The Market Value Impact of Operational Risk Events: U.S. Banks and Insurers

J. David Cummins,
Christopher M. Lewis, and Ran Wei

Federal Reserve Bank of Boston
Implementing AMA For Operational Risk
May 19, 2005

Famous Operational Risk Events

- NASDAQ “Odd eighths” trading scandal (1994)
- Barings Bank collapse (1995) – $1.3 billion loss due to rogue trader
- Leading securities brokers in US fined $1.4 billion (2002) – misleading research reports
- Prudential Insurance (US) fined $2 billion for sales abuses (1990s)
- State Farm Insurance loses $1.2 billion for breach of contract (1999)

Why the Interest In Operational Risk?

- Emphasis on transparency in financial reporting
  - Technological advances make data more readily available
  - Investor advocacy groups demand more disclosure
  - Bank regulators encouraging market discipline as a regulatory device
  - Legislation tightening accounting standards as a result of Enron and World-Com (e.g., Sarbanes-Oxley Bill in US)

Is Operational Risk Increasing?

- Deregulation, globalization, and advances in technology have increased complexity
  - Complex, multinational production processes
  - Financial products with numerous embedded options and guarantees
  - Exploding variety and complexity of hedging products and strategies
- Mergers & acquisitions create risks from incompatible systems & integration problems

Is Operational Risk Increasing?

- New technologies create new risks
  - Automated back office processing systems increase risk of system failure
  - Hedging strategies reduce market and credit risk but create additional operational risks
  - E-banking and E-commerce increase risk of fraud and create new and unknown risks
  - Outsourcing creates new risk exposures

Regulatory and Rating Firm Response

- Basel Committee
  - Incorporates a charge for operational risk in its Basel Capital Accord
  - Established guiding principles for the management of operational risk
- Rating firms (Moody's, Fitch, Standard & Poor's) will consider operational risk in assigning firm financial ratings

Motivation for Study

- In spite of increasing attention to operational risk, little systematic information exists on the extent and impact of operational risk
- Existing evidence is mostly anecdotal
- Basel Committee survey mostly sketchy and does not identify specific firms or events

Study Design

- Utilize a new database – the OpVar database compiled by OpVantage, subsidiary of Fitch
- OpVar contains data on operational loss events in several industries from the 1970s-present obtained from public sources
  - Events announced in the news media
- We analyze the banking and insurance events, focusing on the US

Study Design II

- Conduct an event study to determine the market value impact of operational risk events on US banks and insurers
  - 403 banking events
  - 89 insurance events
- Research question: Do operational risk events have a greater than 1 for 1 impact on firm market value, i.e., does the market react to losses beyond the loss amount itself

What Is Operational Risk?

- Until the Basel Committee's deliberations, no consistent definition existed
- Basel Committee definition:
  "*Operational risk* is the risk of loss resulting from inadequate or failed internal processes, people, and systems, or from external events"
- Operational risks arise from the breakdown of the production processes that constitute a financial institution's value chain, producing goods and services for customers

What Is Operational Risk II?

- Operational risk does not include
  - Strategic risk
  - Reputational risk
  - Systemic risk
  - Market risk or
  - Credit risk

Basel Committee: Op Risk Event Types

- Employment practices and workplace safety
  – losses from violations of health or safety laws, discrimination in employment, personal injury claims
- Internal fraud – losses from fraud,misappropriation of property, circumvention of regulations involving an internal party
- External fraud – fraud by an external party
- Clients, products, and business practices – unintentional or negligent failure to meet professional obligation to clients (including fiduciary violations) or from the nature or design of a product

Basel: Op Risk Event Types II

- Damage to physical assets – losses from damage to property from natural catastrophes (hurricanes, floods) or man-made events (fires, explosions, terrorism, pollution)
- Business disruption and system failures – losses due to hardware or software failure, system design failure, other infrastructure issues
- Execution, delivery, and process management – failed transaction processing or process management or failed relationships with trade counterparties and vendors

Basel Committee: Business lines

- Basel Committee also classifies events into standard business lines (for banks):
  - Corporate finance
  - Trading and sales
  - Retail banking
  - Commercial banking
  - Payment and settlement
  - Agency services
  - Asset management
  - Retail brokerage

Can Operational Risk Be Insured?

