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

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Abstract: Using a unique data set 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 value over the years, while as a share of total transactions, sell positions have declined in more recent years. In line with asset-liability management, life insurers, compared to property-casualty (PC) insurers, tend to write more CDS contracts and hold the contracts for longer periods. Moreover, stock and mutual insurers with different organizational forms show different CDS transaction behaviors. In particular, stock insurers engage in more CDS transactions than mutual insurers do, supporting the managerial discretion hypothesis. We also identify a number of other firm 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.

JEL: C31, D21, G22

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

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 (Bank for International Settlements, 2008).[1] Banks account for a majority of the trading activity in credit derivatives. 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 another asset category as well as an additional risk management mechanism. According to data from the British Bankers' Association (2006), insurers worldwide held 18 percent of the market in credit default swaps (CDS) in sell positions and six percent in CDS purchase positions. The bailout of American International Group (AIG) in September 2008 attracted heated public attention to the use of credit derivatives by insurance companies in the United States and worldwide.

However, to the best of our knowledge, the use of credit derivatives by insurers has received limited research attention. This study intends to fill this important void by examining the positions of their CDS transactions and the factors contributing to the degree of participation by insurers in the CDS market. This is the first attempt to investigate systematically the heterogeneity on the use of CDS by U.S. life 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. Indeed, the credit derivatives market was largely over-the-counter and not regulated by any state or federal authorities during our sample period. Trading activities by major participants, such as banks and hedge funds, are private.[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, the CDS was blamed as the culprit behind the fall of AIG, and the lack of regulation was accused of contributing to systemic risk.

One strand of literature on CDS usage primarily focuses on risk-hedging and/or risk-taking behaviors by banks and hedge funds (e.g., Minton, Stulz and Williamson, 2009; Shao, 2009; Chen, 2011). Since insurers are another major group of active participants in the CDS markets, it is equally important to examine how CDS affects the risk and firm value of insurance companies. 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 with a unique opportunity for examining CDS transactions by insurance companies based on a variety of firm characteristics. The analyses shed light on the trading behaviors and reasons behind CDS participation by a large institution group in the financial market. The

[1] After the financial crisis in 2008, the outstanding CDS notional amount shrank to $26.26 trillion as of the first half of 2010 due to market consolidation (International Swaps and Derivatives Association, Inc.).
[2] Minton et al. (2009) investigate the use of credit derivatives by banks. However, their data is taken from banks' annual reports and is at the aggregate level. Detailed information on CDS transactions by banks is not publicly available.

reported transaction-level CDS data taken from Schedule DB of the regulatory annual statements of life and PC insurance companies include the transaction types (buy or sell), dates (position opening and closing dates), and counterparty information (e.g., names). The detailed nature of the data allows us to analyze CDS purchases and sales separately, test a number of economic hypotheses, and evaluate the determinants of taking different CDS positions by the insurance industry.

One market perception from AIG's debacle was that the insurance company participated in the CDS market only as a seller in order to collect premiums.[3] However, most insurance companies that engage in CDS transactions act not only as sellers, but also as buyers. Selling credit protection is an extension of taking on credit risk in insurance companies' investment activities to generate income and replicate assets to manage liabilities duration. Because the CDS market is more liquid and has large institutional participants with information advantages, trading credit risks through CDS contracts is arguably one of the most efficient ways. On one hand, taking CDS contracts in sell positions provides insurers more flexibility than holding traditional corporate bonds in managing maturity structure and collecting regular interest payments. Trading through CDS contracts has also been shown as a more sensitive indicator of the underlying reference entity's credit risk than corporate bonds (Blanco et al., 2005). On the other hand, buying CDS allows insurers to hedge the credit risks associated with their bond assets, which is the major investment category of insurers.[4] Insurance companies might also invest in CDS simply to enhance their investment income. 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.

This study provides a thorough empirical examination on the descriptive statistics, illustrating how CDS has been practiced differently by insurance companies by considering their investment and underwriting practices as well as their organization forms. Using the unique data set from NAIC over a seven-year period (2001–2007), we first examine whether the insurance companies have solely acted as net sellers as the investors perceive and how the dynamics of their trading behaviors have evolved over time. Next, we examine whether life and PC insurers with different underwriting businesses behave differently in terms of their purchase and sell positions and holding periods. It is important to distinguish the rationales for CDS use between the two insurance groups, which underwrite different types of insurance policies and carry different risk or return profiles. Our results indeed 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 and therefore utilize CDS as an approach to replicate their asset portfolios. Moreover, the average holding period of CDS contracts by PC insurers is less than one year and is shorter than that of life insurers. This is consistent with the notion that PC insurers are likely to trade CDS beyond hedging and asset replication purposes, which usually require a longer holding period. As a result, speculation or income generation can be the reason why PC insurers use CDS transactions to boost their surplus growth.

[3] Adam Davidson, "How AIG fell apart," Reuters, September 18, 2008.
[4] According to Karapiperis (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.

Furthermore, we investigate how an insurer's ownership structure, i.e., stock insurers vs. mutual insurers, affects the position of CDS transactions. Our results show that stock insurers are more actively involved in the CDS market than mutual insurers on both purchase and sell positions. In particular, the finding that stock insurers engage in more buy positions supports the managerial discretion hypothesis (Mayers and Smith, 1988).

