Corporate Hedging in the Insurance Industry: The Use of Financial Derivatives by U.S. Insurers

Article *in* North American Actuarial Journal · February 1996

Source: RePEc

3 authors, including:

J. David Cummins
Temple University
202 PUBLICATIONS **7,432** CITATIONS
SEE PROFILE

Richard D. Phillips
Georgia State University
52 PUBLICATIONS **1,375** CITATIONS
SEE PROFILE

CORPORATE HEDGING IN THE INSURANCE INDUSTRY: THE USE OF FINANCIAL DERIVATIVES BY U.S. INSURERS

J. David Cummins,* Ph.D., Richard D. Phillips,† Ph.D., and Stephen D. Smith,‡ Ph.D.

ABSTRACT

In this paper we investigate the extent to which insurance companies utilize financial derivatives contracts in the management of risks. The data set we employ allows us to observe the universe of individual insurer transactions for a class of contracts, namely, those normally thought of as off-balance-sheet (OBS). We provide information on the number of insurers using various types of derivatives contracts and the volume of transactions in terms of notional amounts and the number of counterparties. Life insurers are most active in interest rate and foreign exchange derivatives, while property/casualty insurers tend to be active in trading equity option and foreign exchange contracts. Using a multivariate probit analysis, we explore the factors that potentially influence the existence of OBS activities. We also investigate questions relating to whether certain subsets of OBS transactions (for example, exchange traded) are related to such things as interest rate risk measures, organizational form and other characteristics that may discriminate between desired risk/return profiles across a cross-section of insurers. We find evidence consistent with the use of derivatives by insurers to hedge risks posed by guaranteed investment contracts (GICs), collateralized mortgage obligations (CMOs), and other sources of financial risk.

1. INTRODUCTION

The world of insurance has become a risky one. Insurers are facing increasing intra-industry competition as well as more intensive competition from other financial institutions such as banks and mutual funds. In response, insurers have developed a number of increasingly complex products and at the same time have had to reduce the profit loadings in these products to compete in the marketplace. In addition, the internationalization of financial markets has exposed insurers to stiffer competition from foreign firms and to levels and types of risks not present in the recent past. Add to this the historically high volatility in the prices of financial assets in the past quarter century, and it is not surprising that insurance company managers are worried about financial risk.

Financial reporting and regulatory requirements also have made insurers more sensitive to the risks inherent in their asset and liability portfolios. The most prominent changes have been the adoption of risk-based-capital requirements, *Financial Accounting Standard (FAS) 115*, requiring mark-to-market accounting for fixed-income securities held in the "trading" or "available for sale" categories, and *FAS 119*, requiring disclosure of the purpose of derivative transactions.

This changing market and regulatory environment has led insurers to explore new techniques for managing their asset and liability risk, without sacrificing income. Many insurers have turned to financial derivatives to manage risk and enhance income. The market for financial derivatives has grown rapidly over the past two decades and now offers a wide variety of contracts to manage nearly all types of financial

*J. David Cummins, Ph.D., not a member of the Society, is the Harry J. Loman Professor of Insurance and Risk Management at the Wharton School, University of Pennsylvania, Philadelphia, and the Victor L. Andrews Visiting Scholar at Georgia State University, Atlanta.

†Richard D. Phillips, Ph.D., not a member of the Society, is Assistant Professor of Risk Management and Insurance and Research Associate in the Center for Risk Management and Insurance Research at Georgia State University, Atlanta.

‡Stephen D. Smith, Ph.D., not a member of the Society, is the H. Talmage Dobbs, Jr., Chair of Finance at Georgia State University, Atlanta, and a Visiting Scholar at the Federal Reserve Bank of Atlanta.

exposures. The contracts range from standardized derivatives that are traded on organized exchanges to individually tailored, over-the-counter (OTC) contracts created for a buyer by a derivatives dealer.[1]

The growth in derivatives markets has greatly expanded the risk management opportunity set available to insurers and other investors. However, following the recent, well-publicized derivatives-related losses of Orange County California, Procter & Gamble, Gibson Greetings, and Barings Bank, derivatives have also become controversial, leading to more intensive scrutiny of derivatives practices by both state and federal regulators.

Against this backdrop, it seems particularly important to understand the level and types of derivatives transactions being undertaken by insurers. However, existing information on insurer derivatives activity is mostly anecdotal, and no comprehensive analysis of usage by insurers has yet been conducted. The purpose of this paper is to remedy this deficiency in the existing literature by providing a detailed statistical analysis of the use of derivatives by U.S. life and property/casualty (PC) insurers. In addition to providing data on the extent of insurer activities, we also investigate the factors that influence the participation decisions of life and PC insurers in the financial derivatives market. This information should prove useful to insurers that are present or potential participants in derivatives markets as well as to regulators concerned about the potential misuse of off-balance-sheet (OBS) contracts.

To conduct this study, we take advantage of the detailed disclosure requirements imposed on insurers by state regulators that provide information on individual holdings and transactions in derivatives markets. Specifically, we use data from Schedule DB of the 1994 annual statements of all U.S. insurers reporting to the National Association of Insurance Commissioners (NAIC). Our data analysis provides, among other things, information on the number of insurers that are actively trading various types of derivatives contracts. Contrary to conventional wisdom, which holds that the vast majority of insurers active in derivatives are life insurers, we find that approximately equal numbers of life and PC insurers are active in derivatives markets.

We also provide information on the types of contracts most frequently traded by insurers and the volume of derivatives transactions. Finally, probit analysis is employed to examine the determinants of derivatives market participation by insurers. We are able to consider questions such as what type of insurers are likely to use various types of derivatives contracts and for what purpose—hedging financial risks, hedging underwriting exposure, or pursuing trading profits uncorrelated with underlying economic activities. We build on earlier work that has presented evidence on the participation decision by banks (Sinkey and Carter 1995; Gunther and Siems 1995), life insurers (Colquitt and Hoyt 1995), and nonfinancial firms (Fenn, Post and Sharpe 1996; Nance, Smith, and Smithson 1993).

The discussion proceeds as follows: In Section 2, we provide an overview of some basic reasons why insurers might wish to employ OBS contracts and briefly review the prior literature on derivatives use by financial institutions. Section 3 describes the database and presents statistics on the number of insurers using derivatives, the volume of those transactions, and statistics on counterparty exposure. Section 4 provides a brief summary of the prior literature on the determinants of corporate hedging and outlines our hypotheses. The determinants of derivatives usage are analyzed in Section 5, and Section 6 concludes.

2. BACKGROUND: DERIVATIVES AND FINANCIAL RISK MANAGEMENT

A. The Need for Financial Risk Management

Insurers serve two primary functions in the economy—a risk-bearing and risk-pooling function and financial intermediation. In their risk-bearing and risk-pooling function, insurers provide a mechanism for individuals and businesses exposed to the risk of loss of life, health, or property to transfer these risks to an insurer in return for a premium payment. The insurer can diversify most of this risk (usually called underwriting risk) by writing insurance on large numbers of policyholders (the risk-pooling function), whose risk of loss is more or less statistically independent. However, diversification does not fully eliminate underwriting risk, giving rise to the need for insurers to hedge this risk.[2]

[1] Some derivatives transactions, such as futures or forward contracts, do not directly create assets or liabilities on insurer balance sheets, but rather generate (sometimes contingent) cash flows. Hence, derivatives are often referred to as off-balance-sheet (OBS) contracts.

[2] Although reinsurance is still the predominant means of hedging underwriting risk, a derivatives market in underwriting risk has begun to emerge. The first exchange-traded insurance derivatives are the catastrophe insurance futures and options introduced by the Chicago Board of Trade (CBOT) in 1992–1993. These contracts have not traded very widely to date, although trading volume has been increasing steadily since a new sequence of contracts was introduced.

The other important economic function performed by insurers is financial intermediation. Financial intermediation involves raising funds by issuing specialized types of debt contracts and investing the funds in financial assets. Although financial intermediation would not be needed if financial markets were complete and frictionless, market imperfections, incompleteness, and gains from specialization in certain types of financial transactions give intermediaries economic value. Intermediaries typically are compensated for their services in the form of yield spreads; that is, they pay less for the funds they borrow than they earn on the funds they lend or invest.

The debt instruments issued by PC insurance companies are insurance policies covering various types of risks such as automobile accidents, fires, work accidents, and lawsuits arising from defective products, professional malpractice, and so on. The funds raised are invested primarily in traded bonds and stocks. Life insurers raise funds by issuing various types of products such as cash value life insurance, annuities, and guaranteed investment contracts (GICs). Like PC insurers, they invest in traded bonds and stocks, but life insurers are also major participants in the markets for privately placed bonds and mortgages.

The intermediation function of insurers gives rise to the majority of their need for financial risk management. One reason that this need arises is because the cash flows of the liabilities issued by insurers have different patterns and characteristics than the cash flows of the assets they invest in. This difference in asset and liability cash flows is in fact part of the definition of financial intermediation. An example is a portfolio of liability insurance policies, in which the cash flows represent payments of liability judgments to claimants. This cash flow pattern is likely to differ from the cash flows of conventional assets such as bonds or stocks. Contracts with unusual cash flow patterns in life insurance include universal life, in which policyholders have a great deal of discretion over the premiums contributed; variable life insurance and annuities, which are linked to equity indices or portfolios; single-premium deferred annuities; and GICs. These contracts typically were created to meet the needs of a particular class of investor and exist precisely because (and only as long as) the insurer has a comparative advantage in creating an asset portfolio that delivers the promised policy cash flows without exposing policyholders to unacceptable levels of risk. Creating these types of asset portfolios requires financial risk management.

Probably the most important of the more complex financial risk management tasks faced by both life and PC insurers is to manage the *duration* and *convexity* of their asset portfolios and to manage relationship between the duration and convexity of assets and the duration and convexity of liabilities. This latter type of risk management is known as *asset-liability management* (ALM) [3]

The traditional ways to manage duration and convexity were through the matching of asset and liability cash flows or through portfolio immunization, that is, structuring asset portfolios so that the durations of assets and liabilities were matched or at least managed to achieve organizational objectives. However, this type of asset-liability management can involve a considerable amount of trading and accompanying transactions costs. Financial derivatives often provide a cheaper and/or more flexible way to manage duration and convexity risk. This type of hedge involves simultaneously buying and/or selling various combinations of derivative contracts, such as swaps, calls, and puts.

B. Hedging versus Speculation

While insurers and other investors can use derivatives to hedge risk, they can also use derivatives for income enhancement or "speculation." There is some concern in the regulatory community about the possibility that higher levels of derivatives activity may increase insurer insolvency risk. While it is certainly possible to construct derivatives positions that would expose insurers to significant amounts of risk, there are also income-enhancement strategies, such as covered call strategies, that are no more risky than more traditional investments such as stocks and bonds [4] Given the

in the fall of 1995. Insurance derivatives are likely to become very important in the future, expanding the industry's capacity to bear risk and smoothing out cyclical price fluctuations (for a discussion, see Cummins and Geman 1995). However, in this paper we focus on financial derivatives.

[3]Intuitively, duration is the sensitivity of the price of an asset to a change in interest rates, for example, the percentage decline in the value of a bond in response to a specified percentage change in interest rates. Convexity is the change in an asset's price sensitivity, that is, duration, when rates change. Duration gives a good indication of how much an asset's price will change in response to a small change in the level of interest rates; but because of the existence of convexity (convexity risk), duration does not give as good an approximation to the price change for relatively large changes in the level of interest rates.

[4]A covered call strategy is one in which the holder of some underlying instrument (for example, share in a stock) writes a call option on that particular investment. This has the immediate effect of generating income for the insurer. If share prices stay the same or decrease, the call is not exercised. If prices rise, the shares are "called

complexities of the derivatives strategies and the dynamic nature of the market, determination of the appropriate type and level of regulation is difficult Considerations include: derivative market reaction to regulations (that is, creation of new derivatives to circumvent regulations), impact on the ability of insurers to manage their risks in an effective and efficient manner, and the level of statutory reporting necessary to provide appropriate information to investors and policyholders For example, increased reporting of derivatives positions, by improving Schedule DB and making the resulting information more conveniently available to investors and policyholders, would enhance the role of market discipline in controlling insolvency risk, and market forces are nearly always more effective than direct regulation

3. THE USE OF DERIVATIVES BY INSURERS

A. The Data

Our data on the use of derivatives by insurers come from Schedule DB of the 1994 regulatory annual statements filed by insurers with the NAIC Parts A through D of Schedule DB list individual transactions across four general categories of derivatives: (a) options, caps and floors owned, (b) options, caps and floors written, (c) collar, swap and forward agreements, and (d) futures In part E of schedule DB, insurers are required to report their year-end counterparty exposure for all the contracts contained in Parts A through D Part E is potentially important because insurers may have reasons to engage in OBS activities during the year but to "clean out" their books for the annual regulatory report, which reflects holdings and liabilities at year-end

The sample of insurers we analyze consisted initially of all life and PC companies that filed regulatory annual statements with the NAIC for report-year 1994, a total of 1,760 life insurers and 2,707 PC insurers Initial screening eliminated firms with zero or negative assets, premiums, or surplus (equity) and firms that lack adequate group affiliation identifiers Although the screening criteria resulted in the elimination of a large number of insurers, these are predominantly very small firms that in the aggregate account for only 2 2% of industry assets The final sample consists of 1,207 life insurers and 2,063 PC insurers Many of these insurers are members of groups that operate under common ownership Because members of groups are likely to share common financial strategies and, in many cases, common investment departments, we analyze firms at the group level as well as at the individual company level The group/unaffiliated sample comprises 1,423 groups and unaffiliated single companies

away" from the writer; however, the insurer can easily deliver the shares since it already owns them The primary motivation for an insurer to undertake this investment strategy is to enhance the income of the insurer by selling the possibility of the capital gain in the underlying asset

B. Extent of Derivatives Usage by Insurers

Number of Users

The numbers of insurers using derivatives, by industry and organizational form, are shown in Table 1, which focuses on the use of derivatives by insurer size quartile, where size is measured by total assets The table shows the extent of derivatives usage by life insurers, PC insurers, and groups/unaffiliated singles Insurers were counted as derivatives users if they reported any derivatives activity in 1994 in Schedule DB of the regulatory annual statement, either within-year transactions or end-of-year holdings The table reveals the familiar size skewness characteristic of derivatives usage by both life insurers (Colquitt and Hoyt 1995) and banks (Sinkey and Carter 1995; Gunther and Siems 1995) Less than 2% of the insurers in the smallest size quartile used derivatives in 1994 In the largest quartile, derivative transactions were reported by 38% of life insurers, 20% of PC insurers, and 35% of the groups and unaffiliated insurers

For the industry as a whole, derivatives use was reported by 12% of life insurers, 7% of PC insurers, and 12 5% of groups and unaffiliated single insurers Although derivatives usage in the PC industry is relatively low, the finding that 142 PC companies are active in OBS securities is somewhat surprising, given the conventional view that derivatives activity is confined almost exclusively to the life insurance industry In fact, the number of PC insurers using derivatives (142) is about the same as the number of life insurers (144)

Table 2 shows that stock firms are more likely to use derivatives than mutuals and reciprocals In the life insurer sample, 16 4% of stock firms use derivatives, compared with 6 7% of mutuals For PC insurers, 9 5% of stock firms use derivatives, compared to 4 3% of mutuals This is consistent with the managerial discretion hypothesis (Mayers and Smith 1988) that stock firms engage in more complex activities on average and have more need to hedge It also could be consistent with more income-enhancement transactions by stock insurers

TABLE 1
PROPORTION OF INSURERS ACTIVE IN DERIVATIVES BY QUARTILE

	Life/Health Insurers	Property/Casualty Insurers	Groups and Unaffiliated
Quartile 1	0.66%	0.58%	1.69%
Quartile 2	0.66	3.29	3.93
Quartile 3	8.28	3.49	9.55
Quartile 4	38.08	20.16	34.83
All Firms	11.93%	6.88%	12.51%
Number of Insurers	1,207	2,063	1,423

TABLE 2
PROPORTION OF DERIVATIVES USERS ORGANIZED AS STOCK COMPANIES BY QUARTILE

	Life/Health Insurers		Property/Casualty Insurers		Groups and Unaffiliated	
	Stocks	Mutuals	Stocks	Mutuals	Stocks	Mutuals
Quartile 1	1.43%	0.00%	1.78%	0.00%	1.69%	0.00%
Quartile 2	0.83	0.00	4.14	2.16	2.25	1.69
Quartile 3	10.76	1.85	3.71	3.38	7.87	1.69
Quartile 4	65.07	48.78	26.51	21.93	22.47	12.36
All Firms	16.42%	6.69%	9.55%	4.30%	8.57%	3.94%
Number of Users	123	21	108	34	122	56

Note: Quartiles are based on assets. Quartile 1 is the smallest size class and quartile 4 is the largest

Types of Contracts

Tables 3 and 4 provide some summary statistics on year-end 1994 open derivatives positions by type of contract for life and PC insurers combined. Table 3 provides information on the number of insurers using each type of contract and Table 4 the notional amounts of the contracts.[5] In both tables, column 1 shows the various derivative contract types, and column 2 shows the number of insurers holding this position at year-end 1994. Based on the number of users, swaps are clearly the most popular type of contract used in the industry. Somewhat surprising is the relatively large number of insurers engaged in writing call options. Other positions with a relatively large amount of activity are short and long futures, put options owned, forwards, and caps. The mean number of open positions significantly exceeds the medians for nearly all contract types, indicating a significant skewness in the data, with a few (fairly large) participants accounting for a disproportionate share of end-of-year holdings.