- Some operational risks can be insured
  - Bankers blanket bond covers internal fraud
  - Property insurance: natural & man-made disasters
  - Liability insurance covers some types of negligence
  - Limited coverage available for systems failure
- Many op risks are “catastrophic” & uninsurable
  - Catastrophic system failure
  - Rogue traders, etc.
  - Transaction processing and counterparty risk
  - Fraudulent misrepresentations to customers

Prior Literature

- Basel Committee operational loss surveys (2001 and 2002)
  - Limited and unrepresentative sample
  - Identities of respondents not revealed
- OpVar database: Fontneuvelle, et al. (2003)
  - Quantify operational risk using probability distributions
  - Operational losses are important source of risk for large, international banks, and the charge for operational risk may exceed charge for market risk

Prior Literature II

- Even though there have been no comprehensive event studies of operational risk events in insurance and banking, there have been analyses of specific types of events
- Palmrose, et al. (2004) – earnings restatements for financial and non-financial firms
- Bhagat, et al. (1994) – inter-firm lawsuits for events including patent infringement

Prior Literature III

- Fields, et al. (1990) – impact of California's Proposition 103 on insurance stocks
- Lamb (1995) – impact of Hurricane Andrew on insurance stocks
- Cummins and Lewis (2003) – effects of September 11, 2001, terrorist attacks on insurance stocks

Op Risk Management: Theory

- Opponents of Basel's operational risk capital charge argue that op risk is non-systematic and can easily be diversified by investors
  - However, unlike other non-systematic risks, op risk is asymmetric, almost always leading to losses rather than gains
  - Thus, firms should manage op risk at least to the point where marginal expenditures = marginal reduction in losses from op risk events

Op Risk Management: Theory II

- Modern theory of risk management argues that even widely held firms can gain from managing risk due to various factors
  - Convex tax schedules
  - Costs of financial distress
  - Informational asymmetries between managers and investors
  - Agency costs, etc.

Op Risk Management: Theory III

- Froot, Scharfstein, and Stein (1993) argue that informational asymmetries between firms and investors cause external capital to be more costly than internal capital
  - Banks have more information about the quality of bank loan portfolios than investors
  - Insurers have more information about exposure distribution and loss reserve adequacy than investors

Op Risk Management: Theory IV

- Therefore, if operational losses cause institutions to forego positive net present value projects because internal capital is depleted, stock prices are likely to decline by more than the amount of the loss
- Moreover, operational risk events may signal poor management quality and poor operational controls, leading the market to reduce estimates of future cash flows

Hypotheses

- H1: If operational risk events deplete internal capital and/or signal the market of poor management quality, then stock prices will decline by more than the amount of the loss
- H2: Firms with stronger growth prospects will have a stronger stock price response due to the loss of internal capital than firms with weaker prospects

Hypotheses

- Trust is an important element in the client's relationship with a bank or insurer. Certain types of events, such as deceptive sales, may damage the client-institution relationship and lead to declines in future sales
- Trust relationship more important in insurance
  - Insurance contracts are longer term on average than banking contracts
  - Insurance does not have Federal deposit insurance

Hypotheses

- H3: Market conduct events will have a stronger effect on stock prices than other types of events
- H4: Market conduct events will have a stronger impact on insurers than on banks

The Database: Op Var

- OpVar has data on publicly reported operational loss events from 1978-present on several industries
  - Event date
  - Description of event
  - Basel event type and business line (for banks)
  - Loss amount
- We independently verified each event and excluded events where the event or event date could not be verified

The Database: OpVar II

- Country coverage – events are reported for most industrialized countries
  - However, 2/3 of events are from the U.S.
  - Fontnouvelle, et al. concluded that U.S. and non-U.S. events had different probability distributions
  - Moreover, probably not advisable to mix data from different national exchanges
  - Therefore, we focus our analysis on the U.S.