Finally, we explore other firm-specific factors that 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. 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 investments. In addition, the profitability of insurers is positively and significantly associated with CDS sell positions. Finally, higher CDS index levels create a disincentive for taking a purchase position but a motivation for a sell position.

This study contributes to the literature in two major ways. First, we add to the literature on the subject of derivative use by insurers (Colquitt and Hoyt, 1997; Cummins, Phillips, and Smith, 1997, 2001) by focusing on credit derivatives. Colquitt and Hoyt (1997) analyze the use of derivatives by life insurers licensed in Georgia. Our study uses data for all U.S. insurance companies for a more recent period compared to their study based on 1992 data, and for credit derivatives rather than other derivatives. Cummins, Phillips, and Smith (1997) present extensive descriptive statistics on the use of derivatives (options, futures, forwards, and swaps) by U.S. life and PC insurers. Cummins, Phillips, and Smith (2001) further specify and test economic hypotheses regarding the factors driving the participation and volume decisions by insurers. In contrast, we present the dynamic use of CDS, the more recently developed derivative, 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 the understanding of the economic rationales behind CDS practice by life and PC insurance companies.

Second, employing the insurance industry, another major participant in the credit derivatives market in our research sample, we complement the study by Minton et al. (2009) and Chen (2011), which systematically and respectively examines the use of credit derivatives by U.S. bank holding companies and hedging funds. Minton et al. (2009) examine the use of credit derivatives by 19 large U.S. bank holding companies from 1999 to 2003. Banks tend to use credit derivatives more for dealer activities than for hedging activities, and a majority of them are net buyers of credit protection. Chen (2011) examines the effect of derivative usage on risk in the hedge fund industry and finds that the use of credit derivatives decreases total risk and idiosyncratic risk for hedge funds but has no significant impact on market risk. The use of credit derivatives by insurance companies could be fundamentally different from that by banks and hedging funds due to their business model and the heavily state-regulated nature of the insurance industry. Using a more recent period of data, we find that insurance companies act as both buyers and sellers, for both hedging and speculation purposes.

The rest of the paper is organized as follows. Section 2 gives some background and develops the 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

Insurers use many existing financial derivatives, such as options, futures, swaps, and forward contracts, to manage financial risks. The existing literature shows that insurers use financial derivatives by consideration of the expected costs arising from financial distress, asset volatility, liquidity, taxes, and organizational forms.[5]

This paper investigates how the insurance industry, as one major player in the CDS market other than banks and hedge funds, uses CDS. For example, Acharya and Johnson (2007) and Norden (2009) find evidence that banks use their private information of their client firms to trade related CDS contracts. Accordingly, since banks are major counterparties of insurance companies, insurance companies may have an information disadvantage relative to banks. CDS allows insurers to enhance investment income, implement their risk management strategy, and replicate their existing asset portfolios. Selling CDS contracts enables an insurer to take the credit risks in exchange for receiving premiums and replicate the revenue structure of coupon payments from holding bonds. Goldfried (2003) argues that CDS offers access to new credit not offered for a specific firm or at a specific term that may not be accomplished through bond transactions. In addition, CDS helps separate the credit and interest rate decisions. Plus, CDS indices provide greater diversification to insurers. On the other hand, buying CDS protection allows insurers to mitigate their exposures 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 bond market, tax considerations, among other things.

Alternatively, insurance companies participate in the CDS market in order to increase their investment income. For speculative purposes, insurers may buy CDS when they expect CDS spreads to widen and sell CDS when they expect the spreads to narrow. Trading CDS is arguably 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.[6] As one of the largest holders of credit risk, insurers can use CDS to alter their exposure to credit risk, replicate asset portfolios, or enhance their investment income.

[5] 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 the use of derivatives. They develop and test specific economic hypotheses related to the use of derivatives in property-liability insurers as well as life insurers.

[6] 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. (2005), and Fung et al. (2008).

Our paper is related to prior studies that investigate the usage of credit derivatives by banks and hedge funds, the other two important participants in the credit derivatives market. For example, Minton et al. (2009) examine the use of credit derivatives by 19 large U.S. bank holding companies from 1999 to 2003. Banks tend to use credit derivatives more for dealer activities than for hedging activities, and a majority of them are net buyers of credit protection. Banks are more likely to be net protection buyers if they engage in asset securitization, originate foreign loans, have lower capital ratios, and have more commercial and industrial loans in a bank's loan portfolio. They find that the use of credit derivatives by banks is limited due to adverse selection and moral hazard problems that make the market for credit derivatives illiquid for the credit exposures of banks.

Shao (2009) examines the effects of credit derivatives on the risks and returns of bank holding companies for three types of credit derivative users: protection buyers, protection sellers, and active users (market makers). She finds that protection buyers reduce overall risks and returns, protection sellers increase risks and returns, while active users experience a small increase in total risk and a small reduction in returns. She concludes that credit derivatives allow a bank to reduce risk by purchasing default protection, or to increase risk and generate additional fee income by selling default protection.