Tables 5 and 6 are similar to Tables 3 and 4 but show the total number of positions (Table 5) and their corresponding notional values (Table 6) opened during 1994. These amounts are expected to be larger than end-of-year holdings because many positions are opened and closed out during the same calendar year. Based on positions opened during the year, writing call options accounts for the largest amount of activity in terms of number of participants and positions taken during the year. Forwards, swaps, and futures also account for significant intra-year volume in terms of both the number of participants and the total notional values outstanding.

Underlying Assets

Tables 7 and 8, for life and PC insurers, respectively, provide a more detailed picture of derivatives activity by breaking down year-end positions by type of underlying asset as well as by type of derivative contract. Table 7 shows that interest rate swaps, interest rate

[5]The notional value of an OBS contract is analogous to the par or face value of an underlying contract. It is important to emphasize, however, that none (or at most, a small amount in the case of options) of this notional value changes hands. It is used instead to calculate the cash flows that change hands.

TABLE 3
DERIVATIVES USE BY LIFE/HEALTH AND PROPERTY/CASUALTY INSURERS:
NUMBER OF USERS AND OPEN POSITIONS AT YEAR-END 1994 BY TYPE OF CONTRACT

Contract Type	Number of Users	Number of Open Derivative Agreements/Positions					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Owned							
Call Options	31	4.81	3.00	5.77	1	27	149
Put Options	41	4.66	2.00	7.74	1	47	191
Caps	24	6.25	3.50	8.44	1	35	150
Corridors	1	8.00	8.00		8	8	8
Floors	16	6.50	2.50	9.78	1	33	104
Financial Options Written							
Call Options	59	11.32	5.00	19.68	1	104	668
Put Options	12	2.08	1.00	1.78	1	5	25
Caps	3	26.67	6.00	40.20	1	73	80
Floors	1	7.00	7.00		7	7	7
Collar, Swap and Forward Agreements Open							
Collars	3	2.00	2.00	1.00	1	3	6
Forwards	38	18.63	11.00	28.41	1	140	708
Swaps	86	16.14	6.00	23.10	1	98	1,388
Futures Contracts Open							
Long Futures	28	6.39	3.00	8.87	1	36	179
Short Futures	43	7.21	3.00	9.25	1	38	310
All Derivative Contracts							
	212	18.74	7.00	34.80	1	306	3,973

TABLE 4
DERIVATIVES USE BY LIFE/HEALTH AND PROPERTY/CASUALTY INSURERS:
NOTIONAL AMOUNTS FOR OPEN POSITIONS AT YEAR-END 1994 BY TYPE OF CONTRACT

Contract Type	Number of Users	Total Notional Amounts ($000's)					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Owned							
Call Options	31	133,828	45,635	150,859	96	500,000	4,148,669
Put Options	41	128,401	22,593	327,031	9	1,870,000	5,264,452
Caps	24	835,624	142,500	1,777,579	5,000	6,500,000	20,054,984
Corridors	1	89,000	89,000	.	89,000	89,000	89,000
Floors	16	613,391	180,250	1,125,289	10,000	4,447,500	9,814,252
Financial Options Written							
Call Options	59	68,068	5,990	147,002	2	615,806	4,016,037
Put Options	12	7,158	1,400	17,736	7	63,000	85,891
Caps	3	610,314	350,000	678,989	100,000	1,380,943	1,830,943
Floors	1	124,937	124,937	.	124,937	124,937	124,937
Collar, Swap and Forward Agreements Open							
Collars	3	90,000	100,000	36,056	50,000	120,000	270,000
Forwards	38	350,969	32,888	1,372,341	18	8,284,915	13,336,838
Swaps	86	449,939	141,045	725,295	3,500	4,590,324	38,694,753
Futures Contracts Open							
Long Futures	28	104,126	46,182	138,275	263	558,915	2,915,521
Short Futures	43	162,415	50,696	277,368	300	1,136,381	6,983,857
All Derivative Contracts							
	212	507,689	67,398	1,377,772	2	10,517,699	107,630,133

Note: Total notional amount for equity call/put options calculated as no of contracts × 100 × strike price
Total notional amount for bond call/put options calculated as par value of underlying bonds.
Total notional amount reported for futures contract calculated as no of contracts × futures payoff × strike price

TABLE 5
DERIVATIVES USE BY LIFE/HEALTH AND PROPERTY/CASUALTY INSURERS:
NUMBER OF USERS AND POSITIONS OPENED DURING THE YEAR 1994 BY TYPE OF CONTRACT

Contract Type	Number of Users	Number of Derivative Agreements/Positions Opened					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Purchased							
Call Options	50	15.04	3.00	33.23	1	163	752
Put Options	62	14.02	4.00	23.46	1	101	869
Caps	19	4.21	4.00	3.10	1	13	80
Corridors	1	8.00	8.00	.	8	8	8
Floors	8	8.63	2.50	14.76	1	44	69
Financial Options Written							
Call Options	121	40.82	15.00	65.63	1	448	4,939
Put Options	32	10.31	5.50	14.00	1	58	330
Caps	4	8.25	3.50	11.41	1	25	33
Floors	1	8.00	8.00	.	8	8	8
Collar, Swap and Forward Agreements Opened							
Collars	4	4.50	2.00	5.69	1	13	18
Forwards	39	79.79	18.00	196.72	1	893	3,112
Swaps	71	28.99	5.00	139.03	1	1,167	2,058
Futures Contracts Opened							
Long Futures	54	21.93	5.00	46.21	1	293	1,184
Short Futures	62	22.81	12.50	29.90	1	145	1,414
All Derivative Contracts							
	268	55.50	16.50	133.08	1	1,222	14,874

TABLE 6
DERIVATIVES USE BY LIFE/HEALTH AND PROPERTY/CASUALTY INSURERS:
NOTIONAL AMOUNTS FOR POSITIONS OPENED DURING 1994 BY TYPE OF CONTRACT

Contract Type	Number of Users	Total Notional Amounts ($000's)					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Purchased							
Call Options	50	173,409	30,000	404,318	3	2,472,225	8,670,427
Put Options	62	664,873	44,146	3,432,286	30	26,868,900	41,222,120
Caps	19	585,092	205,000	1,450,342	5,000	6,500,000	11,116,743
Corridors	1	89,000	89,000	.	89,000	89,000	89,000
Floors	8	832,157	412,500	1,222,402	75,000	3,742,400	6,657,252
Financial Options Written							
Call Options	121	1,337,881	15,781	10,687,001	5	115,274,305	161,883,598
Put Options	32	357,705	16,480	1,148,542	60	6,298,263	11,446,569
Caps	4	570,665	225,000	787,748	94,000	1,738,661	2,282,661
Floors	1	141,352	141,352	.	141,352	141,352	141,352
Collar, Swap and Forward Agreements Opened							
Collars	4	402,500	75,000	706,181	1	1,460,000	1,610,000
Forwards	39	831,412	106,037	2,785,234	18	16,190,987	32,425,073
Swaps	71	412,856	150,000	960,521	3,500	7,498,203	29,312,784
Futures Contracts Opened							
Long Futures	54	817,476	72,221	3,195,160	58	22,780,119	44,143,707
Short Futures	62	1,072,196	178,602	4,389,528	301	34,442,171	66,476,175
All Derivative Contracts							
	268	1,557,752	53,004	10,100,040	5	126,535,051	417,477,460

Note: Total notional amount for equity call/put options calculated as number of contracts × 100 × strike price
Total notional amount for bond call/put options calculated as par value of underlying bonds.
Total notional amount reported for futures contract calculated as number of contracts × futures payoff × strike price.

TABLE 7
DERIVATIVES USE BY LIFE/HEALTH INSURERS: NOTIONAL AMOUNTS FOR OPEN POSITIONS AT YEAR-END 1994
BY TYPE OF RISK AND TYPE OF CONTRACT

Underlying Asset/Risk	Number of Users	Total Notional Amounts ($000's)					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Owned							
Bonds*							
Calls	13	127,414	100,000	128,048	875	436,496	1,656,383
Puts	11	153,130	37,600	256,935	3,000	799,733	1,684,433
Floors	1	350,000	350,000		350,000	350,000	350,000
Equities†							
Calls	6	67,614	70,750	48,628	1,250	125,000	405,686
Puts	8	17,044	3,137	26,260	1,325	72,313	136,354
Foreign Currency							
Puts	1	153,690	153,690		153,690	153,690	153,690
Floors	1	10,000	10,000		10,000	10,000	10,000
Interest Rates							
Calls	6	178,500	142,500	176,556	10,000	500,000	1,071,000
Puts	6	382,458	100,000	729,019	50,000	1,870,000	2,294,750
Caps	23	870,878	160,000	1,808,931	5,000	6,500,000	20,030,197
Floors	15	630,283	160,500	1,160,746	50,000	4,447,500	9,454,252
Corridors	1	89,000	89,000		89,000	89,000	89,000
Financial Options Written							
Bonds*							
Calls	9	141,725	38,000	199,781	10,000	615,521	1,275,521
Puts	2	34,000	34,000	41,012	5,000	63,000	68,000
Equities†							
Calls	14	8,376	2,348	13,182	2	41,023	117,268
Puts	4	402	450	353	7	700	1,607
Foreign Currency							
Calls	2	29,520	29,520	6,393	25,000	34,041	59,041
Puts	3	610,314	350,000	678,989	100,000	1,380,943	1,830,943
Caps	1	105	105		105	105	105
Interest Rates							
Caps	1	124,937	124,937		124,937	124,937	124,937
Floors	1	7,350	7,350		7,350	7,350	7,350
Collar, Swap and Forward Agreements Open							
Bonds							
Forwards	2	12,509	12,509	17,665	18	25,000	25,018
Commodities							
Forwards	1	814	814	.	814	814	814
Swaps	4	13,145	13,101	2,643	10,145	16,232	52,580
Equities							
Swaps	3	90,431	100,000	61,209	25,000	146,292	271,292
Foreign Currency							
Forwards	13	251,562	35,186	608,372	466	2,205,964	3,270,312
Swaps	14	91,627	51,493	135,414	1,900	519,477	1,282,772
Interest Rates							
Collars	3	90,000	100,000	36,056	50,000	120,000	270,000
Swaps	69	515,546	202,500	769,954	3,500	4,590,324	35,572,670
Mortgages							
Forwards	1	30,934	30,934		30,934	30,934	30,934
Futures Contracts Open‡							
Bonds							
Long Futures	17	143,170	100,687	151,225	2,976	558,915	2,433,883
Short Futures	19	153,725	62,652	197,376	301	637,581	2,920,768
Equities							
Long Futures	4	9,705	11,797	6,515	263	14,962	38,818
Short Futures	3	30,314	21,195	23,616	12,617	57,130	90,942
Interest Rates							
Long Futures	2	115,456	115,456	76,565	61,316	169,596	230,912
Short Futures	3	421,736	212,925	508,675	50,696	1,001,587	1,265,208

*Total notional amount for bond call/put options calculated as par value of underlying bonds.
†Total notional amount for equity call/put options calculated as number of contracts × 100 × strike price.
‡Total notional amount reported for futures contract calculated as number of contracts × futures payoff × strike price

TABLE 8
DERIVATIVES USE BY PROPERTY/CASUALTY INSURERS: NOTIONAL AMOUNTS FOR OPEN POSITIONS AT YEAR-END 1994
BY TYPE OF RISK AND TYPE OF CONTRACT

Underlying Asset/Risk	Number of Users	Total Notional Amounts ($000's)					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Owned							
Bonds*							
Calls	1	360,000	360,000		360,000	360,000	360,000
Equities†							
Calls	8	81,445	2,481	135,505	96	299,584	651,557
Puts	19	50,862	4,200	102,641	9	429,467	966,374
Foreign Currency							
Calls	1	750,000	750,000	.	750,000	750,000	750,000
Puts	1	614,345	614,345	651,465	153,690	1,075,000	614,345
Interest Rates							
Caps	1	870,878	160,000	1,808,931	5,000	6,500,000	870,878
Commodities							
Puts	1	22,593	22,593		22,593	22,593	22,593
Financial Options Written							
Bonds*							
Calls	7	157,971	37,000	234,435	1,600	613,300	1,105,800
Equities†							
Calls	31	46,926	1,697	121,632	55	536,461	1,454,711
Puts	5	1,787	2,100	1,587	200	3,870	8,934
Foreign Currency							
Calls	1	3,592	3,592		3,592	3,592	3,592
Collar, Swap and Forward Agreements Open							
Commodities							
Swaps	1	20,000	20,000		20,000	20,000	20,000
Equities							
Forwards	1	54,579	54,579	.	54,579	54,579	54,579
Swaps	3	62,082	77,618	42,134	14,386	94,243	186,247
Foreign Currency							
Forwards	21	474,056	10,008	1,794,048	24	8,284,915	9,955,180
Swaps	4	16,948	15,125	5,537	12,500	25,042	67,792
Interest Rates							
Swaps	8	155,175	57,210	253,395	20,000	772,800	1,241,400
Futures Contracts Open‡							
Bonds							
Short Futures	8	51,723	31,578	53,552	3,443	156,106	413,781
Equities							
Long Futures	6	13,622	1,570	28,688	305	72,109	81,734
Short Futures	8	28,456	8,991	45,676	300	132,466	227,651
Foreign Currency							
Long Futures	2	65,086	65,086	85,325	4,753	125,420	130,172
Short Futures	4	31,971	12,956	43,676	4,753	97,218	127,883
Interest Rates							
Short Futures	3	645,875	752,780	409,171	193,863	990,981	1,937,624

*Total notional amount for bond call/put options calculated as par value of underlying bonds.
†Total notional amount for equity call/put options calculated as number of contracts × 100 × strike price.
‡Total notional amount reported for futures contract calculated as number of contracts × futures payoff × strike price

caps and floors, bond futures, and foreign currency forwards are the most important types of derivatives for life insurers in terms of the number of users reporting open positions at the end of the year. Thus, while interest rate swaps are the most prevalent year-end position by life companies, a number of these institutions also engaged in interest rate risk management via contracts with option-like characteristics. In contrast to life insurers, the most common activity for PC insurers (Table 8) is in foreign currency forward contracts and the writing of equity call options. To the extent that PC companies face substantial foreign exchange

exposure due to foreign-based subsidiaries and/or the holding of foreign bonds or equities, this result is not unexpected.

Tables 9 and 10 are similar to Tables 7 and 8 but show the number of derivatives contracts opened by insurers during 1994. For life/health insurers, positions opened during the year greatly exceed end-of-year holdings for bond calls written, long and short bond futures, foreign currency forwards, and short foreign currency futures. For PC insurers, within-year transactions significantly exceed year-end positions for equity calls written, foreign currency swaps, short bond futures, and short equity futures. Short-term hedging needs may account for part or all of the volume differences in open versus year-end positions.[6]

Counterparty Exposure

It is also important to consider the counterparty exposure of insurers. Credit risk may be higher for OTC counterparties than for exchanges, so a heavy concentration of transactions in a few OTC counterparties could possibly expose insurers to excessive credit risk.

Tables 11 and 12 show data on the counterparty concentration of insurer derivatives transactions at year-end and on positions opened during 1994, respectively. The principal measures of counterparty concentration used here are the mean and median number of counterparties and the counterparty Herfindahl index, based on notional principle.[7] A high value of the Herfindahl index implies that an insurer has its transactions heavily concentrated among one or a few counterparties, with the maximum value of one indicating concentration of all notional principal in a single counterparty. Table 11 shows that the mean and median of OTC counterparties at year-end are 4.7 and 2.0, respectively, and the mean and median OTC counterparty Herfindahl indices are 0.620 and 0.582, respectively. The within-year concentration statistics lead to similar conclusions. Although concentration among exchange counterparties is higher, it has been argued that credit risk for exchange-traded derivatives is lower.

Tables 13 and 14 list the OTC counterparties used by insurers at year-end and during the year, respectively. The counterparties are ranked in terms of the total notional amount outstanding with insurers. The counterparty with the largest notional amount outstanding with insurers at year-end is Goldman Sachs, followed by other large U.S. investment banks such as Morgan Guaranty, Bankers Trust, Salomon Brothers, and Merrill Lynch. A number of foreign counterparties also appear on the list, such as Credit Suisse and Deutsche Bank. The leading dealers (as opposed to users) among U.S. insurers are General Reinsurance Financial and American International Group (AIG). The within-year concentration by counterparty appears much higher than the year-end concentration, but this is primarily due to transactions by Prudential Bache for a handful of insurers.

Table 15 shows concentration of insurer notional derivative values among organized exchanges. The CBOT is the leading exchange in terms of notional principal transactions for insurers, accounting for 89% of within-year notional principal and for 61% of year-end notional principal. The difference between the within-year and year-end values for the CBOT is primarily attributable to bond calls written by life insurers.

