0.14		-2.08	
	(-0.40)		(-0.05)		(-0.78)	
ReRatio	-0.79		-23.01		-14.19	
	(-0.13)		(-3.51)	***	(-2.83)	***
ROA	3.01		7.99		9.22	
	(0.65)		(2.05)	**	(2.38)	**
PW_GW	-0.04		-0.17		-0.12	
	(-0.18)		(-0.93)		(-0.98)	
RBC_Reg	-0.09		-0.05		-0.08	
	(-1.43)		(-1.23)		(-1.43)	
SUP_TA	4.93		-6.58		-1.93	
	(1.52)		(-2.48)	**	(-0.67)	
Spe_Buy	1.67				0.82	
	(3.68)	***			(3.55)	***
Spe_Sell			1.39		0.19	
			(4.02)	***	(0.60)	
Index	-2.60		2.32		-0.35	
	(-3.21)	***	(1.69)	*	(-0.45)	
R-square	45.12		54.63		59.02	
R-square adj. (%)	40.72		50.99		55.55	
F-value for model fit	9.48	***	20.44	***	26.88	***