Chen (2011) examines the use of derivatives and its relation with risk-taking in the hedge fund industry. He shows that the use of credit derivatives decreases total risk and idiosyncratic risk for hedge funds, but has no significant impact on market risk.

Our paper is also related to prior studies on insurance companies' CDS spreads at the sector level. Hammoudeh et al. (2013) examine the CDS spread index for the banking, financial service, and insurance sectors in the short and long run. They find that in the long run, the index of the insurance sector has the highest adjustment, while the banking sector index plays a leading role in the short run. Hammoudeh (2011) looks at the short- and long-run dynamics of U.S. CDS index spreads for the banking, financial service, and insurance sectors and explores their relation with the stock market and government securities during the financial crisis. Their results are useful for regulators who are more interested in financial relations at the sector level than at the firm level and in new regulations of financial institutions such as Basel III.

2.1. Life Insurers vs. PC Insurers

In general, insurance companies receive premiums before they pay 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 activities under the scrutiny of regulation. The significant difference between life and PC insurers in their business specialization leads to a difference in their underwriting behavior, investment activities, and regulatory requirements.

Life insurance companies underwrite life insurance, annuities, and guaranteed investment contracts (GICs), and they invest the funds primarily in publicly traded bonds. On the other hand, PC insurers underwrite the policies covering different types of risks, such as

automobile accidents, fire, work accidents, weather-related catastrophes, and lawsuits arising from malpractice or defective products. As a result, both life and PC insurers face significant interest rate risk and duration gap risk, and they tend to have positive equity duration gaps with the duration of assets exceeding the duration of liabilities (Staking and Babbel, 1995).

We hypothesize that life insurers buy less and sell more CDS and hold CDS for a longer period than PC firms for the following reasons. First, the motivation to buy CDS to hedge bond portfolios by life insurers may be tempered by their greater expertise in analyzing credit risk. Life insurance companies tend to hold a larger proportion of bonds as their major asset category to accommodate the long-term insurance policies. The investment activities enable life insurers to develop in-house expertise in analyzing credit risk. This reduces the motivation for life insurers to hedge the bond credit risk by purchasing CDS.

Second, life insurance companies hold a larger proportion of bonds than PC insurers and are more sensitive to interest rates because their policies pay periodic returns. Writing CDS contracts, which is parallel to buying bonds, allows life insurers to collect a fixed insurance premium periodically over a specified period. They 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.

Third, 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 buyers is hampered by their liquidity requirements.

Additionally, the portfolios of PC and life insurers vary in terms of the characteristics of the contracts, such as maturity. Therefore, we predict that life insurance companies are less likely to trade their CDS positions frequently and tend to hold CDS for a longer period. In contrast, due to greater motivation to boost surplus growth and less stringent regulatory requirements on reserves, PC insurers may invest in CDS simply for speculation purposes. PC insurers may hold CDS for a shorter period than life insurers. Collectively, we expect to observe different CDS behaviors between life and PC insurers, and thus we formulate the following descriptive hypotheses:

H1-1 (Buy and Sell Position): *Life insurers tend to buy less and sell more CDS contracts than PC Insurers do.*

H1-2 (Holding Period): *Life insurers tend to hold CDS contracts for a longer period than PC insurers do.*

2.3. Stock Insurers Versus Mutual Insurers

Mutual and stock insurers are the two primary ownership structures of the insurance industry. 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. 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 by evaluating two competing hypotheses, namely, the *managerial discretion hypothesis* and the *managerial risk aversion hypothesis* that have been developed and empirically tested in the existing literature.[7]

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 activities because stock owners can reduce agency costs through increased monitoring of management behavior.[8] In contrast, the merger between owners and policyholders in mutual insurers (mutuals) results in less-effective control of the conflict between owners and executives over effort, payout policy, and risk management activities.[9] The potentially important control mechanisms are infeasible for 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.

Selling or buying CDS protection is a complex activity that requires a high level of managerial discretion. As a result, insurers 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, whether as buyer or seller.[10]

On the other hand, the *managerial risk aversion hypothesis* suggests that stock insurers are less likely than mutuals to participate in hedging activity (Colquitt and Hoyt, 1997). Well-diversified stockholders of a public insurance company 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, 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. As poorly diversified stakeholders, management and 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 hedging risks. Consequently, mutuals are expected to purchase more CDS protection

[7] For example, the studies by Colquitt and Hoyt (1997) and Cummins et al. (2001) investigate the link between the 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.

[8] 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 incentive compensation.

[9] 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 a lower level of compensation and compensation sensitivity appropriate for control of owner-manager conflicts in mutuals.

[10] This is consistent with the findings of Cummins et al. (1997), that stock insurers have more reasons to use derivatives for hedging than mutuals and also are likely to have a comparative advantage to serve as derivatives dealers.

to hedge credit risk and sell less CDS protection in order to carry less risk. Correspondingly, we expect the descriptive statistics to be in line with the following hypotheses:

H2-1 (Managerial Risk Aversion and Managerial Discretion Hypothesis): *Stock insurers are expected to engage in more CDS sales transactions than mutual insurers, according to either managerial risk aversion or managerial discretion hypotheses.*

H2-2 (Managerial Discretion Hypothesis): *Stock insurers are expected to engage in more (less) CDS purchases transactions than mutual insurers if the managerial discretion (risk aversion) hypothesis dominates.*

Table 1 summarizes the differences between life and PC insurers in terms of their underwriting behaviors and investment activities, and the corresponding hypotheses related to their CDS trading positions and holding periods. Table 1 also summarizes the differences in ownership structures between stock and mutual insurers and the managerial discretion and the managerial risk aversion hypothesis related to the CDS trading activities.