The above discussion is intended to provide some insight into the extent and composition of derivatives usage by insurers. In the next section we employ some formal statistical tests in an attempt to isolate the insurer-specific factors that play a role in determining whether an insurer is likely to engage in various OBS activities.

4. DETERMINANTS OF DERIVATIVES USAGE: PRIOR RESEARCH AND HYPOTHESES

A. Prior Research

A number of empirical studies of the determinants of derivatives usage by financial institutions have been conducted in recent years, including Kim and Koppenhaver (1992), Venkatachalam (1995), Sinkey and Carter (1995), and Colquitt and Hoyt (1995), among others.[8] These papers investigate a number of hypotheses about the use of derivatives, including the issue of whether derivatives are used for hedging or income enhancement.

[6] For example, if an insurer wished to lock in the rate on monthly predictable cash flows, it will show 12 contracts opened (and later closed) during the year, but only 1/12 of this level in the year-end financial statements.

[7] The Herfindahl index is defined as follows: $H = \sum_{i=1}^{n}(N_i/N)^2$, where N_i = total notional principal with counterparty i, N = total notional principal with all counterparties, and n = total number of counterparties. The statistic is calculated for each active insurer.

[8] Fenn, Post and Sharpe (1996) study the use of derivatives by nonfinancial firms and find that such firms use swaps to protect against fluctuations in debt-financing costs due to changes in interest rates.

TABLE 9

DERIVATIVES USE BY LIFE/HEALTH INSURERS: NOTIONAL AMOUNTS FOR POSITIONS OPENED DURING THE YEAR 1994 BY TYPE OF RISK AND TYPE OF CONTRACT

Underlying Asset/Risk	Number of Companies	Total Notional Amounts ($000's)					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Purchased							
Bonds*							
Calls	21	238,306	97,200	349,856	53	1,289,125	5,004,427
Puts	15	499,645	215,000	970,009	3,000	3,900,600	7,494,675
Caps	1	600,000	600,000		600,000	600,000	600,000
Equities†							
Calls	11	127,603	20,231	350,984	3	1,183,100	1,403,632
Puts	11	85,334	3,761	180,372	517	556,225	938,673
Foreign Currency							
Calls	1	50,000	50,000		50,000	50,000	50,000
Puts	1	294,894	294,894		294,894	294,894	294,894
Floors	1	54,846	54,846		54,846	54,846	54,846
Interest Rates							
Calls	4	69,978	63,707	20,920	52,500	100,000	279,914
Puts	7	474,960	100,000	735,847	1,200	1,870,000	3,324,720
Caps	17	605,897	200,000	1,535,403	5,000	6,500,000	10,300,256
Floors	8	825,301	412,500	1,221,545	75,000	3,742,400	6,602,407
Corridors	1	89,000	89,000		89,000	89,000	89,000
Financial Options Written							
Bonds*							
Calls	16	8,954,164	294,250	28,709,819	10,000	114,309,375	143,266,621
Puts	14	739,031	164,700	1,645,567	5,000	6,169,125	10,346,437
Equities†							
Calls	32	81,736	3,777	260,599	7	1,160,950	2,615,563
Puts	8	17,641	1,663	45,089	182	129,138	141,129
Foreign Currency							
Calls	2	111,420	111,420	122,216	25,000	197,840	222,840
Puts	2	45,750	45,750	49,851	10,500	81,000	91,500
Interest Rates							
Calls	1	200,000	200,000		200,000	200,000	200,000
Caps	4	570,665	225,000	787,748	94,000	1,738,661	2,282,661
Floors	1	141,352	141,352		141,352	141,352	141,352
Collar, Swap and Forward Agreements Opened							
Bonds							
Forwards	2	89,259	89,259	126,206	18	178,500	178,518
Commodities							
Forwards	1	814	814		814	814	814
Swaps	4	15,123	10,145	16,622	1,000	39,203	60,493
Equities							
Swaps	3	78,822	75,000	20,996	60,000	101,467	236,467
Foreign Currency							
Forwards	18	1,496,434	103,072	4,038,454	18	16,190,173	26,935,808
Swaps	6	97,481	51,511	147,928	3,117	392,473	584,888
Interest Rates							
Collars	4	402,500	75,000	706,181	0	1,460,000	1,610,000
Swaps	55	457,178	170,000	1,002,212	3,500	7,105,729	25,144,777
Mortgages							
Swaps	2	42,477	42,477	24,362	25,250	59,704	84,954
Futures Contracts Opened‡							
Bonds							
Long Futures	38	990,774	167,516	2,990,005	58	17,621,020	37,649,420
Short Futures	37	659,822	163,345	1,253,705	301	6,468,393	24,413,399
Equities							
Long Futures	6	21,225	12,832	19,663	1,034	51,815	127,350
Short Futures	4	96,165	69,944	65,954	51,673	193,100	384,662
Foreign Currency							
Long Futures	1	982,090	982,090		982,090	982,090	982,090
Short Futures	2	1,535,828	1,535,828	2,044,906	89,860	2,981,795	3,071,655
Interest Rates							
Long Futures	4	1,086,541	83,417	2,060,936	2,320	4,177,009	4,346,163
Short Futures	4	7,495,078	997,286	13,682,322	11,964	27,973,778	29,980,314

*Total notional amount for bond call/put options calculated as par value of underlying bonds.
†Total notional amount for equity call/put options calculated as number of contracts × 100 × strike price.
‡Total notional amount reported for futures contract calculated as number of contracts × futures payoff × strike price

TABLE 10
DERIVATIVES USE BY PROPERTY/CASUALTY INSURERS: NOTIONAL AMOUNTS FOR POSITIONS OPENED DURING THE YEAR 1994 BY TYPE OF RISK AND TYPE OF CONTRACT

Underlying Asset/Risk	Number of Companies	Total Notional Amounts ($000's)					
		Mean	Median	Standard Deviation	Minimum	Maximum	Total
Financial Options Purchased							
Bonds*							
Calls	4	107,260	4,400	208,503	241	420,000	429,041
Caps	1	3,700	3,700		3,700	3,700	3,700
Equities†							
Calls	17	45,229	2,000	97,755	63	299,584	768,887
Puts	32	46,511	6,123	89,361	30	423,615	1,488,350
Foreign Currency							
Calls	2	18,514	18,514	11,417	10,441	26,587	37,027
Puts	2	54,825	54,825	24,448	37,538	72,113	109,651
Interest Rates							
Caps	1	212,787	212,787		212,787	212,787	212,787
Financial Options Written							
Bonds*							
Calls	11	53,818	16,900	90,907	1,000	274,000	592,000
Equities†							
Calls	72	134,567	7,557	765,783	5	6,484,850	9,688,798
Puts	12	9,079	1,740	14,999	60	46,923	108,953
Foreign Currency							
Calls	2	111,420	111,420	122,216	25,000	197,840	222,840
Puts	2	305,331	305,331	385,134	33,000	577,662	610,662
Collar, Swap and Forward Agreements Opened							
Equities							
Swaps	3	87,239	94,243	69,616	14,386	153,088	261,718
Foreign Currency							
Forwards	19	279,470	106,037	382,962	281	1,562,890	5,309,932
Swaps	5	525,581	144,000	916,462	3,989	2,149,411	2,627,904
Interest Rates							
Swaps	7	44,512	15,250	50,778	7,800	150,000	311,584
Futures Contracts Opened‡							
Bonds							
Long Futures	4	58,680	32,703	75,478	3,675	165,638	234,719
Short Futures	9	354,167	430,322	330,896	2,735	825,945	3,187,503
Equities							
Long Futures	7	71,713	41,663	104,814	937	296,131	501,993
Short Futures	12	287,958	109,868	589,033	627	2,139,248	3,455,493
Foreign Currency							
Long Futures	4	75,493	21,816	115,908	9,236	249,106	301,973
Short Futures	3	12,587	18,404	10,589	365	18,994	37,762
Interest Rates							
Short Futures	4	486,347	473,319	461,964	7,767	990,981	1,945,387

*Total notional amount for bond call/put options calculated as par value of underlying bonds.
†Total notional amount for equity call/put options calculated as number of contracts × 100 × strike price.
‡Total notional amount reported for futures contract calculated as number of contracts × futures payoff × strike price.

Kim and Koppenhaver consider the characteristics that are associated with swap market participation by a sample of banks from the mid-1980s to the early 1990s They find that much of the notional values in swaps is explained by dealer, as opposed to position, activities Moreover, while dealer-driven participation is directly related to capitalization levels, they find that the level of notional values is inversely related to capitalization levels. They argue that these results make sense to the extent that market discipline would require dealers to have relatively large capital ratios for protection against default risk, while for users the higher capital levels act as a substitute for other risk reduction activities such as interest rate swaps

TABLE 11
COUNTERPARTY EXPOSURE IN END-OF-YEAR HOLDINGS FOR 1994

Variable	Number of Companies	Mean	Median	Standard Deviation	Minimum	Maximum
All Counterparties						
Number of Counterparties per Company	212	3 774	2.000	5 083	1 000	31 000
Number of Transactions per Counterparty	212	5 545	3.000	7 041	1 000	44.000
Counterparty Herfindahl	212	0.710	0.981	0 340	0.064	1.000
OTC Counterparties						
Number of Counterparties per Company	138	4 717	2.000	5 545	1 000	27 000
Number of Transactions per Counterparty	138	4 021	2.500	4 652	1 000	27.000
Counterparty Herfindahl	138	0 620	0 582	0.353	0.067	1.000
Organized Exchanges						
Number of Counterparties per Company	91	1 319	1 000	0.758	1 000	4 000
Number of Transactions per Counterparty	91	7 907	3 000	10.206	1 000	48.000
Counterparty Herfindahl	91	0.926	1.000	0.178	0.338	1.000

TABLE 12
COUNTERPARTY EXPOSURE IN POSITIONS OPENED DURING THE YEAR 1994

Variable	Number of Companies	Mean	Median	Standard Deviation	Minimum	Maximum
All Counterparties						
Number of Counterparties per Company	268	2 940	1 000	4.073	1 000	35.000
Number of Transactions per Counterparty	268	21 362	7 000	35.075	1 000	257.500
Counterparty Herfindahl	268	0 792	1 000	0 283	0 048	1.000
OTC Counterparties						
Number of Counterparties per Company	144	3 563	2 000	4 694	1 000	31.000
Number of Transactions per Counterparty	144	11 124	2 708	24 180	1 000	240.000
Counterparty Herfindahl	144	0 716	0 951	0 324	0 051	1 000
Organized Exchanges						
Number of Counterparties per Company	145	1 545	1 000	1.067	1 000	5.000
Number of Transactions per Counterparty	145	34 108	13 000	50.087	1 000	293.000
Counterparty Herfindahl	145	0.905	1.000	0.197	0.263	1.000

Gunther and Siems (1995), using more recent (early 1990s) data on banks, concluded that capitalization levels are related to the extent of derivatives usage, but not to the decision on whether to participate in derivatives markets They found that highly capitalized banks tend to use derivatives to a greater extent than banks with weaker capital positions The authors point out that this could be consistent with banks using derivatives for income-enhancing ("speculative") activities, with market discipline and/or regulation constraining weaker banks' participation Alternatively, it could suggest that highly capitalized banks use derivatives to hedge unwanted risk.

Gunther and Siems also report that their measure of interest rate risk exposure, the absolute value of the difference in the value of assets and liabilities repricing or maturing within one to five years divided by total assets, is actually inversely related to the use of nonswap derivatives. While the authors interpret this result as evidence of speculative activities by banks in OBS contracts, their dependent variable excludes interest rate swap positions, which would logically be a superior instrument for hedging intermediate term interest rate risk than the short-dated exchange-traded contracts that define their dependent variable. Indeed, Kim and Koppenhaver (1992) provide evidence that this same interest rate risk measure is positively related to swap activities, conditional on variables that account for nonswap derivatives activities

Gunther and Siems also find that banks whose debt financing includes high levels of subordinated claims (notes and debentures) relative to assets engage in

TABLE 13
OTC COUNTERPARTIES AT YEAR-END 1994

Rank	Counterparty	Number of Companies Using Counterparty	Total Notional Amount Outstanding	Percentage of Total Industry OTC Notional
1	Goldman Sachs	35	$11,661,292,733	12 1%
2	Morgan Guaranty	29	11,583,928,965	12 0
3	Bankers Trust	36	11,359,451,231	11 8
4	Salomon Brothers	45	6,277,215,409	6 5
5	Merrill Lynch	49	5,461,390,937	5 7
6	Prudential Bache	10	4,982,500,401	5 2
7	UBS Securities	15	4,942,663,326	5 1
8	Lehman Brothers	23	4,505,237,641	4 7
9	General Re Financial	17	3,018,925,231	3 1
10	Morgan Stanley	29	2,740,188,832	2 8
11	Credit Suisse	27	2,037,799,372	2 1
12	Citibank	16	2,018,544,392	2 1
13	Deutsche Bank	14	1,724,412,763	1 8
14	First Chicago	15	1,684,643,467	1 7
15	Republic National Bank—New York	2	1,680,187,168	1 7
16	Chase Manhattan Bank	15	1,540,110,495	1 6
17	Swiss Bank	12	1,245,353,905	1 3
18	AIG	16	1,175,746,335	1 2
19	Barclay's Bank PLC	20	1,165,776,187	1 2
20	J P Morgan	9	977,334,093	1 0
21	Chemical Bank	21	850,294,905	0 9
22	ABN-AMBO Bank	3	850,000,000	0 9
23	Bank of America	10	707,078,653	0 7
24	Bank of Montreal	6	637,483,190	0 7
25	Columbine Life Insurance Co	1	567,700,000	0 6
26	Security Life of Denver	1	567,700,000	0 6
27	Royal Bank of Canada	11	538,732,814	0 6
28	Ford Motor Credit	1	530,000,000	0 5
29	Bear Stearns	2	460,000,000	0 5
30	Credit Lyonnais	7	427,413,059	0 4
31	Bank of Tokyo	2	422,000,000	0 4
32	First Boston	7	357,420,000	0 4
33	Nomura Bank ITL	6	337,144,300	0 3
34	Bank of New York	6	327,133,959	0 3
35	Bank of Nova Scotia	8	258,340,286	0 3
36	Copley Financing Corporation	1	240,000,000	0 2
37	CAD Imperial Bank	8	218,152,334	0 2
38	Societe Generale	4	210,059,229	0 2
39	Sumitomo Bank Limited	2	205,000,000	0 2
40	Schroder	1	203,850,000	0 2
41	ING Capital Markets	3	188,594,385	0 2
42	Banque Paribas	4	162,330,000	0 2
43	Nationsbank	4	161,600,000	0 2
44	ODC Capital Corp	1	146,400,000	0 2
45	Lloyds Bank	4	132,950,079	0 1
46	CU Assurance Co. PLC	3	123,130,966	0 1
47	Paine Webber	2	112,460,415	0 1
48	Toronto Dominion SEC	5	104,910,747	0 1
49	Cobank	3	104,343,646	0 1
50	Applause	1	102,222,000	0 1
	All Others (65)		$ 1,038,141,550	1 1%
	Unknown	29	3,402,842,651	3 5

TABLE 14
OTC COUNTERPARTIES ON CONTRACTS OPENED DURING THE YEAR 1994

Rank	Counterparty	Number of Companies Using Counterparty	Total Notional Amount Outstanding	Percentage of Total Industry OTC Notional
1	Prudential Bache	9	$64,737,627,643	36 8%
2	Goldman Sachs	30	21,599,604,258	12.3
3	Salomon Brothers	33	9,687,057,758	5 5
4	Bankers Trust	22	8,835,745,906	5 0
5	Morgan Stanley	26	7,429,192,842	4 2
6	Merrill Lynch	38	6,086,695,215	3.5
7	Lehman Brothers	23	5,822,472,637	3 3
8	UBS Securities	11	5,388,846,273	3 1
9	Swiss Bank	11	4,475,425,663	2.5
10	Morgan Guaranty	15	4,129,848,121	2.3
11	Citibank	17	3,333,947,009	1 9
12	First Chicago	12	2,197,833,726	1 2
13	Bank of America	6	2,111,420,374	1 2
14	Kidder Peabody	1	2,089,003,805	1 2
15	Credit Suisse	14	1,780,550,000	1 0
16	First Boston	8	1,689,891,927	1 0
17	AIG	8	1,662,690,653	0 9
18	Bank of New York	4	1,485,735,628	0.8
19	Deutsche Bank	8	1,347,998,865	0 8
20	Republic National Bank—New York	2	1,270,000,000	0 7
21	Barclay's Bank PLC	13	1,174,318,515	0.7
22	Chase Manhattan Bank	12	953,063,988	0 5
23	Chemical Bank	18	848,191,915	0 5
24	J P Morgan	8	844,764,013	0 5
25	General Re Financial	8	663,300,000	0 4
26	Royal Bank of Canada	6	641,798,085	0 4
27	ABN-AMBO Bank	3	574,538,194	0 3
28	Bank of Montreal	7	557,836,488	0 3
29	Ford Motor Credit	1	500,000,000	0 3
30	Columbine Life Insurance Co.	1	468,200,000	0 3
31	Security Life of Denver	1	468,200,000	0 3
32	Paine Webber	4	423,037,759	0 2
33	CAD Imperial Bank	3	363,858,302	0 2
34	Bear Stearns	5	293,865,394	0.2
35	ING Capital Markets	1	290,000,000	0 2
36	Republic of New York	1	250,723,600	0 1
37	Nomura Bank ITL	3	250,416,528	0 1
38	Northern Trust	2	232,376,709	0 1
39	Marshall & Ilsley	1	231,033,028	0 1
40	Bank of Boston	1	219,000,000	0 1
41	Bank of Tokyo	2	205,000,000	0 1
42	Nationsbank	4	171,900,000	0.1
43	Sumitomo Bank Limited	2	130,000,000	0 1
44	Lloyds Bank	2	118,721,758	0 1
45	Bank of Nova Scotia	2	107,500,000	0 1
46	Mercadian	1	80,000,000	0 0
47	National Westminster Bank PLC	3	72,825,603	0.0
48	Postipankki Bank	1	64,119,217	0 0
49	Russell 2000	1	60,000,000	0 0
50	Toronto Dominion SEC	5	55,346,694	0 0
	All Others (83)		$ 794,169,123	0.5%
	Unknown	51	6,649,641,928	3.8