The Database: OpVar III

- Industry coverage – we focus the analysis on banks and insurers
  - Concerns about regulation of op risk have been focused on the financial industry
  - With convergence of the financial sector, banks and insurers are increasingly competing with each other for asset accumulation products such as annuities and mutual funds

The Database: OpVar IV

- Loss size coverage – we focus on “large” losses, defined as losses of at least $10 million
  - More likely to be “material” events from an accounting perspective
  - High frequency, low severity events are predictable and therefore already included in expense budget and embedded in stock prices
  - Larger events are more likely to provide new information to the market

Event Study Sample

- To be included in the event study sample, firms have to be publicly traded at the time of the event
- This criterion eliminated a substantial number of events from the overall sample
  - 288 of 691 banking events were eliminated, leaving 403 banking events
  - 152 of 241 insurance events were eliminated, leaving 89 insurance events

Event Study Sample II

- Characteristics of omitted firms
  - Banks – mostly privately owned and a few mutuals
  - insurers – mostly mutuals and a few privately owned insurers

Methodology

- We conduct an event study to measure the effect of op risk events on stock prices
  - Three factor return generating model
    - » Market return
    - » Industry factor to distinguish abnormal returns from overall movements in bank or insurance stocks
    - » Interest factor – both banks and insurers are very sensitive to interest rate changes
  - Standard market model – robustness check

Three-Factor Model

$$R_{jt} = \alpha_j + \beta_j R_{mt} + s_j R_{INDt} + h_j I_t + \varepsilon_{jt}$$

R_{jt} = return on stock j on day t

R_{mt} = return on CRSP equally weighted market index on day t

R_{INDt} = return on bank or insurer industry index on day t

I_t = change in the 1-year constant maturity Treasury bill on day t

Industry Indices For 3-Factor Model

- Banking industry
  - Commercial banks: SIC 602x
  - Investment banks and brokerage firms: SIC 6211
- Insurance industry
  - Life insurers: SIC 631x
  - Health insurers: SIC 632x
  - Property-liability insurers: SIC 633x

Robustness Check: The Market Model

- The standard event study approach uses the market model to measure expected returns on stocks in the sample

$$\mathbf{R_{it}} = \alpha_{\mathbf{i}} + \beta_{\mathbf{i}}\,\mathbf{R_{mt}} + \varepsilon_{\mathbf{it}}$$

- where R_{it} = return on stock i on day t
  R_{mt} = return on the market portfolio on day t

Calculating Abnormal Returns

- Three factor model

$$AR_{jt} = R_{jt} - \hat{\alpha}_j - \hat{\beta}_j R_{mt} - \hat{s}_j R_{INDt} - \hat{h}_j I_t$$

- Market model

$$AR_{jt} = R_{jt} - \hat{\alpha}_j - \hat{\beta}_j \, R_{mt}$$

- where AR_{jt} = abnormal return for stock j, in period t

Data and Methodology VI

- The cumulative abnormal return (CAR) for stock j in a given event window (T_1,T_2) is :

$$CAR_{(T_1,T_2)j} = \sum_{t=T_1}^{T_2} AR_{jt}$$

- Average cumulative abnormal return (CAR) for all N events:

$$\overline{CAR}_{(T_1,T_2)} = \frac{1}{N}\sum_{j=1}^{N} CAR_{(T_1,T_2)j} = \frac{1}{N}\sum_{j=1}^{N}\sum_{t=T_1}^{T_2} AR_{jt} = \sum_{j=1}^{N}\left(\frac{1}{N}\sum_{t=T_1}^{T_2} AR_{jt}\right)$$

Significance Tests

- Banking sample affected by clustering of events, e.g.,
  - NASDAQ odd-eighths price manipulation (1997)
  - Brokerage firm conflict of interest (2002)
- Accordingly, we use Jaffee's (1974) calendar time t-test to correct for cross-sectional dependence caused by clustering
- For consistency, we also use it for insurance sample even though little clustering is present
- Other tests also conducted to check robustness