Table 1. A Comparison of Characteristics and Hypotheses between Life/PC Insurers and Stock/Mutual Insurers

Hypothesis on CDS trading activity		
Selling (buying) position	Buy fewer CDS, sell more CDS	Buy more CDS, sell fewer CDS
Holding period	Longer	Shorter

	Stock Insurers	**Mutual Insurers**
Ownership structures	Manager, stockholder, and policyholder functions are separated	Policyholder and owner functions are not separated
Hypothesis on CDS trading activity		
Managerial discretion hypothesis	More active as both buyers and sellers	Less active as buyer or seller
Managerial risk aversion hypothesis	More active as sellers	Buy more CDS, sell fewer CDS

3. Data

Because insurers are heavily regulated at the state level, a report of the insurer's use of derivatives, including CDS transactions, is required by the National Association of Insurance Commissioners (NAIC). 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 transactions and evaluate the determinants behind their positions of CDS.

We compile the data for this study from regulatory annual statements filed by insurers with NAIC for the period from 2001 to 2007. Our analyses are based on Schedule DB, which

contains individual CDS transactions volume within a year and at the end of the year. We conduct the analysis based on the individual firm level that includes either a stock or mutual insurer. We collect the notional amount of CDS transactions, date of opening position, date of termination, date of maturity, consideration received or paid, and gain (loss) on termination. In addition, we manually identify each transaction to gather information on the CDS position (purchase or sale), underlying reference entity, counterparty of the CDS, etc.

This data source yields 72 insurance companies that engage in CDS transactions from 2001 to 2007, 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 of which 3,864 transactions are in sell positions and 2,965 are in buy positions.

Table 2 presents the list of names of counterparties for the insurers' CDS transactions. Also reported are the transaction frequency and volume and the percentage of sale positions for insurers with their corresponding individual counterparty. The right two columns show the transaction volumes for the insurers' sell and purchase positions with each counterparty, respectively. The data indicate that during this period insurance companies dealt with 29 counterparties who took opposite directions in CDS transactions, mainly large banks. For example, Deutsche Bank, Citigroup, Goldman Sachs, J. P. Morgan, Lehman Brothers, Merrill Lynch, Morgan Stanley, Barclays, UBS, Credit Suisse First Boston, Bank of America, and Bear Stearns account for 89% of the total notional amount of CDS transactions. This indicates that insurance companies are engaged in CDS transactions with large banks 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 is precisely why AIG was bailed out by the government. As shown in the last row of the Table 2, the total number of transactions is 6,829, and the total transaction amount over our sample period is $104.6 billion, with insurance companies taking 56.6% in sale positions.

Table 2. Insurers' CDS Transaction Amounts 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
J.P. 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 Suisse	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

4. Empirical Analysis

To empirically test the hypotheses articulated above, we first conduct univariate analyses to provide a thorough examination of CDS utilization over time, CDS utilization by life and PC insurance companies, and utilization by stock and mutual insurers. Following the descriptive 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. 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 as shown in Table 3. The total number of insurers for each year is the number of insurers that participated in the CDS buy or sell transactions for a given year. The total transaction amounts for each year are the aggregate amounts of CDS buy and sell positions for a given year. Summary statistics are reported for the CDS transaction amounts in millions. The number of transactions by year is also reported. The number of CDS-user insurers has increased over the 2001-2007 period. As shown in Panel A of Table 3, the aggregate notional amount is $104.6 billion from 72 insurers between 2001 and 2007. The sum of CDS transaction amounts has increased dramatically year after year, with a big increase in 2007 from $27.1 million to $42.7 million. 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.

Table 3. CDS Transaction 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 Transaction	% of Sales Transaction
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 Transaction
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% levels, 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***

In addition, the average proportion of sell positions for insurers is 56.6% over the whole sample period. 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. As shown at the bottom of Table 3, the chi-square test (Test 1) rejects the null hypothesis at the 1% level, supporting the conclusion that the percentage of sell transactions is different from 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 have 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 (Test 2) rejects the null hypothesis at the 1% level.

Panel B and Panel C of Table 3 split the full sample into Protection Seller and Protection Buyer subsamples. Both CDS buyers and sellers among insurance companies have increased during the period of 2001 and 2007. During the sample period, 59 insurance companies write CDS contracts while 62 insurers purchase CDS contracts.[11] 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 B, sell positions 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. Both panels show that the aggregate amount of sell and buy positions has increased over time with the exception of 2006, when insurers decrease their sell positions by about 1% (from 10,577 in 2005 to 10,522 in 2006), as shown in Panel B, and increase 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 the sell positions, especially in later years, in line with the finding in Panel A that insurers increase the percentage of their purchase positions gradually. The dynamics of the insurers' trading behavior may arise as the result of greater familiarity with the features of the new asset class and changing credit risk conditions over time.