TABLE 15
EXCHANGE COUNTERPARTIES AT YEAR-END 1994

Exchange	Number of Companies Using Exchange	Total Notional Amount Outstanding	Percentage of Total Industry Exchange Traded Notional
Chicago Board of Trade (CBOT)	36	$6,814,876,588	61 11%
Chicago Board of Options Exchange	31	2,340,684,750	20.99
New York Stock Exchange	13	1,015,164,830	9.10
NASDAQ	3	331,969,500	2 98
MATIF	1	232,073,282	2.08
Chicago Mercantile Exchange	4	194,875,950	1.75
London International Financial Future	1	71,692,554	0 64
American Stock Exchange	11	37,688,900	0 34
Options Clearing Corporation	1	19,808,400	0 18
Kansas City Board of Trade	3	15,038,250	0.13
Philadelphia Stock Exchange	5	9,303,000	0 08
Pacific Stock Exchange	3	5,404,500	0 05
American OPT Exchange	1	1,332,000	0.01
Tokyo Stock Exchange	2	604,485	0 01
Philadelphia OPT Exchange	1	580,000	0.01
Chicago Stock Exchange	1	62,500	0.00
Unknown Exchange	3	60,841,291	0.55

TABLE 16
1994 EXCHANGE COUNTERPARTIES ON CONTRACTS OPENED DURING 1994

Exchange	Number of Companies Using Exchange	Total Notional Amount Outstanding	Percentage of Total Industry Exchange Traded Notional
Chicago Board of Trade (CBOT)	56	$187,558,963,048	88 88%
Chicago Board of Options Exchange	53	11,741,503,705	5 56
New York Stock Exchange	32	1,945,723,680	0.92
London International Financial Future	3	1,250,835,489	0 59
MATIF	1	1,208,772,636	0.57
Chicago Mercantile Exchange	10	880,466,295	0.42
Kansas City Board of Trade	3	642,405,900	0 30
NASDAQ	3	474,045,226	0.22
Options Clearing Corporation	1	417,371,900	0 20
American Stock Exchange	23	330,489,500	0.16
Int'l Monetary MKT	2	326,155,068	0.15
Philadelphia Stock Exchange	16	104,274,500	0 05
Pacific Stock Exchange	8	34,949,250	0 02
Tokyo Stock Exchange	3	12,479,768	0 01
American OPT Exchange	1	10,384,250	0.00
Philadelphia OPT Exchange	2	7,005,000	0 00
Midwest Stock Exchange	2	3,760,500	0 00
Chicago Stock Exchange	2	1,655,000	0.00
Unknown Exchange	3	4,073,155,379	1.93

higher levels of OBS activity than banks with less subordinated debt The positive association between subordinated claims and derivatives usage provides evidence that, from a regulatory perspective, more highly capitalized banks are more likely to engage in OBS activities This follows from the fact that a certain percentage of subordinated debt claims are allowed to be counted as capital for purposes of determining risk-based-capital ratios for banks

Venkatachalam (1995) reports that while, on average, derivatives are used for hedging fluctuations in bank equity prices, a significant percentage of the firms in his sample appear to display a positive partial correlation between changes in the value of equity and changes in the value of their OBS positions Our approach to the examination of hedging versus "speculative" activities partly involves a decomposition of certain OBS positions into those associated with the

purchase of volatility versus its sale. In particular, we are able to isolate some factors influencing insurers to purchase options, caps and floors versus writing these same contracts. This approach has the advantage of being able to directly measure whether insurers are writing volatility protection for others versus hedging their own cash flows.

The literature on insurer participation in derivatives markets is much more limited than that concerning banks. Colquitt and Hoyt (1995) investigate the determinants of the use of futures and options by life insurers. They find that large insurers are more likely to engage in derivatives activity than smaller firms and that stock insurers are more likely to use derivatives than mutuals. The former finding is consistent with the banking literature and is usually attributed to economies of scale in human capital investments associated with derivatives. The Colquitt and Hoyt finding for stock insurers is consistent with the managerial discretion hypothesis (see Mayers and Smith 1988) that stocks have a comparative advantage in conducting more complex and/or risky types of insurance business than mutuals because owners can more easily monitor and control management in the stock form of ownership, reducing agency costs. The tendency of stock firms to conduct more complex or risky types of business, in turn, implies that they have more reason to use derivatives for hedging than mutuals and also are likely to have a comparative advantage in acting as derivatives dealers.

Colquitt and Hoyt also find that the use of OBS contracts is positively related to measures of interest rate risk exposure. They find that insurers domiciled in states prohibiting investment of general account funds in futures or options are less likely to engage in these OBS activities, but that usage is more likely for firms in these states as the level of separate account assets increases.

We extend the work of Colquitt and Hoyt in a number of dimensions. First, in addition to studying the determinants of derivatives usage in general, we also investigate factors influencing the use of various types of derivatives such as options, swaps, and futures. Second, whereas Colquitt and Hoyt based their analysis on life insurers licensed in Georgia, our sample includes the universe of insurers reporting to the NAIC. Thus, we analyze derivatives usage by PC insurers, as well as life insurers, and conduct a separate analysis of insurance groups as well as individual companies. We believe that these extensions are important in isolating the rationales for derivatives use across organizations with substantial cross-sectional variation in risk/return profiles.

B. Hypotheses

We have a number of hypotheses, some of them taken from earlier work, about the factors that influence derivatives instrument choices and year-end exposure decisions. At the overall participation level, we expect size to be positively related to OBS activity if there are significant economies of scale in human capital investment and derivatives trading (Booth, Smith and Stolz 1984; Hoyt 1989). However, these scale economies, if they exist, may be offset by the fact that larger insurers may be more diversified and therefore in less need of OBS contracts as additional risk management tools. This potentially negative relationship is, however, predicated on the idea that OBS activities are almost solely for purposes of hedging. Our overall expectation is that information/transactions cost economies of scale will dominate any built in diversification benefits, resulting in greater usage by larger insurers.

Organizational form, that is, the mutual versus stock form of ownership, is another potential determinant of variability in the use of OBS instruments among insurers. The managerial discretion hypothesis suggests that stocks are expected to engage in more OBS activity than mutuals because stocks are more likely to be involved in complex and/or risky lines of business that give rise to the need for hedging. However, the use of derivatives by stock insurers is also likely to hinge on whether OBS activities are beneficial to stockholders and the degree to which stockholders are able to align managers' interests with their own. Conventional theory would suggest that hedging is not beneficial to stockholders and thus that the existence of corporate hedging is evidence of agency costs. However, more recent work (for example, Froot, Scharfstein, and Stein 1993; Nance, Smith, and Smithson 1993) suggests that hedging may be a way to control certain types of incentive or principal-agent problems or otherwise enhance value if markets are incomplete, and thus may benefit stockholders. Smith and Stulz (1985) hypothesized that firms faced with a convex tax schedule could reduce expected taxes, and therefore increase firm value, by lowering the volatility of its taxable earnings stream.

Another organizational variable of some interest involves line-of-business specialization. Life insurers are generally believed to have higher interest rate risk exposure than their PC counterparts because there is an investment component in many life insurance contracts and policyholders are interest rate sensitive. Interest rate sensitivity has increased over the past 20 years with the introduction of universal life insurance, variable life insurance, and various types of new annuity products. Participation in the market for GICs

provides another source of interest rate risk exposure for many life insurers PC insurers' liabilities are also rate sensitive in the sense that their fair value reflects the present value of future loss cash flows However, PC insurers' liabilities are generally shorter term than those of life insurance, and PC insurers do not face the risk of disintermediation, such as the risk that policyholders will surrender policies or withdraw funds to take advantage of investments offering more attractive yields

Both life and PC insurers also face interest rate risk on the asset side of the balance sheet because a large percentage of their investments are in rate-sensitive, long-term, fixed-income obligations There have been few studies of the duration of insurer assets and liabilities, but the existing literature suggests that the equity of many insurers is subject to a positive duration gap (for example, Cummins and Weiss 1991; Staking and Babbel 1995) Because financial statement data are not sufficient to permit duration to be estimated, we use asset maturity and liability mix as proxies We would expect larger maturity duration gaps to be associated with higher usage of OBS contracts that allow insurers to transfer this interest rate volatility

To measure interest rate risk exposure due to asset holdings, we are able to disaggregate the bond portfolio into publicly traded and privately placed bonds and also into four general categories of bond instruments—CMOs, loan-backed bonds, other structured bonds, and non-loan-backed bonds The disaggregation allows us to account for differential exposure of the major bond categories to interest rate and liquidity risk For example, insurers may use derivatives to hedge the liquidity risk of privately placed bonds, and higher usage rates may also be associated with holdings of CMOs because of the potential for thinness of trading during periods of high rate volatility and the negative convexity of these instruments

In a similar fashion, we would want to account for the degree of market risk exposure the institution faces, via its holdings of equity and/or exchange rate risk We control for these factors by including variables that measure the overall percentage of investment in equity securities We would expect equity holdings to be positively associated with derivative usage if the insurers' motivation is to hedge this equity exposure or to enhance their income by writing covered calls (see footnote 3) By looking at the purchase and sale of some contracts, we can ask whether the demand is for the purchase or sale of volatility-altering contracts such as options

Similar arguments can be made for foreign exchange exposure Larger positions in foreign securities and/or the existence of foreign-based subsidiaries may generate a demand for selling this volatility, presumably through forward and futures markets for foreign exchange (parts C and D of Schedule DB) To the extent that insurers are not typically major market makers, we would expect to find little evidence of selling volatility through options (Part B of Schedule DB) Residual equity exposure would presumably be managed in a fashion similar to that of domestic securities and should carry a similar sign

Although the use of derivatives by most insurers is a relatively recent phenomenon,[9] insurers have long used reinsurance as a way of hedging underwriting risk and more recently have used financial reinsurance to hedge interest rate exposure and other types of financial risk (Tiller and Tiller 1995) We account for the use of reinsurance by including in our regressions the ratio of ceded reinsurance premiums written to direct premiums written plus reinsurance assumed.[10] If there is a significant relationship between underwriting risk and returns in financial markets, then reinsurance designed to reduce underwriting risk might serve as a substitute for OBS activities Financial reinsurance is more likely to be a substitute for OBS transactions, but this type of reinsurance is a relatively recent product that is imperfectly proxied by our reinsurance variable On the other hand, reinsurance and financial derivatives might be complements if insurers that engage in hedging of underwriting risk are also more likely to hedge financial risk

To account for differences in business mix across insurers, we use a set of variables reflecting specialization in various PC and life/health lines of insurance For PC insurers we include variables that reflect specialization in long- and short-tail lines of business As discussed above, the fair value of insurer liabilities reflects the discounted value of the loss cash flows Thus, interest rate changes have a more pronounced effect on the fair value of liabilities in long-tail lines than in short-tail lines Because PC insurers are heavily invested in long-term bonds, long-tail liabilities may serve in part as a natural hedge against interest rate risk exposure from the bond portfolio to the extent that the fair value of these liabilities is inversely related to interest rates Thus, we might expect PC insurers with higher proportions of long-tail liabilities to be less likely to engage in derivatives transactions designed to

[9] Lehman Brothers (1994) reports that some of the more sophisticated insurers have been using derivatives for more than 20 years However, only a few large insurers fall into this category

[10] This measure of reinsurance is also used by Colquitt and Hoyt (1995) and by Mayers and Smith (1990)

manage interest rate risk. On the other hand, short-tail liabilities are not as sensitive to interest rates; thus PC insurers with relatively large positions in the short-tail lines may be more likely to hedge interest rate risk through the use of derivatives.

Cash value life insurance policies, individual annuities, and group annuities are generally associated with higher interest rate risk than policies (such as term life and group life) that primarily protect against mortality risk. Cash value life insurance and annuities incorporate a variety of options that expose insurers to prepayment and disintermediation risk due to competition from other financial intermediaries such as banks and mutual funds. Thus, we expect insurers with relatively large cash value life insurance and annuity reserves to be more likely to use derivatives to manage risk.

As a final control variable, we use a regulatory dummy set equal to 1 if the company is domiciled in a state that prohibits general account funds from being invested in certain OBS contracts and to 0 otherwise. We would expect this variable to carry a negative sign in the empirical specification if the more restrictive regulatory environment is not already captured by our measures of such factors as equity market participation and other investment restrictions that may be formally or informally imposed by states that wish to limit insurers' positions in activities that regulators believe are excessively risky.

Absent accounting, regulatory, or information effects, the same factors associated with positions during the year should retain explanatory power for end-of-year holdings. However, to the extent that there is different regulatory treatment for derivatives use across life and PC underwriters, we would expect to see institutions that are less penalized, for example, in terms of risk-based capital requirements, engage in more derivatives usage. For example, because the life insurer risk-based-capital formula includes a charge for the use of swaps, whereas the PC formula includes no charges for derivatives, life insurers may be less likely than PC insurers to hold non-zero swap positions at year-end.

There may also exist accounting reasons for end-of-year positions that differ from those found on an average day during the year. Widely held stock corporations, for example, must report financial condition information to both state regulatory agencies and the SEC, the latter on a quarterly basis. Mutual insurers, on the other hand, have fewer external reporting requirements. To the extent that the more widely dispersed information on stock insurers is impounded into their stock prices, repositioning outstanding contracts in the year-end reports would not yield positive value. Because mutuals have fewer disclosure requirements (and the fact that regulatory calculations apply to year-end balances), mutuals have more opportunity to manage any informational transfers associated with reporting reflections of the underlying risk of the cash flows. There may be other reasons, beyond any associated with capital requirements, that would encourage institutions to alter year-end positions, for example, "window-dressing."

5. DETERMINANTS OF DERIVATIVES USAGE: RESULTS

A. Users and Non-users: Summary Statistics

Tables 17 and 18 focus on the asset and liability portfolios of insurers, their use of reinsurance, and other company characteristics. The tables reveal that PC insurers tend to hold higher proportions of their portfolios in stocks than do life insurers, whereas life insurers invest more in CMOs, privately placed bonds, and real estate and mortgages than do PC insurers. Both types of insurers are heavily invested in publicly traded bonds. The average maturities of bond portfolios for life insurers are higher than those for PC firms.

Life insurers that use derivatives invest more in mortgages, real estate, and privately placed bonds than non-users and have proportionately more GICs, individual life insurance reserves, and group annuity reserves than non-users. PC derivatives users hold proportionately more stocks, CMOs, and loan-backed bonds than non-users. Both life and PC insurers that use derivatives have less of their portfolios in cash and short-term investments than non-users, suggesting that derivatives are given used to manage liquidity risk by generating cash flows when interest rates are moving in directions that either reduce the market value of the firms' assets or increase the market value of the firms' liabilities.