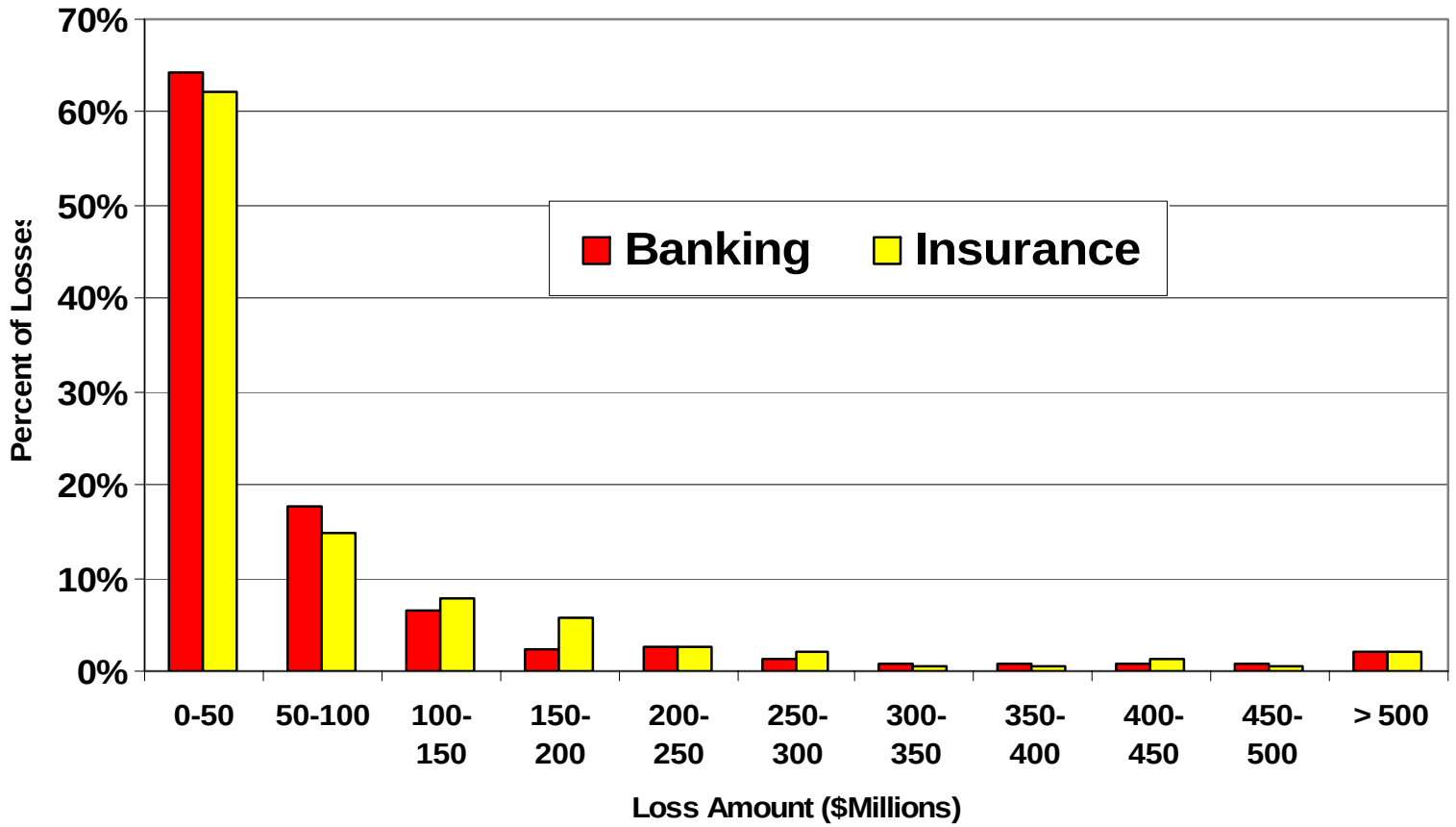
Calendar Time t-Test

- Events grouped into portfolios
  - Events occurring on same day are placed in a portfolio
  - Non-clustered events form single-stock portfolios
- CAR for a portfolio

$$CAR^{i}_{(T_1,T_2)} = \frac{\sum_{All\ j \in Portolio\ i} CAR_{(T_1,T_2)j}}{N_i}$$