4.2. Life Insurers vs. PC Insurers

4.2.1 Comparisons of Transaction Positions

To provide descriptive results for H1, we present the results of CDS comparisons between life and PC insurers in Table 4. Between 2001 and 2007, the number of life insurers using CDS increases from 11 to 49, whereas the number for PC insurers remains stable and small, ranging from five to 12. 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 of Table 4, 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.

[11] 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. In 2007, there are 52 buyers and 49 sellers among insurers.

We form three tests: Test 1 (T1), Test 2 (T2), and Test 3 (T3). The purpose of the tests is as follows: T1 tests if the percentage of sell positions is equal to 50% for life insurers, T2 examines if the percentage of sell positions is 50% for PC insurers, and T3 tests if the percentage of sell positions for life and PC insurers is the same. According to chi-square tests in Test 1 and Test 2, both percentages are shown to be significantly different from 50% at the 1% level. In Test 3, the null hypothesis that the percentage of sell positions for life and PC insurers is equal can be rejected at the 1% level. These results indicate that life insurers act as net sellers, while PC insurers act as net buyers. In addition, there is 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. This trend 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 take 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 of Table 4 displays comparisons between life and PC insurers with respect to overall CDS transactions, purchase positions, and sell positions. The data indicate 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 descriptive results are consistent with the expectation illustrated in H1-1, that life insurers sell more CDS contracts and buy fewer CDS contracts than PC insurers.

Table 4. CDS Transaction 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	5,118.7	1.0	904.7	928	72.6
2006	42	20,328	484.0	109.5	4,284.3	1.0	890.5	1,144	56.3
2007	49	29,962	611.5	127.7	5,599.5	0.2	1,178.2	2,021	61.3
Total	60	77,095	383.6	81.0	5,599.5	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	3,270.3	2.7	951.0	235	24.3
2006	10	6,745	674.5	402.4	3,260.3	6.2	977.3	367	25.9
2007	12	12,721	1060.1	382.0	5,154.3	6.1	1,515.2	640	33.1
Total	12	27,523	491.5	104.7	5,154.3	2.0	958.6	1,455	28.7

Panel C: Comparison of Life and P&C 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
P&C	491.48	104.71	P&C	396.92	62.75	P&C	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 tests for mean difference and the Wilcoxon statistic tests for median difference.
***,** and* denotes significance of the chi-square test at the 1%, 5%, and 10% levels, 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***

4.2.2 Comparison of CDS Holding Periods

Next, we analyze the holding periods of CDS transactions for life and PC insurers with an aim to shed light on the purpose of CDS holdings by insurance companies. Results are reported in Table 5. 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 (in years) as the difference in terms of the number of days between the date of the open position and the date of the termination position, divided by 365 days. For active positions, the holding period (in years) is defined as the difference in the number of days between the position opening date and the last day of our sample period, divided by 365 days.

As shown in Panel A of Table 5, the average and median CDS holding periods for the terminated subsample are 1.68 and 1.01 years, respectively. The holding period ranges from a minimum of one 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 column of Panel B in Table 5, life insurers have an average holding period of 1.85 years, about 0.91 years longer than 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 are likely to 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, life insurers tend to hold CDS contracts for a longer period than PC insurers do. When we break down the sample by sell and purchase positions, as shown in the upper-right panel, we find that insurers hold CDS contracts for a significantly longer period (an average of 2.13 years and a median of 1.81 years) if they are sellers than if they are buyers (an average of 1.01 years and a median of 0.52 year).

Even more interestingly, we break down the sample first by sell/purchase position and then by type of insurer. The lower-left panel of Panel B of Table 5 shows that the average holding period 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 very likely due to speculation rather than hedging. With regard to the average holding periods of sell positions as shown in the lower-right panel of Panel B, the holding period for life insurers is 2.26 years, significantly longer than that for PC insurers (1.24 years). This suggests that life insurers are likely to sell CDS to collect premiums for revenue generation or asset replication purposes. The median holding period of sell positions for PC insurers is 0.49 years, suggesting that PC may sell CDS for speculation purposes. Taken together, PC insurers act more like derivative dealers in purchase and sale positions than life insurers do.

Panels C and D of Table 5 present the holding period for CDS positions that are 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. However, the main difference in the holding period between the two types of insurers is with respect to the sell side (see the lower-right panel). This conclusion 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.