B. Multivariate Modeling

Although the averages provide some intriguing suggestive evidence on our hypotheses on derivatives use by insurers, multivariate methods are needed to provide more definitive answers. Accordingly, we estimate probit models of derivative usage with a dependent variable equal to 1 if the insurer uses derivatives and equal to 0 otherwise. We estimate models for overall

TABLE 17
MEANS OF INDEPENDENT VARIABLES FOR NON-USERS VERSUS USERS

Variable	Life/Health Insurers		Property/Casualty Insurers		Groups and Unaffiliated Singles	
	Non-users	Users	Non-users	Users	Non-users	Users
Total Assets (000,000's)	$656.5	$8,594 7	$248.8	$1,710.1	$563.5	$11,125 7
Stocks	7.5%	6.9%	9 9%	19.2%	9 3%	12.6%
Real Estate	6.2%	8.7%	1 6%	2.4%	3.9%	5.9%
Publicly Traded Bonds	60 7%	55 5%	64.9%	61 6%	63.2%	58 0%
Privately Placed Bonds	2 4%	9 8%	0 9%	1 6%	1 3%	5 4%
Cash + Short-Term Investments	6.85%	2.73%	7 56%	4 57%	7 78%	3.70%
All Other Assets	16.41%	16 35%	15.04%	10.62%	14.52%	14.32%
Average Maturity Publicly Traded Bonds	7 67	9 84	6.36	8 05	6.78	8 92
Average Maturity Privately Placed Bonds	2.46	7 11	1.65	4 18	1 92	5 71
Commercial Liability Reserves	—	—	21.9%	19.7%	12 4%	8.7%
Auto Liability Reserves	—	—	19.3%	26 1%	12 0%	10 8%
Auto Physical Damage Reserves	—	—	4 7%	5 7%	3 1%	3 1%
Multiperil Reserves	—	—	14 9%	14.3%	12.2%	5.5%
Group Life Reserves	11 2%	4 5%	—	—	4.2%	1 7%
Individual Life Reserves	47 5%	53.6%	—	—	14 6%	28 7%
Group Annuity Reserves	1 7%	6 3%	—	—	0 5%	3.7%
GICs	0 4%	5 2%	—	—	0 2%	2 6%
Accident and Health Reserves	4 5%	3 8%	1.7%	1 0%	2 6%	2 4%
Life/Health Premiums Ceded to Reinsurers	14.4%	13.4%	—	—	4.8%	7.4%
Property/Casualty Premiums Ceded to Reinsurers	—	—	34.9%	31.3%	20.8%	16 5%
Single Unaffiliated Company Dummy	0 26	0.08	0 29	0.20	—	—
Stock Organizational Form Dummy	0.70	0.85	0 59	0.76	—	—
Affiliated Member Active In Derivatives Dummy	0.08	0 62	0.09	0.57	—	—
Group Stock Organizational Form Dummy	—	—	—	—	0 64	0 69
Property/Casualty Group Dummy	—	—	—	—	0.62	0.35
Life Group Dummy	—	—	—	—	0.30	0.34
Surplus Herfindahl Index	—	—	—	—	0.87	0.64

TABLE 18
BOND PORTFOLIO DISTRIBUTION AND MATURITY BY CATEGORY

Variable	Life/Health Insurers		Property/Casualty Insurers		Groups and Unaffiliated Singles	
	Non-users	Users	Non-users	Users	Non-users	Users
Publicly Traded Commercial Bonds	70.2%	54 3%	83.6%	79 5%	79 8%	66 2%
Publicly Traded CMOs	11.3%	18.1%	5.6%	8 6%	7.1%	13.7%
Publicly Traded Loan-Backed Bonds	10 9%	8.9%	7 0%	7.6%	8.5%	8.9%
Publicly Traded Other Bonds	1 5%	1.8%	1 4%	1.5%	1 6%	1 9%
Privately Placed Commercial Bonds	3.2%	14.5%	1.1%	2 5%	1.7%	7.9%
Privately Placed CMOs	0.1%	0.5%	0 0%	0.1%	0.1%	0.4%
Privately Placed Loan Backed Bonds	0 3%	0 8%	0.1%	0 1%	0 1%	0 5%
Privately Placed Other Bonds	0.2%	1 1%	0.2%	0 2%	0 1%	0 6%
Average Maturity Publicly Traded Commercial Bonds	6 756	8.731	5 891	7.474	6 010	8.060
Average Maturity Publicly Traded CMOs	6 016	10 158	4.313	7 014	4 811	8 604
Average Maturity Publicly Traded Loan-Backed Bonds	7.537	11 208	4.998	8 683	5.872	10 079
Average Maturity Publicly Traded Other Bonds	2.032	6.398	1 091	3.426	1.440	4 867
Average Maturity Privately Placed Commercial Bonds	2 337	6 925	1 475	3.586	1 774	5.238
Average Maturity Privately Placed CMOs	0 826	4 823	0.134	1 416	0 390	4 281
Average Maturity Privately Placed Loan-Backed Bonds	1.133	5 383	0 340	0 972	0.643	3 700
Average Maturity Privately Placed Other Bonds	0.819	4.000	0.214	1.313	0.386	3.080

derivatives usage and for each of the five major categories of derivatives transactions/holdings reported in Schedule DB. The probit models are estimated by using maximum likelihood methods. Logit and Gompit models also were estimated, with similar results. For a discussion of probit, see Greene (1990).

The use of multivariate statistical models, such as our probit model, provides important insights into the influence of the independent variables (insurer characteristics) on the dependent variable (derivatives use or non-use) that cannot be obtained from tables of averages and are also difficult to extract from cross-tabulations. In effect, the multivariate models allow us to focus on the influence of each variable, after controlling for the influence of all other variables in the equation. The influence of each independent variable is measured by its sign and magnitude as well as the statistical significance of its coefficient, as discussed below. The importance of controlling for other possibly influential factors when evaluating the effect of a specific variable involves the idea that the variable in question may appear to be important (unimportant) when considered in isolation but may be unimportant (important) after controlling for other potentially influential insurer characteristics.

In interpreting the probit results, the reader should keep in mind that the dependent variable equals 1 if an insurer uses derivatives and equals 0 if the insurer does not use derivatives. Thus, variables with positive coefficients are associated with the use of derivatives and variables with negative coefficients are associated with non-use. It is also worth reiterating that the dependent variable is set equal to 1 if the insurer showed *any* activity in sections 1 through 3 on Parts A through D of Schedule DB; that is, the insurer is counted as a derivatives user if it reported year-end derivative positions, if it opened derivatives positions during the year, or if it closed derivative positions during the year.

To give the reader an idea of how well the empirical specification explains the variability of the dependent variable, the likelihood ratio index has been calculated for each probit equation. The likelihood ratio index ranges from 0 to 1 and can be interpreted in a similar manner to the R^2 statistic reported in ordinary least squares regressions. For a more technical discussion of the likelihood ratio index, see Maddala (1983).

C. Probit Results: Life Insurers

This section reports results for individual life/health insurance companies; that is, each company is treated as a separate observation unit regardless of whether it is a member of a group. To control for group affiliation, we include a dummy variable equal to 1 if the insurer is a member of a group in which at least one other group member is active in derivatives. A dummy variable is also included for unaffiliated single companies. Thus, the category not represented by a dummy variable consists of members of groups where at most one group member is active in derivatives.

The life/health insurer results, presented in Table 19, show clearly that size (measured by the natural logarithm of assets) is a strong determinant of the use of derivatives. Thus, like earlier authors, we find evidence consistent with the existence of significant economies of scale in human and fixed capital. The findings imply a minimum size before OBS activities become viable from a cost perspective. Reinforcing this finding, an insurer is much more likely to use derivatives if it is a member of a group in which at least one other insurer engages in OBS transactions. This is intuitively appealing to the extent that, if one member of the group is involved, then the marginal cost of other group members taking advantage of the risk/return opportunities afforded by OBS contracts is declining to the extent that each member of the group rationally does not duplicate these fixed costs.

Life insurer involvement in derivatives is also correlated with the degree of reinsurance, as Colquitt and Hoyt found. However, note that it is significantly positively correlated with the writing of options, caps, and floors and with the reporting of counterparty exposure at year-end but not with the use of other types of derivatives. To the extent that most life insurers have positive equity duration gaps, writing call options on bonds may be a complement to reinsurance for flattening out the relationship between interest rates and equity value. However, at this point we cannot rule out the possibility that life insurers are taking on more volatility in OBS contracts (for example, by writing bond and equity calls) as they simultaneously use reinsurance markets to sell off the financial risk component of their life insurance claims. The purchase of derivatives contracts also seems to be correlated with the average maturity of publicly traded bonds. This could again be viewed as an attempt to shorten the duration of equity by purchasing interest rate caps and/or buying put options on long-term bonds.

Interestingly, the use of swaps and futures contracts is highly correlated with the percentage of CMOs (particularly those that are privately placed) and the percentage of GICs issued by the institution. One interpretation of these results is that life and health institutions are hedging the duration gap between privately placed CMOs, which may look attractive because of their yields but may have poor liquidity, and

TABLE 19
PROBIT REGRESSIONS RESULTS FOR LIFE/HEALTH COMPANIES

	Any Derivatives Activity	Buying Options	Writing Options	Swaps, Forwards and Collars	Futures	End-of-Year Counterparty
Intercept	−8 6912*	−9.8702*	−7.2478*	−18.2937*	−7 7654*	−12.2988*
Log Assets	0 3343*	0 3601*	0.2293*	0.7356*	0.3000*	0.4413*
Stocks	0.4113	0 9266	0 9090	1 1052	−0.0147	0.9172
Real Estate	−1.3487	−2 0014	0.1236	−5 7044*	−1.0796	−1.4923
GICs	3.1328*	1.9488*	0 4247	6 6962*	3.7015*	2.4059‡
Publicly Traded Commercial Bonds	−0 5759	−0.1365	0 3320	−2.4443‡	−1 0143	0 1914
Publicly Traded CMOs	−0 4359	−0 4867	0.1391	−0.6710	−1 4462	0 9373
Publicly Traded Loan-Backed Bonds	−0 1933	1 6554	0.2337	−2.1903	−0.3980	0.5930
Publicly Traded Other Bonds	−10.1851‡	−1 3156	−5.6562	−6 8738	−5.1888	−0.7223
Privately Placed Commercial Bonds	0.5147	−0.0325	−2 5482	2 6482	0.2147	4.1822*
Privately Placed CMOs	21.3578†	19.3110	16 7593	31 4762‡	36 3088‡	19 1315
Privately Placed Loan-Backed Bonds	−0 0842	4.1189	−0 8522	3.0948	5 4317	5 3790
Privately Placed Other Bonds	6 2962	12 8734	3 3007	16.1040	−4 4388	−1 3822
Average Maturity Publicly Traded Commercial Bonds	0 0221	−0 0204	0 0298	−0 0163	0.0036	0.0072
Average Maturity Publicly Traded CMOs	−0.0076	−0.0164	−0 0174	0 0327	−0.0141	−0.0313†
Average Maturity Publicly Traded Loan-Backed Bonds	−0.0144	0.0185	0 0055	−0 0196	−0 0006	0 0075
Average Maturity Publicly Traded Other Bonds	0 0282‡	0 0348‡	0.0062	0.0465‡	0.0333†	0 0210
Average Maturity Privately Placed Commercial Bonds	0.0028	0 0477†	−0 0174	0.0628†	−0.0064	−0.0003
Average Maturity Privately Placed CMOs	0.0141	0 0237	0.0149	−0 0429‡	0.0220	−0.0094
Average Maturity Privately Placed Loan-Backed Bonds	0.0114	−0.0088	−0 0104	−0 0012	0 0007	0 0045
Average Maturity Privately Placed Other Bonds	−0 0001	−0.0422	0 0311	0.0103	−0.0419	0 0099
Group Life Reserves	0 1826	−0 0346	0.1188	2.6311‡	0.3730	0.2570
Individual Life Reserves	0.7897‡	0 5361	0.2803	1.8453‡	0.3525	0.3362
Group Annuity Reserves	0.8178	1.2085	−0.9005	0 5939	1 5579†	0.1384
Accident and Health Reserves	0.7773	0.6627	0 2719	1 4972	0 8385	0 2507
Life/Health Premiums Ceded to Reinsurers	0 4923	0 5167	1.0644*	0.4368	0.4222	1 1214‡
Single Unaffiliated Company	0 3230	−0 4478	0.3438	0.4945	0.1261	0.4258
Stock Dummy	0 1496	−0 0414	0.0738	0.1591	−0.1544	0.5617†
Affiliated Member Active in Derivatives Dummy	1.2434*	0.8048*	0 8168*	0 9446*	0 8530*	0.9556*
Log L	−221 748	−143.119	−149.977	−94.751	−119.475	−134 373
Number of 0's	1,063	1,137	1,159	1,129	1,150	1,132
Number of 1's	144	70	48	78	57	75
Likelihood Ratio Index	0.50	0.46	0.26	0.67	0.48	0.52

*Significant at the 1% level
†Significant at the 10% level.
‡Significant at the 5% level

GICs, which are typically shorter term and reasonably rate sensitive It is, of course, possible that some of these (short) positions (for example, futures) are also attempts to dynamically hedge the convexity risk displayed by CMOs A final possibility for the positive CMO-derivatives correlation may be the similarity of analytical capabilities required to successful manage this asset class and incorporate derivatives into the firm's investment strategies.

We also note that the percentage of reserves held as individual life reserves is positively related to the use of derivatives, in particular, swap contracts, which mainly consist of interest rate swaps for life insurers. To the extent that individual life reserves represent interest-sensitive instruments, their behavior may mirror to some extent that displayed by GICs, which are also highly correlated with the use of swaps

Finally, stock insurers are somewhat more likely to report year-end counterparty exposure than mutuals, as expected, if mutuals can exploit information asymmetries to gain value by year-end balance sheet window-dressing. This finding also would be consistent with the managerial discretion hypothesis, also as expected, if our asset or reserve categories do not fully capture the differences between stock and mutual asset and product portfolios.

D. Probit Results: Property/Casualty Insurers

Results for the probit regressions that focus only on PC insurers (shown in Table 20) provide a number of similarities, but also a number of sharp contrasts, when compared to results for their life insurer counterparts Similar to life insurers, and for what we suppose are very similar reasons, both size and group affiliation with an OBS user are positively associated with the use of derivatives by PC companies.

TABLE 20
PROBIT REGRESSIONS RESULTS FOR PROPERTY/CASUALTY COMPANIES

	Any Derivatives Activity	Buying Options	Writing Options	Swaps, Forwards and Collars	Futures	End-of-Year Counterparty
Intercept	−7.9100*	−7 1762*	−6.8488*	−15.1918*	−8.6921*	−10.5763*
Log Assets	0.3028*	0 2060*	0.2221*	0.6377*	0.3230*	0.4069*
Stocks	1.4809*	1 5935†	1.5405‡	0.2131	0 1219	0.5986
Real Estate	3.6538*	4 6418*	3.8574‡	0 4982	0 6111	4.3155
Total Commercial Bonds	−0 2860	0.3239	0 2506	0 2922	−0 9229	−0 3466
Total CMOs	1 0826	2 3885‡	2 0654‡	−0 5982	−5 4174‡	−1 3789
Total Loan-Backed Bonds	0 3365	0.5742	0 4770	1 1758	−1 5982	1.1418
Total Other Bonds	−0 4355	0.2023	−0 3590	1.9400	−1.4798	−2.8172
Average Maturity Total Commercial Bonds	0.0128	−0 0060	0.0252	−0.0112	0.0357	0.0292
Average Maturity Total CMOs	0.0009	−0 0078	−0.0130	0.0111	0.0280	0.0110
Average Maturity Total Loan-Backed Bonds	0 0020	0.0054	−0 0112	0 0189	−0.0227	0 0019
Average Maturity Total Other Bonds	0 0312‡	0.0157	0 0182	0 0595‡	0 0526‡	0 0398†
Commercial Liability Reserves	−0.6885‡	−0.7839†	−0.3895	−1.6627‡	−0.7853	−1.5855*
Auto Liability Reserves	0.0945	0 3824	0.3128	0.2550	−0 9546	−0.5914
Multiperil Reserves	0.0906	−0 0955	0.2998	−2.6080†	−0.2835	−0.0777
Auto Physical Damage Reserves	0.9814‡	0 4000	1.3203*	−6.2179	−2.2045	−0.3878
Accident/Health Reserves	−0 5368	−0 4533	0.0992	−9 3455	−3.2661	0.4804
Property/Casualty Premiums Ceded to Reinsurers	−0 5404†	0.1447	−0 5863‡	0 5573	0 0034	−0 0319
Single Unaffiliated Company	0.7776*	0.4098†	0 5876*	0 4463	0 8573‡	0 4680
Stock Dummy	0.1612	0 3647†	−0.0687	−0.1754	0 6231*	0.1857
Affiliated Member Active in Derivatives Dummy	1.3977*	1.0117*	1.2032*	0.9489*	0.9977*	1.2255*
Log L	−324 241	−158.024	−252.113	−76.163	−80.166	−98.567
Number of 0's	1,921	2,016	1,979	2,031	2,036	2,026
Number of 1's	142	47	84	32	27	37
Likelihood Ratio Index	0.37	0.30	0.28	0.54	0.44	0.47

*Significant at the 1% level.
†Significant at the 10% level.
‡Significant at the 5% level.

There also appears to be a tendency for unaffiliated single firms to use derivatives, particularly in terms of writing caps, floors, and options. The greater use of derivatives by unaffiliated insurers may reflect the fact that they forfeit a source of diversification by not being organized as a group and thus may have a greater need to hedge through the use of derivatives. An insurance group is similar to a portfolio of options, worth more to the owners than an option on a portfolio. Under corporate law, the creditors of an insolvent subsidiary cannot reach the assets of other members of the group unless they are successful in "piercing the corporate veil," which usually requires a finding of fraud or similar wrongdoing by the group's owners. The portfolio-of-options effect may be stronger for PC insurers than for life insurers because PC insurers are more exposed to volatility from their underwriting operations, whereas the underwriting risk exposure of life insurers is minimal. Thus, the option to fail may be worth more to PC insurers, motivating PC insurers that are not members of groups to engage in other types of risk management.