Table 5. CDS Holding Period (in Years) by Life and PC Insurers

Panel A: Positions Terminated

	N.	Mean	Median	Max	Min	Std. Dev.
Total	2,875	1.68	1.01	6.32	0.00	1.67

Panel B: Pairwise Comparison for Positions Terminated

Life/PC	N.	Mean	Median	Buy/Sell	N.	Mean	Median
Life	2,346	1.85	1.19	Buy	1,161	1.01	0.52
PC	529	0.94	0.40	Sell	1,714	2.13	1.81
Dif.		0.91	0.79	Dif.		-1.12	-1.29
Test Stat.		13.78***	12.52***	Test Stat.		-20.47***	-15.07***

Buy	N.	Mean	Median	Sell	N.	Mean	Median
Life	838	1.11	0.60	Life	1,508	2.26	2.02
PC	323	0.75	0.35	PC	206	1.24	0.49
Dif.		0.36	0.25	Dif.		1.02	1.53
Test Stat.		5.53***	6.15***	Test Stat.		8.19***	8.18***

Panel C: Positions Not Terminated

	N.	Mean	Median	Max	Min	Std. Dev.
Total	3,954	2.21	2.13	8.49	0.01	1.51

Panel D: Pairwise Comparison for Positions Not Terminated

Life/PC	N.	Mean	Median	Buy/Sell	N.	Mean	Median
Life	3,028	2.28	2.16	Buy	1,804	2.04	1.46
PC	926	1.98	1.62	Sell	2,150	2.35	2.35
Dif.		0.30	0.54	Dif.		-0.31	-0.89
Test Stat.		5.47***	4.61***	Test Stat.		-6.62***	-6.20***

Buy	N.	Mean	Median	Sell	N.	Mean	Median
Life	1,090	2.00	1.34	Life	1,938	2.43	2.39
PC	714	2.10	2.03	PC	212	1.60	1.14
Dif.		-0.10	-0.69	Dif.		0.83	1.25
Test Stat.		-1.48	-2.89***	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 the mean difference and the Wilcoxon statistic for the median difference. *** denotes significance at the 1% level.

4.3. Public Insurers Versus Mutual Insurers

4.3.1. Comparisons of CDS Positions

Table 6 demonstrates CDS usage by distinguishing stock insurers from mutual insurers. Our sample includes 44 stock insurers and 28 mutual insurers that engage in CDS transactions between 2001 and 2007. Consistent with H2-1 and H2-2, we find that stock insurers are more actively involved in the CDS market than mutual insurers, in terms of both the aggregate notional amount and the number of transactions. As shown in Panel A of Table 5, stock insurers engage in 5,662 CDS trades, with a total notional amount of $91.4 billion. This is in sharp contrast to mutuals, which have 1,167 transactions, with a total notional amount of $13.3 billion.

Panel C of Table 6 shows the results based on the *t*-test and Wilcoxon test for testing the respective mean and median differences in the CDS trading amounts between stock and mutual insurers. Results suggest that stock insurers use more CDS than mutuals, which is significant at the 1% level. To test H2, we further break down the sample by transaction type. A comparison of the purchase (and sell) positions between stock and mutual insurers also shows significant differences. Stock insurers engage 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. The finding that stock insurers engage in more CDS sell positions than mutual insurers supports H2-1, 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 mutuals supports H2-2, which is consistent with the managerial discretion explanation only.

Table 6. CDS Transaction 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	5,118.7	2.7	1,009.4	970	66.0
2006	36	24,562	682.3	271.5	4,284.3	6.2	1,038.4	1,278	49.6
2007	40	37,673	941.8	264.0	5,599.5	0.2	1,453.7	2,228	53.1
Total	44	91,357	531.2	115.3	5,599.5	0.2	1,007.6	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	1,863.3	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	2,191.7	2.5	479.5	433	61.4
Total	28	13,260	156.0	39.5	2,191.7	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
Public	531.14	115.30	Public	303.51	45.00	Public	227.63	32.50
Private	156.00	39.50	Private	70.32	9.00	Private	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***

4.3.2. Comparison of CDS Holding Periods

An analysis of holding periods in Table 7 sheds more light on the trading behavior of stock and mutual insurers. In general, hedging transactions are more likely related to longer holding periods, whereas speculation transactions are more likely associated with shorter holding periods. Several points from our descriptive results are worth mentioning. First, for positions terminated, as shown in Panel A, stock insurers hold buy positions for an average of 0.93 years and a median of 0.50 years, both significantly shorter than for CDS held by mutual insurers. The short investment horizon suggests that stock insurers are likely to buy CDS for speculation purposes rather than for 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 either revenue enhancement or asset replication purposes. Third, for positions not terminated, as displayed in Panel B of Table 6, stock insurers hold purchase positions for a shorter period than mutual insurers, implying that stock insurers trade more frequently than mutuals and act more like derivative dealers.

Table 7. CDS Holding Period (in Years) by Stock and Mutual Insurers

Panel A: Pairwise Comparison for Positions Terminated

Stock/Mutual	N.	Mean	Median
Stock	2,417	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	1,431	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	1,470	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	1,775	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 the mean difference and the Wilcoxon statistic for the median difference. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

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

The hypotheses stated in Section 2 are supported based on our univariate analyses examining the behaviors of life and PC insurers and further for stock insurers and mutual 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. Our study focuses on volume decisions specifically for CDS users 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. To test the hypotheses on the use of CDS discussed in the previous sections along with other related hypotheses, we use a multivariate regression analysis as follows:

$$Position = \alpha + \beta_1 Life + \beta_2 Stock + \beta_3 Size + \beta_4 Life\_Size + \beta_5 CashRatio + \beta_6 BdRatio + \beta_7 StkRatio + \beta_8 \mathrm{Re}Ratio + \beta_9 ROA + \beta_{10} PW\_GW + \beta_{11} RBC\_\mathrm{Re}g + \beta_{12} SUP\_TA + \beta_{13} Spe\_Buy + \beta_{14} Spe\_Sell + \beta_{15} Index + \varepsilon$$

CDS trading volumes for a given insurer are 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). Year dummies are included in the regression. T-statistics are based on robust standard errors adjusted for clustering by insurance companies.

The dependent variables in Model 1-3 are LBuyAmt, LSellAmt, and LAmt; they represent the natural logarithm of aggregate notional amounts over a year of CDS purchase, sell, and total positions, respectively. A number of independent variables are included in the regression analysis. Below we discuss the definition of these variables and predictions of their relation to the use of CDS.

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

Size is defined as the natural logarithm of total assets of the insurer. There are fixed costs for setting up CDS derivative activities and obtaining expertise to manage them. Larger firms tend to have the infrastructure in place that allows economies of scale in the information and transaction costs entailed in setting up CDS operations. They also tend to have more resources, including human capital, to execute and monitor CDS transactions and manage counterparty risk. However, large insurers may be more diversified and have a lower need to use CDS for hedging purposes. Thus, larger firms are expected to undertake more CDS transactions if the economies-of-scale explanation dominates the 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' use of CDS, similar to those used in Cummins et al. (2001) as they discuss the use of other derivatives. 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 total investment assets. It 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 fewer financial constraints.

BdRatio is defined as the bond investment ratio. If CDS are purchased to hedge the credit risk embedded in their bond holdings, insurers with a higher BdRatio should buy more CDS. Therefore, BdRatio is positively correlated with LAmtBuy. On the other hand, as argued in Norden and Wagner (2008), CDS and bonds both reflect general credit risk and thus insurers with more bond holding are likely to reduce their CDS participation in a sell position to reduce their credit risk exposure. Consequently, BdRatio would be negatively correlated with LAmtSell. However, if CDS is 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. *ReRatio* is defined as the real estate investment ratio. Investments in stock and real estate may expose insurers to more market and liquidity risk. As emphasized in Fong, Valente, and Fung (2010) about the importance of credit risk and liquidity risk, to limit their risk exposure, insurers with a higher StkRatio and ReRatio are more likely to engage in CDS buy positions rather than 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 are 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 buy and 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. This may motivate insurers to use more bonds for asset-liability management and thereby buy more CDS protection to replicate their asset portfolios. Thus, a positive relation is expected between PW_GW and LAmtBuy. At the same time, because of their need to manage asset-liability duration, insurers may be motivated to use CDS to replicate the bond portfolio. Thus, 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.[12] Insurers are subject to risk-based capital regulations, which outline the actions

[12] Kessler (2008) indicates the importance of regulations on supply and demand curves of insurance services and products.

that regulators can take when this ratio falls below a certain threshold. *SUP_TA* is the ratio of surplus equity to total assets. 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. Insurers with higher RBC_Reg and SUP_TA are less likely to experience financial distress and are more inclined to comply with regulatory requirements; they are therefore less likely to engage in CDS sell transactions. Therefore, these two variables should be negatively related to LAmtSell.

To test whether the insurer also uses CDS for speculation, we construct two variables, SPE_Buy and SPE_Sell. *SPE_Buy* is a dummy variable that is equal to 1 if the insurer engages in a purchase transaction that is terminated within a year. *SPE_Sell* is a dummy variable that is equal to 1 if the insurer engages in a sale transaction that is terminated within a year. If insurers close a transaction within a year, 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 more CDS for speculation. Similarly, SPE_Sell is expected to be positively associated with LAmtSell if an insurer is likely to sell more CDS for speculation.

Index is a variable that measures the impact of the overall CDS market condition. The CDS index used in this study is the average of investment-grade North America CDS index levels over one year. Forte and Pena (2009), Fung et al. (2008), and Tang and Yan (2010) show the useful leading role of CDS on corporate bonds and the general stock market. We use CDS *Index* to measure the price of credit risk. Higher index levels are associated with higher premiums, leading to a lower demand for CDS and greater supply of CDS by insurers. Therefore, Index is expected to be negatively related to LAmtBuy and positively related to LAmtSell.

4.5 Results of Multivariate Regression

Table 8 reports the descriptive statistics of the variables employed in the multivariate regression model for the whole sample. 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 totals $30.27 billion, with a range from $213 million to $219.05 billion, confirming that large insurers are major participants in the CDS market. The average investment ratio in cash and short-term investments 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 40 basis points to 142 basis points, with a mean of 62 basis points and a median of 50 basis points.

Table 8. Descriptive Cross-Sectional Statistics (N = 257)

Variable	Mean	Std. Dev	Min	Max	Median
Life	0.79	0.41	0.00	1.00	1.0
Stock	0.66	0.47	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
PW_GW (%)	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:
Life is a dummy variable that is equal to 1 if the firm is a life insurer and 0 otherwise; Stock is a dummy variable that is equal to 1 if the firm is a stock insurer and 0 otherwise; TA is total assets of an insurer in millions of dollars; CashRatio is defined as the cash and short-term investment ratio; BdRatio is the bond investment ratio; StkRatio is the stock investment ratio; CashRatio is the cash and short-term investment ratio; and ReRatio is the real estate investment ratio. ROA is the return on assets; 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 position closed within a year, and Spe_Sell is a dummy variable if the insurer has a sell position closed within a year; and Index is the average of investment-grade North America CDX index level over a year.