There are several important contrasts between the life insurer and PC insurer results. First, we note that the percentage of assets held in stocks is strongly positively related to the use of derivatives by PC insurers but is not a significant determinant of the use of derivatives by life insurers. More specifically, stocks held are positively associated with the writing and buying of options by PC insurers. The strong relationship with writing calls and/or buying puts is consistent with covered call and "dividend capture" strategies.[11] The fact that end-of-the-year counterparty exposure is not related to the level of stock holdings provides some auxiliary evidence that these positions may not be carried over from year to year. (Recall from Tables 8 and 10 that the number of insurers showing within-year equity call option transactions is much larger than the number showing end-of-year positions in these contracts.)

Second, the relationship between real estate holdings and the use of OBS contracts differs between PC and life companies. For life insurers, real estate is significantly negatively related to the use of swaps but is not related to the use of other types of derivatives. This makes sense to the extent that real estate values are less sensitive to interest rate changes than, say, a fixed-income security, hence the lower need for swap contracts as a risk management tool. For PC companies, on the other hand, real estate holdings are positively associated with the purchase and sale of options but not associated with swaps.

A third contrast between PC and life insurers is the relationship between reinsurance and OBS contracts. For PC insurers, the use of reinsurance is inversely related to the writing of options. This result contrasts sharply with that reported for life insurers. One interpretation of this result is consistent with the hypothesis that PC insurers that choose to focus on the generation of income as opposed to risk management, can accomplish this task by writing options, for which they receive a fee, and simultaneously abstaining from the (potentially costly) reinsurance of their liabilities.

Writing long-tail commercial policies (general liability and worker compensation insurance) seems to be associated with a lower likelihood of being party to OBS contracts, particularly swaps. This would be consistent with the interpretation of long-tail liabilities as a natural hedge for interest rate risk in the asset portfolio, thus reducing the need for interest rate risk management.

A somewhat puzzling finding is the positive relationship between auto physical damage insurance and OBS activity, specifically the writing of options. Based on reasoning similar to that in the long-tail commercial case, OBS transactions might be related to the short-tailed auto physical damage line because the fair value of liabilities in this line is mostly unaffected by changes in interest rates. OBS transactions may be related to short-tail auto physical damage to the extent that heavy reliance on these typically short-term contracts results, ceteris paribus, in a larger equity duration gap. Another possible explanation is that auto physical damage tends to be a relatively profitable line of business. Thus, a concentration in auto physical damage may be complementary to other income-enhancing strategies like the writing of covered call, discussed earlier.

E. Probit Results: Groups and Unaffiliated Single Companies

At a general level, the group results (shown in Table 21) mirror, to a larger extent, the results reported for the individual life and PC insurers. Large groups and those with relatively heavy exposure in stocks and/or GICs tend to be heavily involved in OBS activities—the former in writing options and the latter in swap

[11] Dividend capture is a covered call strategy that involves the purchase of the security for the sole purpose of receiving the dividend. By simultaneously writing a call option, the insurer is protected should the ex-dividend price fall by more than the amount of the dividend.

TABLE 21
PROBIT REGRESSIONS RESULTS FOR ALL GROUPS

	Any Derivatives Activity	Buying Options	Writing Options	Swaps, Forwards and Collars	Futures	End-of-Year Counterparty
Intercept	−6.8969*	−7.8522*	−5.5534*	−16.3751*	−7.5916*	−10.3514*
Log Assets	0.2662*	0.2697*	0.1736*	0.7076*	0.3069*	0.3947*
Stocks	1.7472	1.2948	1.9748	0.6557	0.7906	1.9076‡
Real Estate	−0.4644	−0.0449	0.9827	−2.0900	−2.4477	−1.8021
GICs	2.9641*	2.4425†	1.7768	5.2492*	4.2849*	4.1215*
Publicly Traded Commercial Bonds	−0.3720	−0.3034	0.2091	−0.5988	−1.2334†	−0.0630
Publicly Traded CMOs	0.2755	0.4704	0.6673	0.3228	−2.4125†	0.4485
Publicly Traded Loan-Backed Bonds	0.0747	1.4290	0.2336	0.9557	−1.0229	1.6532
Publicly Traded Other Bonds	0.3815	0.7770	0.4718	−2.8245	−9.8446	−3.4972
Privately Placed Commercial Bonds	0.1087	0.9068	−3.4933	1.4486	1.0505	2.2137
Privately Placed CMOs	3.9159	3.5988	9.8633	14.4148†	9.3661	6.8268
Privately Placed Loan-Backed Bonds	−0.5498	5.4371	−1.8728	9.5701	2.7038	3.2331
Privately Placed Other Bonds	−8.6560	2.8131	−4.1695	13.8516	3.4831	3.4604
Average Maturity, Publicly Traded Commercial Bonds	0.0223	0.0029	0.0158	0.0093	0.0153	−0.0061
Average Maturity, Publicly Traded CMOs	−0.0059	−0.0033	−0.0071	−0.0018	−0.0089	−0.0320†
Average Maturity, Publicly Traded Loan-Backed Bonds	−0.0030	0.0197	−0.0073	0.0061	−0.0119	0.0164
Average Maturity, Publicly Traded Other Bonds	0.0123	0.0202	−0.0069	0.0367	0.0469‡	0.0260
Average Maturity, Privately Placed Commercial Bonds	0.0103	0.0252	0.0128	0.0120	0.0086	0.0014
Average Maturity, Privately Placed CMOs	0.0479*	0.0441‡	0.0300†	0.0029	0.0366†	0.0298
Average Maturity, Privately Placed Loan-Backed Bonds	0.0044	0.0088	−0.0218	0.0065	−0.0031	0.0260
Average Maturity, Privately Placed Other Bonds	0.0121	−0.0489†	0.0453‡	−0.0387	−0.0311	−0.0309
Commercial Liabilities Reserves	−0.3227	−0.0004	0.1352	−2.6315‡	−0.8040	−1.3621
Auto Liabilities Reserves	0.0958	0.7763†	0.4175	−2.6530	−0.8285	−0.1749
Auto Physical Damage Reserves	1.2445‡	1.1468	1.5017*	0.0746	−2.9627	0.2716
Multiperil Reserves	−0.1687	−3.4658‡	0.2286	−1.4669	−1.0081	0.5714
Group Life Reserves	−0.4813	−0.5295	0.1868	−12.4003†	−0.2941	−0.2426
Individual Life Reserves	0.4833	0.7109	0.5552	0.0649	0.4097	0.2641
Group Annuity Reserves	2.2968‡	2.9821*	0.7276	0.1655	3.8267*	1.6757
Accident and Health Reserves	0.3929	0.5307	0.2346	−0.0770	−2.9305	−0.2351
Life Premiums Ceded	1.2663*	1.5291‡	1.4732*	0.4390	0.2530	2.1412*
Property/Casualty Premiums Ceded	−0.0926	0.4561	−0.2219	0.9533	0.8407	−0.2589
Group Stock Organizational Form Dummy	0.1607	0.1217	0.0030	0.0738	0.1286	0.3786†
Property/Casualty Group Dummy	0.3687†	0.9235*	0.0349	1.0045‡	0.4703	0.3300
Life Group Dummy	−0.3417	−0.1168	−0.6270	0.0316	0.4440	−0.4297
Surplus Herfindahl Index	−0.0441	−0.8819‡	0.0422	−0.4578	−0.3897	−0.2140
Log L	−347.869	−175.731	−266.967	−92.414	−114.283	−131.601
Number of Non-users	1245	1343	1333	1355	1368	1357
Number of Users	178	80	90	68	55	66
Likelihood Ratio Index	0.35	0.43	0.20	0.66	0.51	0.51

*Significant at the 1% level
†Significant at the 10% level
‡Significant at the 5% level

contracts. Substantial investments in long-term privately placed bonds are again correlated with the writing of options, caps, and floors

Life premiums ceded and individual life reserves remain correlated with derivatives usage—with the former being related to both the writing and purchase of options, caps, and collars In the group models, high levels of group annuity reserves are also associated with a high likelihood of derivatives usage, particularly the purchase of option-type contracts To the extent that these are interest-sensitive accounts, the writing of interest rate floors or call options on bonds to fund the purchase of, say, interest rate caps makes some sense from the perspective of self-financing interest rate risk strategies This would again tend to flatten out the equity/interest rate relationship, for which there is some evidence that the insurer earns a high reward/risk ratio (Staking and Babbel 1995)

We note that the writing of auto physical damage policies retains a strong positive association with the writing of option-type contracts, while long-term privately placed CMOs are associated with a high probability of futures activity (duration hedging) and the purchase of option-type contracts (for example, puts and calls or caps and floors) in an effort to hedge the negative convexity of these contracts

Finally, the dummy variable for states that prohibit insurers from using derivatives was insignificant and was eliminated from the final versions of the regressions. This finding, which is contrary to the Colquitt and Hoyt results, may be due to the fact that their sample consisted of life insurers licensed in Georgia, a state that prohibits domestic companies from using derivatives Because few major insurers are domiciled in the prohibiting states, the result may disappear in our larger sample Also, our larger set of control variables may be absorbing any regulatory effect.[12]

6. CONCLUSIONS

Like other types of financial and nonfinancial firms, insurers are increasingly using financial derivatives to manage risk Although the overall proportion of all insurers using derivatives remains small, derivatives use has become widespread among firms in the largest size quartile. The proportion of life insurers using derivatives is higher than the proportion of PC users, but the number of life and PC firms using derivatives is approximately equal

Interest rate swaps, caps, and floors and bond futures are the types of contracts used by the largest number of life insurers reporting year-end derivatives positions in their financial statements, consistent with the use of such contracts by life companies to manage interest rate risk Some life insurers also tend to write substantial amounts of bond calls and puts during the year, little of which remains open at the end of the year Life insurers are also actively trading foreign currency forwards For PC insurers, the contracts used by the largest number of insurers are equity calls written, foreign currency forwards, and equity puts purchased. Based on transactions during the year, a substantial volume of notional principle in the PC industry also arises from positions in equity options and short positions in bond futures and equity futures An overall conclusion is that life insurers are using derivatives primarily to manage interest rate and exchange rate risk, while PC insurers are active in equity and foreign exchange derivatives markets.

In addition to number of insurers trading in derivatives markets and the volume of notional principal, we also conduct a probit analysis of determinants of the use of derivatives by insurers Consistent with prior research on insurers and banks, we find evidence that significant economies of scale affect the use of derivatives Large firms are much more likely to use derivatives than smaller firms Reinforcing this evidence is the finding that insurers that are members of groups in which at least one other group member uses derivatives are significantly more likely to engage in derivatives trading

We also find evidence that derivatives are used to manage the positive duration gap that tends to characterize insurer equity. For example, insurers that write more GICs and hold more individual life reserves and annuity reserves are more likely to use derivatives. Bond portfolio maturity is also positively correlated with the use of derivatives, and there is evidence that insurers tend to use derivatives to hedge the risk of CMOs and privately placed bonds Insurers also appear to be using derivatives as part of equity income-enhancement strategies and to manage convexity risk.

Interestingly, we find that PC insurers who write more short-tail auto physical damage insurance are more likely to use derivatives than those writing long-tail commercial liability and worker compensation insurance. We also find that the level of reinsurance is inversely related to the use of derivatives by PC insurers, which is the opposite of what we, and Colquitt and Hoyt before us, find for life insurers Specifically, derivatives usage in the form of writing options is correlated with reinsurance for both PC and life insurers,

[12]The omission of the regulatory variable had no noticeable effect on the coefficients of the other variables in the probit models.

but with different signs. Unfortunately, at the level of aggregation used in this study, we are unable to distinguish between the hypotheses that one or the other of these types of insurers is using derivatives as a complement or substitute for risk taking on the balance sheet. The problem is that the writing of options, caps, and floors can be used either to reduce risk or increase income. Investigating the source of the demand by insurers for these contracts is a major priority in our plans for future research.

We also find significant differences between positions taken during the year and positions that remain open at the end of the year. In particular, stock companies seem to display little difference between within-year and end-of-year positions, while mutuals display more end-of-year variation vis à vis their positions during the year. This result is consistent with the hypothesis that prices are at least partially revealing and therefore that managers of stock corporations have less incentive to engage in management of end-of-year positions. Stock companies in general tend to engage in more derivatives trading, a result that is consistent with the managerial discretion hypothesis.

We have been able to report on the universe of insurers that report derivatives usage in Schedule DB in this paper. Unfortunately, this may understate the actual amount of activity there is in financial instruments with embedded derivative features. In particular, structured notes, which are fixed-income securities with derivative characteristics, provide insurers a way to utilize derivatives in their investment strategies without having to specifically identify their usage. For example, an insurer could purchase a five-year structured note for which the coupon rate is tied to movements in the S&P 500 index instead of the more conventional fixed-rate coupon. This security combines a five-year "plain vanilla" bond with an embedded swap contract paying a fixed rate and receiving the return of the S&P 500 index. Under statutory accounting rules, this type of instrument is reported in Schedule D of the annual statement, but Schedule D does not provide enough detail to distinguish this bond from bonds that do not have embedded derivatives. Investigating the popularity of these investments and determining what effect their existence may have on an insurer's decisions to participate directly in derivative markets is clearly an avenue for future research.

More work needs to be done on the question of whether the regularities that we find in these data are related primarily to efforts to flatten the relationship between insurer surplus value and financial market prices or, alternatively, to strategies involving what might be called "covered" income strategies such as the dividend capture hypothesis outlined in this paper. This is a topic for future research that will hopefully enable us to shed light on the issue of whether usage of some contracts is associated with risk reduction, while other contracts may be used to enhance income while attempting to keep additional risk exposure at a minimum.

ACKNOWLEDGMENTS

Financial assistance from the Society of Actuaries (specific groups within the Society of Actuaries included the Investment Section, the Financial Reporting Section, the Committee on Knowledge Extension Research, the Committee on Financial Research, and the Committee on Life Insurance Research), the Casualty Actuarial Society, Bankers Trust Inc., the Center for Risk Management and Insurance Research at Georgia State University, and the Policy Research Center at Georgia State University is gratefully acknowledged. We thank the following individuals for their helpful comments on this paper: David Hall, Samuel Cox, Gregory Niehaus, Lucien Burnett, Martin Nance, Laura Benedict, Peter Hepokoski, Stephen Reddy, Len Graus, and Robert Reitano. The authors also thank Robert Klein, Michael Barth, and the National Association of Insurance Commissioners for their assistance in collecting the data. Any errors are, as usual, our responsibility.

REFERENCES

BOOTH, JAMES R., SMITH, RICHARD L., AND STOLZ, RICHARD W. 1984. "Use of Interest Rate Futures by Financial Institutions," *Journal of Bank Research* 15:15–20.

COLQUITT, L. LEE, AND HOYT, ROBERT E. 1995. "Determinants of Corporate Hedging Behavior: Evidence from the Life Insurance Industry," Working Paper, University of Georgia, Athens, Ga.

CUMMINS, J. DAVID, AND GEMAN, HÉLYETTE. 1995. "Pricing Insurance Catastrophe Futures and Call Spreads: An Arbitrage Approach," *Journal of Fixed Income* 4:46–57.

CUMMINS, J. DAVID, AND WEISS, MARY A. 1991. "The Structure, Conduct, and Regulation of the Property-Liability Insurance Industry," in R. W. Kopcke and R. E. Randall, eds., *The Financial Condition and Regulation of Insurance Companies*. Boston, Mass.: Federal Reserve Bank of Boston.

FENN, GEORGE W., POSNER, MITCH, AND SHARPE, STEVEN A. 1996. "Why Nonfinancial Firms Use Interest Rate Derivatives," Working Paper, Capital Markets Section, Federal Reserve Board, Washington, D.C.

FROOT, KENNETH A., SCHARFSTEIN, DAVID S., AND STEIN, JEREMY C. 1993. "Risk Management: Coordinating Investment and Financing Policies," *Journal of Finance* 68:1629–58.