Table 9 reports the cross-sectional regression results. The dependent variables are: LAmtBuy for Model 1, LAmtSell for Model 2, and LAmt for Model 3. The coefficient on the dummy variable, *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 H2-1.

Table 9. Cross-Sectional Analysis of the Use of CDS

This table presents the coefficient estimates of the following cross-sectional regression and its variations:

$$Position = \alpha + \beta_1 Life + \beta_2 Stock + \beta_3 Size + \beta_4 Life\_Size + \beta_5 CashRatio + \beta_6 BdRatio + \beta_7 StkRatio + \beta_8 \mathrm{Re}Ratio + \beta_9 ROA + \beta_{10} PW\_GW + \beta_{11} RBC\_\mathrm{Re}g + \beta_{12} SUP\_TA + \beta_{13} Spe\_Buy + \beta_{14} Spe\_Sell + \beta_{15} Index + \varepsilon$$

Dependent variables for position are LAmtBuy, LAmtSell, and LAmt in Models 1-3, which are the natural logarithm of aggregate notional amount of CDS purchase positions, sales positions, and total positions for an insurer over one 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 earlier in Table 7. 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 the *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 variable	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	***

The coefficient on the dummy variable, *Stock*, is positive and significant in Model 2 and Model 3. This finding confirms 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. Overall, these results provide evidence supporting the hypotheses that life insurers behave differently from PC insurers due to their specialization in line-of-insurance business; stock insurers and mutual insurers behave differently in CDS transactions due to their organizational forms.

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 on average a 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 transactions less when they hold more bonds. Specifically, we find that BdRatio is negatively related to LAmtSell in Model 2, indicating that insurers whose assets include less in bond holdings are likely to engage in more CDS sales, either as an alternative asset to assume credit risk or to replicate their bond portfolios. The coefficient for BdRatio is positive but not significant in Model 1.

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. Another explanation is that large banks may avoid dealing with the insurer as a counterparty if its 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 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 the notion that the volume of CDS transactions is higher when CDS is bought or sold for speculation.

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. 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 are also consistent with the notion that insurers tend to sell more CDS protection when banks and other market participants have a higher demand for the protection because they expect that overall credit risk is higher. For example, since the subprime crisis in the summer of 2007, banks have significantly increased their net CDS protection in order to hedge more aggressively their credit risk exposure. For 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 7% (from 25.9% to 33.1%), respectively. It appears that insurance

companies are willing to take on more credit risk in exchange for receiving higher CDS premiums.

5. Conclusions

The fledgling 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 over-the-counter market has not been well-regulated, leading to great opacity with respect to market participants and their trading behaviors. Nonetheless, the requirement for insurers to report their derivative use to NAIC offers us a unique opportunity to reveal what is going on behind the scene.

Using 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. Consistent with asset-liability duration management, life insurers are more active participants in the CDS market than PC insurers, 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, consistent with the notion of liability duration matching. In contrast, PC insurers, with the average CDS holding period less than one year, appear to buy CDS contracts for income generation and speculation to realize capital appreciation.

With regards to organization form, stock insurers tend to engage in more CDS transactions on both the purchase side and sell side 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 multivariate regression analysis indicates that the purchase and sell amounts of CDS by insurers are reliably associated with a number of insurer-specific characteristics, such as size, bond investment ratio, real estate allocation ratio, profitability, and CDS market factor. Our evidence suggests that insurers engage in CDS transactions not only for the purpose of hedging but also for speculation. This supports the ongoing efforts of regulators to monitor the use of derivatives by insurers in the past years. In May 2008, the New York State Insurance Department began distinguishing “naked” as opposed to “covered” CDS contracts depending on the motivation for writing them, whether for speculation or hedging. Later in September 2008, the New York State Insurance Department announced that it planned to begin in 2009 regulating covered CDS as a type of insurance contract.

Our paper contributes to the literature by providing a better understanding of the need to increase the transparency of the trading activities of insurance companies and the largely unregulated CDS market. Schich (2009) argues that the financial crisis had an increasingly visible impact on the insurance industry, primarily through their expanded investment activities beyond core insurance business. He finds that the problem for insurance companies largely stemmed from either engaging in investment-bank-like activities, selling CDS protection, or both. Consistent with his view, our paper highlights the importance of improve supervisory framework by regulators and improving internal control, risk management, and corporate

governance by insurance companies, depending on the underwriting behaviors and ownership structures in the insurance sectors.

As shown in our paper, the major counterparties of insurance companies are large banks. Minton et al. (2009) find that banks tend to use credit derivatives more for dealer activities than for hedging activities, and a majority of them are net buyers of credit protection. We find that insurance companies act as both buyers and sellers for both hedging and speculation purposes. Since banks have more private information on their borrowers' credit risk (Acharya and Johnson, 2007), insurance companies may trade with a relative information disadvantage compared with banks. An interesting future research avenue is to examine how CDS use for hedging or speculation purpose affects the risks and financial performance of insurers.

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