GREENE, WILLIAM H 1990 *Econometric Analysis* New York: Macmillan Publishing Company

GUNTHER, JEFFERY W., AND SIEMS, THOMAS F 1995 "The Likelihood and Extent of Bank Participation in Derivative Activities," Working Paper, Federal Reserve Bank of Dallas, Dallas, Tex

HOYT, ROBERT E 1989 "Use of Financial Futures by Life Insurers," *Journal of Risk and Insurance* 56:740–49

KIM, SUNG-HWA, AND KOPPENHAVER, G 1992 "An Empirical Analysis of Bank Interest Rate Swaps," *Journal of Financial Services Research* 7:57–72

LEHMAN BROTHERS 1994 "Derivatives Use by Insurers: How Derivatives Are Changing the Way Insurers Operate " New York

MADDALA, G S 1983 *Limited-Dependent and Qualitative Variables in Econometrics* New York: Cambridge University Press

MAYERS, DAVID, AND SMITH, CLIFFORD W. Jr. 1990 "On the Corporate Demand for Insurance: Evidence from the Reinsurance Market," *Journal of Business* 63:19–40

MAYERS, DAVID, AND SMITH, CLIFFORD W Jr 1988 "Ownership Structure Across Lines of Property-Liability Insurance," *Journal of Law and Economics* 31:351–78

NANCE, DEANA R , SMITH, CLIFFORD W Jr., AND SMITHSON, CHARLES W 1993 "On the Determinants of Corporate Hedging, *Journal of Finance* 68:267–84

SINKEY, JOSEPH F , AND CARTER, DAVID 1995 "The Determinants of Hedging and Derivatives Activities by U S Commercial Banks," Working Paper, University of Georgia, Athens, Ga

SMITH, CLIFFORD W., AND STULZ, RENÉ M 1985 "The Determinants of Firms' Hedging Policies," *Journal of Financial and Quantitative Analysis* 20:391–405

STAKING, KIM B , AND BABBEL, DAVID F 1995 "The Relation Between Capital Structure, Interest Rate Sensitivity, and Market Value in the Property-Liability Insurance Industry," *Journal of Risk and Insurance* 62:690–718

TILLER, JOHN E , AND TILLER, DENISE FAGERBERG 1995 *Life, Health & Annuity Reinsurance* Winsted, Conn : ACTEX Publications

VENKATACHALAM, MOHAN 1995 "Value-Relevance of Banks' Derivatives Disclosures," Working Paper No 95-13, University of Iowa, Iowa City, Iowa

DISCUSSIONS

L. Lee Colquitt* and Arlette C. Wilson†

Derivatives can be used effectively as financial risk management tools, and the derivatives markets have grown and evolved considerably over the last several years in response to the complex risk profiles currently facing firms participating in today's global economy More specifically, many insurers have entered these markets in an attempt to manage the interest rate, equity and foreign exchange rate risks to which they are exposed as a result of the products they offer and the makeup of their assets

Messrs Cummins, Phillips and Smith's study concentrates on the use of financial derivatives by U S insurers Our discussion of this paper focuses on (1) the contributions of the study, (2) observations and suggestions for improvement, and (3) proposed accounting that may affect derivatives usage by insurers

Contributions of the Study

Although the statistical analysis is usually the primary focus of a study such as this, one noticeable contribution of this paper is the clear and concise explantion of the insurer's role as a financial intermediary and the function that derivative instruments serve in the financial risk management of the firm Following this explanation and a description of the data is perhaps the most significant contribution of the paper: the detailed statistical analysis of derivatives usage by U S life and property/casualty insurers The authors provide a thorough breakdown of derivatives activities by insurers that is not found in the current literature The strengths of the dataset used to accomplish this analysis include the size of the dataset, the inclusion of property/casualty data and the availability of group data In addition, the expansion of the reporting of derivatives transactions required by Schedule DB of the 1994 statutory annual statement of insurers allows for the analysis of the participating counterparties, the exchanges on which the derivatives contracts are traded and a comparison of a firm's within-year trading activity and its end-of-year reporting

Finally, Messrs Cummins, Phillips and Smith contribute to the current stream of literature in this area by identifying both the determinants of derivatives usage in general and the factors affecting an insurer's use of specific categories of derivatives contracts The authors' ability to link specific insurer liabilities and assets to the trading of specific derivatives contracts produces some interesting findings Also, their incorporation of group data into the probit model reinforces the economies of scale and informational economies hypotheses Finally, they link year-end counterparty exposure to stock firms, suggesting that mutual firms are able to "exploit information asymmetries to gain value by year-end balance sheet window-dressing."

*Lee Colquitt, not a member of the Society, is in the Department of Finance, Auburn University, Alabama

†Arlette C Wilson, not a member of the Society, is in the School of Accountancy, Auburn University, Alabama

Observations and Suggestions for Improvement

The authors use the term "hedging" both in the title and text of their paper However, without the specific reporting of a hedge by the sample firms, the reader is forced to assume, along with them, that the sample firms are hedging and not speculating with derivatives To their credit, the authors attempt to identify assets or liabilities of the firm that, when coupled with the use of specific derivatives contracts, suggest the existence of a hedging strategy

In 1992, Schedule DB required that for each contract traded, the insurer was to report whether or not a hedge existed as a result of the trade Included in the dataset used by Colquitt and Hoyt (1996) in their study of the determinants of hedging by insurers, some insurers report the use of derivatives but also report that a hedge did not exist with any of the derivatives traded Although these firms used derivatives, they were not considered "hedgers" by Colquitt and Hoyt Other insurers reported using some derivatives as hedging instruments and using some of the derivatives as speculative investments These firms were considered as "hedgers." However, only that portion of their entire portfolio of derivatives specifically identified as hedging instruments was included in the continuous measure of their hedging Although a study of the determinants of derivatives "usage" can provide interesting results (as Cummins et al demonstrate), it is important for them to recognize the distinction between a study on hedging with derivatives and a study on the use (whether it be for hedging or speculation) of derivatives This study would more conservatively be described as the latter

Because of the relative infancy of the use of derivatives, one inherent weakness that accompanies the study of derivatives use by insurers is the lack of participation by most insurers in derivatives trading Given that the authors' measure of derivatives usage is based on any derivatives activity of the firm, the percentages of "users" in the property/casualty, life/health, and group samples are 6 88%, 11 93%, and 12 51%, respectively However, when the definition of "users" is more narrowly defined to include only those that are trading specific contracts, the number of "users" is quite small With several of the models, there are so few "users" that we are intuitively uncomfortable with the power of the results For example, in the property/casualty model, the number of futures "users" is only 27 versus 2,036 "non-users" (roughly 1 3%) As more participation in this and other derivatives activity increases, so will the ability of these authors and others to produce more powerful and convincing results

Another concern that we have with the analysis of "users" defined as those using specific contracts is the potential bias that might result from this narrow classification of the sample firms For example, a "user" in the sample of firms writing options includes all firms that are writing options However, included among the "non-users" are (1) firms that are not using *any* derivatives, (2) firms that are not writing options but *are* buying options, (3) firms that are not writing options but *are* trading futures contracts, and (4) firms that are not writing options but *are* entering into swaps contracts and so on Perhaps the model could be improved by using a categorical dependent variable that divides the users into groups that use various combinations of derivatives By classifying "users" in this way, if there is a difference in the characteristics and behavior of a firm that is not trading *any* derivatives versus a firm that is not writing options but *is* trading futures, then the model would capture these differences

While the authors include variables that test most of their proposed hypotheses, an independent variable not included in the model is one representing the tax status of the firm In Colquitt and Hoyt (a subsequent version not available to Cummins et al at the time of their writing), a variable measuring whether or not the insurer paid federal income tax or capital gains tax during the previous two years is included in the model The results of this variable support the tax hypothesis posited by the authors Firms that were more likely to be in the convex portion of the tax curve (those firms not paying federal income tax or capital gains tax during the previous two years) were more likely to hedge with futures and options to lower the volatility of their taxable income and thereby reduce the expected taxes of the firm The results of a tax variable included in these models would be interesting to see

Although the authors include a stock/mutual variable to test the effects of organizational form on the insurer's use of derivatives, there is no specific mention of how mutual-owned stock companies are classified As a result, we are left to assume that the stock firms that are wholly owned by mutual firms maintain their "stock" classification The findings of Mayers and Smith (1992, 1994) suggest that stock firms that are wholly owned by mutual firms tend to behave as mutual firms The practice of reclassifying wholly owned stock firms as mutual firms has been adopted by other research of insurance company operations (see Colquitt and Hoyt 1996; Cox, Gaver and Wells 1996) Given a reclassification of mutual-owned stock firms, the organizational form results would likely be considerably different than those found by the authors

Finally, Cummins et al do not indicate whether their models exhibit any violations of underlying regression theory such as heteroscedasticity or multicollinearity. If the disturbances in the underlying regression are heteroscedastic, the maximum likelihood estimates are inconsistent and the variance/covariance matrix is inappropriate. If multicollinearity exists, the estimates in the model may be highly sensitive to the particular observation set and to the specification of the model. Confirmation from the authors regarding the testing and, where necessary, appropriate correction for these problems would strengthen the validity of their results.

Proposed Accounting for Derivatives

The authors report interesting data on within-year trading activity versus end-of-year open positions. For example, the number of options used during the year appear to be significantly greater than the number of options still open at year-end. This decrease in derivatives activity at year-end might be influenced by the accounting and reporting requirements for these derivatives. An interesting question that can be answered with future research may be, What will be the effect of new financial reporting requirements on derivative usage?

In January 1992, the Financial Accounting Standards Board (FASB) began a project to redefine reporting requirements for hedging transactions. As the FASB progressed through the project, one ultimate objective became apparent: fair value accounting for all derivatives. In June 1996, the FASB issued an exposure draft proposing accounting for derivatives and for hedging activities. The comment period ended October 11, 1996, and unless the constituency can provide some very convincing arguments against the currently proposed approach, the FASB plans to issue a final standard during the second quarter of 1997.

The remainder of this discussion focuses on the proposed accounting for derivatives and hedging activities and examples of specific changes that might affect management strategies and usage of certain types of derivatives.

Proposed General Requirements

The proposed accounting for derivatives would require all derivatives to be marked to fair value and reported on the balance sheet as assets or liabilities. The change in fair value would be included in current earnings unless the derivative was specifically designated as a hedge of the fair value of existing assets, liabilities or firm commitments (referred to as a fair-value hedge) or designated as a hedge of cash flows of a forecasted transaction (a cash-flow hedge). The special accounting allowed for fair value and cash-flow hedges would be significantly different from current hedge accounting in most instances.

For a fair-value hedge, the unrealized gain or loss from a change in the fair value of the derivative would be included in current earnings. In addition, changes in the fair value of the hedged item that occurred during the hedging period would be simultaneously recognized as an adjustment of that item and included in income to the extent that the gain or loss offsets changes in the fair value of the derivative. Changes in the value of an asset, liability or firm commitment that existed prior to the hedge period would not be recorded. Also, changes in the fair value of the hedged item that exceed changes in the fair value of the derivative would not be recorded. This reporting would be a significant change from the conventional deferral approach currently used for hedging transactions.

To illustrate this approach, assume that Company X is holding fixed-rate investments of $10,000,000 that result in a fair-value exposure. To hedge this exposure, X enters into a $10,000,000 interest rate swap to received LIBOR and pay fixed. If, by year-end, interest rates increase, the fair value of the swap will increase while the value of the investments will decrease. Assume that the fair value of the swap increases to $100,000 while the investments' fair value is $9,910,000. Both the $100,000 gain and the $90,000 loss would be included in current earnings, and both the swap and the investments would be reported at their fair values.

Suppose that the value of the investments had been $9,870,000 at year-end. The $100,000 gain from the derivative would be reported in current earnings. However, only $100,000 of the $130,000 loss would be reported in current earnings. The investments would be reported at $9,900,000, which is greater than its fair value. The change in the value of the investments could occur as a result of factors other than just changes in interest rates. But the proposed approach is based on the entire change in the fair value of the hedged item, even if only one particular risk attribute of the item is hedged.

For a cash-flow hedge, the unrealized gain or loss from changes in the fair value of the derivative would be included as a separate component of stockholders' equity until the projected date of the forecasted transaction. The company would recognize in earnings the total amount of fair-value changes accumulated in stockholders' equity for that derivative on the originally projected date of the forecasted transaction being hedged. Note that an interest-rate swap conducted to effectively change variable-rate debt to fixed-rate debt

is a cash-flow hedge, while a swap conducted to effectively change fixed-rate debt to variable-rate debt is a fair-value hedge.

The proposed method would significantly change hedge accounting as we currently know it. A few of those changes that might affect the reporting of insurance companies are discussed below.

Inability to Hedge Held-to-Maturity Investments

Insurance companies will not be able to hedge debt securities classified as held-to-maturity. The proposed standard indicates that designating a derivative as a hedge of a debt security that is classified as held-to-maturity undermines the notion of that classification. This is because the classification is based on an underlying investment intent that renders changes in value of the security to be irrelevant. Swaps on such securities to convert interest from fixed to variable would no longer qualify as a hedging activity.

Inability to Use Net Written Options as Hedging Instruments

Combinations of options entered into contemporaneously, whether free standing or embedded in a derivative, would be considered a net written option if a net premium is received in cash or as a favorable rate or other term either at inception or over the life of the contract. Many derivative financial instruments with written options, such as a sale of swap options, are important to interest rate risk management. Any net written option would be carried at fair value with changes in fair value included in current earnings.

The Entire Change in the Fair Value of a Hedged Item Is Considered Rather Than Just the Change in the Fair Value of a Hedged Attribute

A company may not achieve the desired offset to the gain or loss on the derivative if the company hedges only one of several attributes of the risk of changes in the fair value of a hedged item (for example, foreign currency, interest rate, credit rating). For instance, suppose a company holds a debt of 10,000,000 LCU (local currency units) with a fixed rate of 8%. The company enters into a currency swap to change the debt to a fixed-rate basis of 10% on $8,000,000. The currency agreement effectively changes the debt so that the company will pay a fixed U.S. dollar amount for the principal and interest. Both the debt and the swap will change in value with a change in exchange rates, U.S. interest rates and the foreign country's interest rates. However, the swap only hedges foreign exchange rate and foreign interest rate changes. Assume the following changes:

	Gain (Loss) from Changes in		
	Foreign Debt	Currency Swap	Aggregate Position
Exchange Rates	$50,000	($50,000)	—
Foreign Interest Rates	($15,000)	$15,000	—
U.S. Interest Rates	—	($ 7,000)	($7,000)
Total Change	$35,000	($42,000)	($7,000)

The net loss of $7,000 is due entirely to the U.S. interest rate risk and not to the currency risk of the debt that was also hedged by the swap. According to the proposed accounting, the $7,000 would be included in current income. This situation would not have existed if the company had issued fixed-rate debt in U.S. dollars rather than trying to create the same economic effect with the currency swap.

Unrealized Gains or Losses from Cash-Flow Hedges Are Included in Income at the Date of the Forecasted Cash Flow

This requirement could result in a mismatch of the timing of gain and loss recognition. Assume a company enters into an interest rate swap to hedge a variable rate debt. Settlement of the swap and payment of interest on the variable rate debt is every six months. This swap would qualify as a cash-flow hedge. However, if the six-month variable interest payment was due on March 31 and the company's fiscal year was the calendar year, interest expense would be accrued on December 31. The transfer from stockholders' equity to income would not be made until the date of the forecasted cash flow on March 31. This would result in a mismatch. The intent of the swap was to convert the interest expense to a fixed rate. However, because of the mismatch, interest expense is recorded on December 31 at the variable rate.

Other Reporting Requirements That Could Affect Management Strategies

The proposed approach provides a more narrow framework than that currently used for designations by requiring that the hedged item be identified in terms of the entire asset or liability or a uniform percentage of the item. A company would not be permitted to designate a shorter duration derivative against part of the

outstanding period of the hedged item. For example, a company would not be allowed to hedge a five-year debt with a three-year swap because this would not represent all of the hedged item.

A derivative designated as a cash-flow hedge must have a contractual maturity date or repricing date that is on or approximately the same date as the date the forecasted transaction is expected to occur. As a result, many current hedging strategies that utilize a series of short-term derivative transactions to take advantage of the more efficient derivatives pricing in short-term contracts will not qualify. The shorter contract in itself does not fix the price or rate of the forecasted transaction until the forecasted transaction date. The proposed accounting could result in companies incurring additional costs or risks merely to comply with a financial reporting requirement.

Gains and losses on derivatives used to hedge a cash-flow position are currently deferred as assets and liabilities until the hedging transaction occurs. Proposed accounting would include these changes in fair value as a component of stockholders' equity resulting in volatility of the equity of the company.

Given that the FASB issues its final standard on the accounting and reporting requirements for hedging transactions in the upcoming year, it will be interesting to see the effect of these new requirements on derivatives usage, not only for insurance companies but for all enterprises.

REFERENCES

COLQUITT, L. LEE, AND HOYT, ROBERT E. 1996. "Determinants of Corporate Hedging Behavior: Evidence from the Life Insurance Industry," Working Paper, University of Georgia, Athens, Ga.

COX, LARRY A., GAVER, KENNETH M., AND WELLS, BRENDA P. 1996. "Life Insurers, Junk Bonds, and Guaranteed Investment Contracts," Working Paper, University of Georgia, Athens, Ga.

FINANCIAL ACCOUNTING STANDARDS BOARD. 1996. "Accounting for Derivatives and Similar Financial Instruments and for Hedging Activities," Proposed Statement of Financial Accounting Standard. Stamford, Conn.: FASB, June 20.

MAYERS, DAVID, AND SMITH, CLIFFORD W. 1992. "Executive Compensation in the Life Insurance Industry," *Journal of Business* 65:51–74.

MAYERS, DAVID, AND SMITH, CLIFFORD W. 1994. "Managerial Discretion, Regulation, and Stock Insurer Ownership Structure," *Journal of Risk and Insurance* 61:638–55.

Gary G. Venter and Morton Lane

The use of financial derivatives is widespread yet controversial, so it is timely that these authors provide an analysis of what kind of insurers tend to use which instruments, and also some insights into why they use them. This is an important paper, both in cataloguing what is done and in trying to explain the relationships found. Towards the latter it offers several hypotheses, but in many cases further work is needed to develop alternative hypotheses and test them.

Financial risk management is presented as arising from the role of insurers as financial intermediaries, which the authors see as having value due to market imperfections and incompleteness. They do not mention the significant role of tax incentives, but this may be because they believe taxation is a market imperfection.

Asset-liability mismatch is portrayed as the principal area of financial risk facing insurers. The authors define this as managing the relationship between the duration and convexity of assets and the duration and convexity of liabilities. However, duration and convexity can be regarded as giving the first two moments of the portfolio yield curves, and just managing them is not enough to guarantee financial performance. The shape of the entire yield curve can change, leading to complex financial risk. Direct hedging may be able to provide better total interest rate risk management than traditional asset-liability strategies—not just cheaper or more flexible methods for dealing with duration and convexity. In the property-casualty arena, with shorter liability durations, yield risk analysis is further complicated by the significance of the additional expected yield from investing longer, as well as the impact of cash flow from expected growth—all of which should provide interest in derivative use.

The authors also draw a distinction between the use of derivatives for hedging versus their use for income enhancement. Although riskier strategies may increase expected income, their effects on actual income are not known. Thus, a more precise distinction would be between using derivatives to decrease risk versus using them to enhance *expected* yield, perhaps by accepting increased risk. For instance, writing covered calls is included in the income enhancement camp, but this could also be a strategy for reducing variability of asset positions already held by giving up some of their upside potential. What is readily measurable is purchasing options versus writing them, but this distinction is not very useful for analyzing risk taking or risk reduction unless the underlying positions are known.

A considerable part of this paper is descriptive information from Annual Statement Schedule DB. It may be interesting to note that insurers tend to write more calls and buy more puts, at least in notional amounts,

during a year, but more of the calls purchased are still open at year-end Notional amounts more than $400 billion were traded by insurers in 1994 Some of the data are confusing, however For instance, it is difficult to reconcile the data split by stock and mutual companies in Table 2 with the totals in Table 1, particularly for the intercompany groups.

Determinants of Derivative Usage

The intellectual core of the paper, however, is in the probit analysis of factors involved in the use of derivatives and the hypotheses on those factors. Some of these factors are discussed below

Size

Larger insurers are hypothesized to be more likely to use derivatives, and this is indeed found This finding is expected on the basis that larger insurers are more likely to be able to afford a derivatives trading staff. A counter hypothesis is that larger insurers will be more diversified and thus less in need of hedging. However, when it comes to interest rate risks, being more diversified in products sold or even investments does not necessarily reduce risk Size here is measured by assets, and other measures of size might also be significant, even though correlated

Organizational Form

Stock companies are hypothesized to need more hedging than mutual companies, but only a very weakly significant relationship is found Hedging has historically been viewed as not beneficial to shareholders, because they can diversify more efficiently than the firms can hedge. However, some more recent counterarguments to this are cited, mostly along the lines that hedging can actually increase firm income in some cases An example of this reasoning that the authors do not mention is that hedging can increase the value of the insurance contract, by reducing the probability of insurer default, and thus increase company income through improved market access and higher rates Hedging can also lower the cost of capital, thereby reducing debt service costs and increasing the present value of future earnings.

The weakness of the relationship found may be due to mutual companies using derivative transactions as proxies for capital, which they have reduced capacity to raise otherwise.

Line of Business

For property-casualty companies, having commercial liability reserves seems to decrease the probability of derivative activity, while having large auto physical damage reserves seems to increase the probability of writing options. Commercial liability has a long payout pattern for a property-casualty line, and this is hypothesized as leading to less need for hedging by providing a duration match for the long-term bonds that dominate property-casualty insurer portfolios This is somewhat questionable, however, because these reserves are also subject to inflationary pressures that might accompany higher interest rates It could be the imperfect correlation between inflation and interest rates that leads to the reduced hedging observed.

Large reserves in short-tailed lines sounds like an oxymoron, and the relationship to increased derivative activity may be just an additional size effect. However, if these indicate a lack of long-tailed reserves, this may provide reason to hedge long bonds, as the authors hypothesize. Yet this should be picked up by the long-tail reserve dummy This area seems to need further study

For life-health companies, having large individual or group life reserves seems to be significant in predicting the use of swaps, forwards, and collars The authors hypothesize that, for individual life, this may be due to imbedded options within the life contracts, but this does not appear to explain the parallel result for group life, which is, if anything, even stronger Issuing GICs seems to lead to less use of derivatives, hypothesized to be due to their shorter term However, hedging activity might be expected by issuers of GICs to help guarantee performance.

Other Investments

Investing in stocks and real estate is found to be associated with derivative use by property-casualty companies. If the derivatives are used for income enhancement, the use of these vehicles may represent a different, more risk-taking company attitude towards investment than the bond-only strategy, which has been regarded as more conservative. It was in fact more conservative in statement accounting before bonds had to be marked to market. On the other hand, the derivatives may be used for hedging, which would leave open the possibility that insurers that invest in stocks and real estate are not less risk averse than other insurers

Life companies that invest in CMOs use more swaps and futures, which does make sense as a hedging activity However, it would be informative to determine how this varies with different types of CMS's Investing in longer maturity government bonds seems to increase the use of derivatives for both life and property/casualty insurers

It may be interesting to relate hedging activity to trading volume, because much of the hedging may be for short-term purposes relating to turnover For instance, if an investor were anticipating buying bonds and thought rates were going to fall, then it might buy futures temporarily to lock in the rate.

Reinsurance

For life companies, buying reinsurance is significantly positively related to writing options, while for property-casualty companies it is significantly negatively related The reasons for this are really a topic for further research, especially as to the types of options being written The authors speculate that life companies may be writing bond options as part of their asset-liability management process and that this reduced volatility may reduce the need for reinsurance As an alternative, they submit that these life companies are taking on volatility through options and simultaneously reducing other types of volatility with reinsurance.

For property-casualty companies, the authors see writing options as potentially a risk-taking income enhancement strategy similar to keeping insurance risk net; that is, companies that like one strategy would like the other It would be interesting to test this over time as reinsurance gets cheaper or more expensive to determine whether buying more reinsurance is accompanied by more or less options writing.

Hedging Insurance Risk

While the emphasis of the paper is on hedging financial risk, the significant relationships with reinsurance suggest that derivatives are also used in the context of hedging insurance risk.

Some of these questions about where to hedge—through options or reinsurance—are being confronted for the first time in other contexts Catastrophe PCS options traded at the Chicago Board of Trade can be viewed as investment or synthetic reinsurance And it is a question that will confront insurers and reinsurers as they evaluate whether they will invest in catastrophe bonds, such as those promoted by the California Earthquake Authority Property-casualty companies will be able to take that risk on the liability side of the balance sheet through traditional underwriting Or they can take that risk on the asset side of their balance sheet through their investment portfolio by buying catastrophe bonds One may have greater liquidity; the other may have greater leverage. With more deals coming in the future, as the increased interest by insurers in such transactions suggests will happen, there may be stronger links between investments that are derivative-like in character and the liabilities or the reinsurance activities of the portfolio

This paper presents some important groundwork for determining who might and might not be attracted to these areas of endeavor.

Joan Lamm-Tennant*

This paper begins by providing a comprehensive accounting of the level and type of financial derivatives by U S. insurers. Information is reported for life versus property/casualty insurers, detailing the number of insurers using various types of derivative contracts, the volume of transactions in terms of notional amounts, and the number of counterparties The authors then establish a series of hypotheses on factors that may influence the existence of OBS activities and test their hypotheses using multivariate probit analysis

This paper begins with a simple accounting of the use of derivatives, yet it is so well written and interspersed with insights/intuitions that I read the first 10 pages with intense interest. I have great appreciation for the tedious process of compiling these data—your tolerance is commendable—and you now have a valuable database with enough detail to support an insightful description of the industry's use of derivatives as well as further meaningful research efforts.

This paper, in and of itself, is a significant and meaningful contribution to the literature Nevertheless, I encourage continued work to better understand the insurers' motives for participating in the derivatives market: hedging financial risks, hedging underwriting exposure, or pursuing trading profits uncorrelated with underlying economic activities

Background

On page 15 (column 1), the authors mention that the most important financial risk management tasks faced by both life and property/casualty insurers are to manage the durations and convexity of their assets portfolios and to manage relationships between the duration and convexity of assets and that of liabilities. Although I strongly agree with this statement for the life insurer, I suggest that property/casualty insurers face a different set of issues The appropriateness of interest rate sensitivity measures for property/casualty liabilities is debatable since their liabilities are largely driven by alternative risks.

*Joan Lamm-Tennant, not a member of the Society, is Professor of Finance, College of Commerce and Finance, Villanova University,

On page 15 (column 2), the authors mention that financial derivatives often provide a cheaper and/or more flexible way to manage duration and convexity. It may be appropriate to mention some of limitations at this point such as basis risk.

Extent of Derivatives Usage by Insurers

I am not suprised with the observation (on page 16, last paragraph) that stock insurers use derivatives more frequently than mutual insurers, because the empirical evidence is convincing that stock insurers take on more risk and manage this risk more effectively than mutual insurers (Lamm-Tennant and Starks 1993).

The most common activities for PC insurers are in foreign currency forward contracts and in writing of equity call options, which differ from the most common activity for life insurers. The authors attribute the use of foreign currency forward contracts to their foreign exchange exposure caused by foreign subsidiaries and/or holding foreign bonds/stocks. An explanation could also be offered for writing equity call options because property/casualty insurers tend to invest more heavily in domestic equities than life insurers.

Determinant of Derivatives Usage Hypotheses

Let me turn to the second and more interesting contribution of the paper, which is analysis of factors influencing the existence of OBS activities. Hypotheses were set forth as follows:

1. Size is expected to be positively related to OBS activity.
2. Stocks are expected to engage in more OBS activity.
3. Larger maturity duration gaps are associated with higher usage of OBS contracts.
4. Reinsurance could be either positively or negatively related to OBS activity. Reinsurance designed to reduce underwriting risk might serve as a substitute of OBS activities. Alternatively, reinsurance and financial derivaties may serve as a complement if insurers that engage in hedging underwriting risk are also more likely to hedge financial risk.
5. PC insurers with higher proportions of long-tail liabilities would be less likely to engage in derivatives designed to manage interest rate risk. Life insurers with relatively large cash value life insurance and annuity reserves would be more likely to use derivatives designed to manage interest rate risk.

On page 19: I recommend that the authors set forth the hypotheses upfront by simply enumerating them and then following with a discussion. Readers appreciate the ease of early recognition of the various hypotheses. The underlying arguments or supporting theory may then follow. The authors might consider developing a table that reports the hypothesis, the variable proxy, and the expected sign.

Size is expected to be positively related to OBS activity due to significant economies of scale in human captial investment and derivative trading. However, these economies of scale may be offset by the fact that larger insurers may be more diversified and therefore in less need of OBS contracts as a risk management tool. The authors may mention that large insurers also hold an advantage in the negotiation and pricing of alternative risk management tools such as the purchase of reinsurance.

Variable Estimation

The authors may consider an estimation of the maturity gap between asset and liabilities in accordance with a technique first applied to banks by Flannery and James (1984) and later applied to property/casualty insurers by Lamm-Tennant, Starks and Stokes (1996).

Results

The results are largely consistent with the hypotheses with noteworthy differences between life and property/casualty insurers. Of particular interest are the results regarding group versus unaffiliated single firms. That is, the greater use of derivatives by unaffiliated insurers may reflect the fact that they forfeit a source of diversification offered through the corporate structure. Since these results are largely PC specific, it may also indicate that the option to fail may be worth more to PC insurers, motivating PC insurers that are not members of groups to engage in other types of financial risk management. Further exploration of this result would cast valuable insights into corporate structure within the PC insurance industry.

REFERENCES

FLANNERY, M., AND JAMES, C. 1984. "The Effect of Interest Rate Changes on the Common Stock Returns of Financial Institutions," *Journal of Finance* 39:1141–53.

LAMM-TENNANT, J., AND STARKS, L. 1993. "Stock versus Mutual Ownership Structures: The Risk Implications," *Journal of Business* 66:29–46.

LAMM-TENNANT, J., STARKS, L., AND STOKES, L. 1996. "Considerations of Cost Trade-offs in Insurance Solvency Surveillance Policy," *Journal of Banking and Finance* 20: 835–52.

AUTHORS' REPLY

J. David Cummins, Richard D. Phillips, and Stephen D. Smith

We appreciate the comments from Colquitt and Wilson, Venter and Lane, and Lamm-Tennant. This is an exciting area of research, and we are the first to acknowledge that, in the future, much more productive work can be done in this area. We first respond to some of the particular comments and then close this response with a few more general comments.

Mr. Colquitt and Ms. Wilson take exception to our use of the term "hedging" as opposed to risk management, with the idea that some actual or reported derivatives activity may not be intended to hedge the firm's underlying risk exposure but rather to increase expected returns. This is fine as far as it goes. However, we note that their example of positions reported that are not associated with a particular underlying risk is not necessarily evidence that the firm is not hedging. Indeed, this situation may arise from the basic distinction between a so-called "macro" hedge and a "micro" (or asset-specific) hedge. If the insurer rationally wishes to hedge its exposure, it may well take a position in derivatives that is not matched to any particular asset but instead hedge against, say, overall changes in the value of the firm or whatever the objective function may be.

They also make note of some potential statistical problems with the dataset we used in this study. Specifically, they suggest the heteroscedasticity and/or multicollinearity may be problems. While not reported, the coefficients of the variables used here are quite stable across various model specifications. Moreover, severe collinearity can "blow up" the standard errors. We note that the significance (or lack thereof) of the variables used here is quite stable across the alternative estimated models, suggesting that there is no multicollinearity problem.

To test for heteroscedasticity, we conducted a likelihood ratio test using assets, the square root of assets, and the reciprocals of these variables as alternative weighting variables. The tests failed to reject the hypothesis that the heteroscedasticity-adjusted results are the same as the unadjusted results. Accordingly, we find no evidence that the results are biased due to heteroscedasticity. Since the results are virtually identical in the adjusted and unadjusted runs and in view of the lack of evidence that heteroscedasticity is a problem, we report the unadjusted results in the article.

They also argue that some of the users of a particular given instrument can be a small fraction of the population. However, the variables employed are often significant despite the well-known problems associated with small sample sizes. Moreover, their own suggestion that we further decompose the data (for example, users who write puts but do not buy futures) would cause the users in these groups to be even smaller.

The final issue that Colquitt and Wilson raise is the lack of a tax variable in the estimated equations. Although not reported in this paper, we did include a tax variable similar to one that Colquitt and Hoyt (1995) used in an earlier paper investigating the use of futures by life insurers. This tax variable did not add to the explanatory power of the models and was therefore excluded from the final estimation runs. We look forward to including the new tax variable that they discuss in future work.

Finally, we are pleased with their discussion of proposed tax law changes and their potential effect on derivatives usage. The changes FASB is proposing will fundamentally change the accounting rules that govern the ways that hedging with derivatives affects the balance sheet and income statements of insurers. We concur that it will be very interesting to see the effect of these rule changes on the propensity for insurers to participate in derivative markets.

Messrs. Venter and Lane note that our use of the term "income enhancement" should be stated in an expected value sense. This is true, of course, but we thought the term was adequate because yields that are certain would imply that there is no risk—and managing risk is the point of paper.

They also argue that it is difficult to distinguish between hedging and income enhancement strategies. While we agree (see our comments on Colquitt and Wilson's discussion), their particular example, that writing covered calls could be viewed as risk-reducing, seems to make sense only if risk is measured by unexpected large *gains*, not losses. While we acknowledge that a covered call position on a particular security could conceivably be used to construct a macro hedge, it not clear to us how this would work in a practical situation.

Ms. Lamm-Tennant makes a number of presentation-style suggestions for the paper that would have been nice to implement if time and publication schedules would have allowed. We do appreciate the suggestions, however, and we will keep them in mind as we continue our derivatives research.

She finds it interesting that such a large percentage of stock companies participate in derivative markets relative to their mutual firm counterparts. Although

this is true in the univariate case, once we control for other factors that influence the decision of whether to participate in derivative markets, we were not able to find an organizational form effect Perhaps more finely defining our organizational form dummy variables, as Colquitt and Wilson mention in their discussion, will allow us to document this result in the multivariate case as well

In conclusion, we again thank the reviewers for their comments Financial risk management is potentially valuable for the very reason that it allows investors to allocate risks to those who are best able to bear it in an efficient fashion However, it is precisely this efficiency property that allows some users of these contracts to purchase additional risks in ways that may be cheaper than purchasing the underlying instrument or instruments In the future, we intend to further investigate the relationship between specific derivative activities and measures of macro exposure (that is, volatility, equity duration, and so on) as well as profitability measures In this way we may begin to resolve the question of how much of this derivatives activity is due to hedging rationales and how much is due to income enhancement strategies

REFERENCES

COLQUITT, L LEE, AND HOYT, ROBERT E 1995 "Determinants of Corporate Hedging Behavior: Evidence from the Life Insurance Industry," Working Paper, University of Georgia, Athens, Ga

Discussions on this paper will be accepted until July, 1, 1997 The authors reserve the right to reply to any discussion See the Table of Contents page for detailed instructions on the preparation of discussions