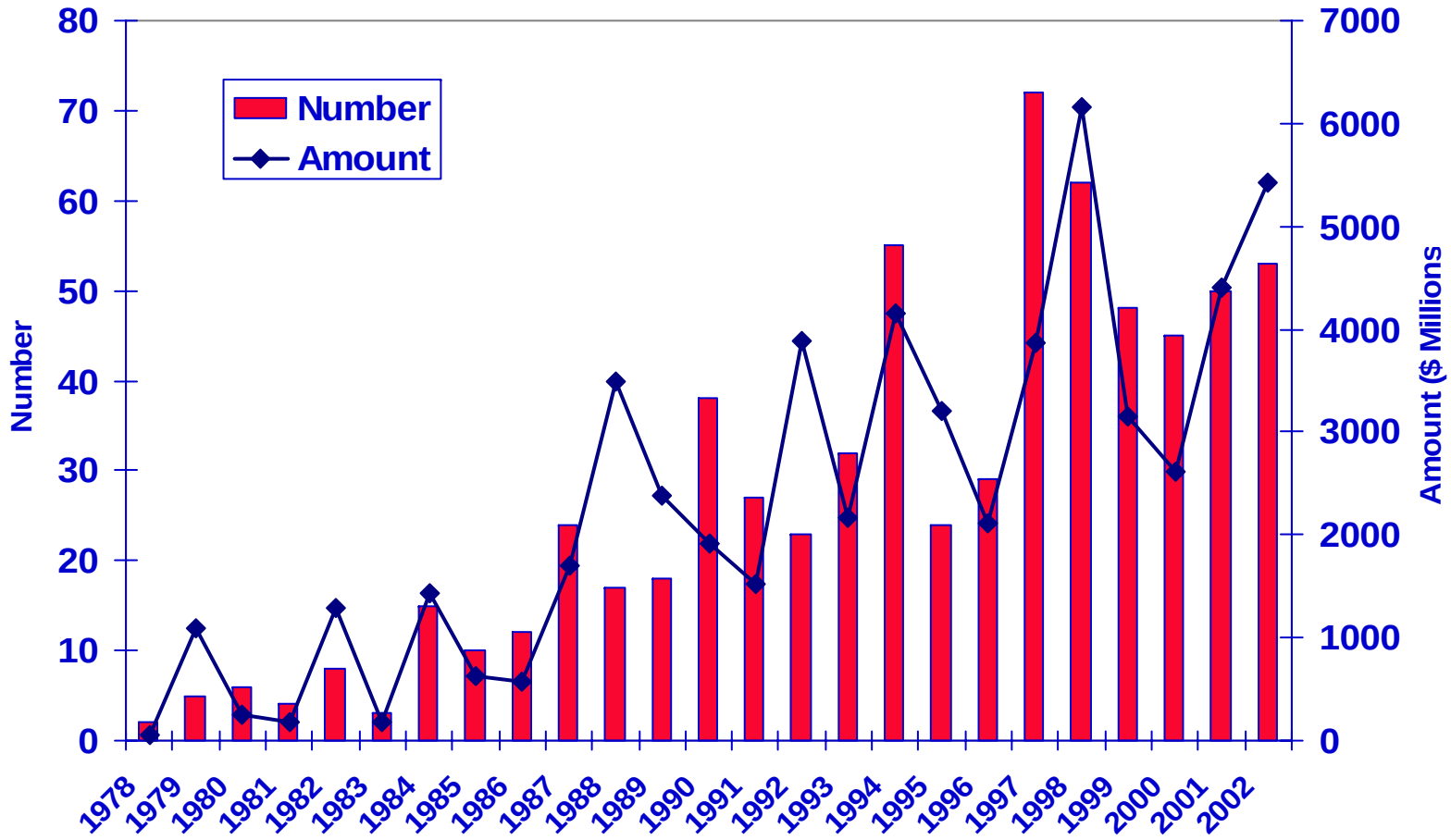
- CARs then tested for significance (see paper for discussion)

Severity Distribution of Operational Losses



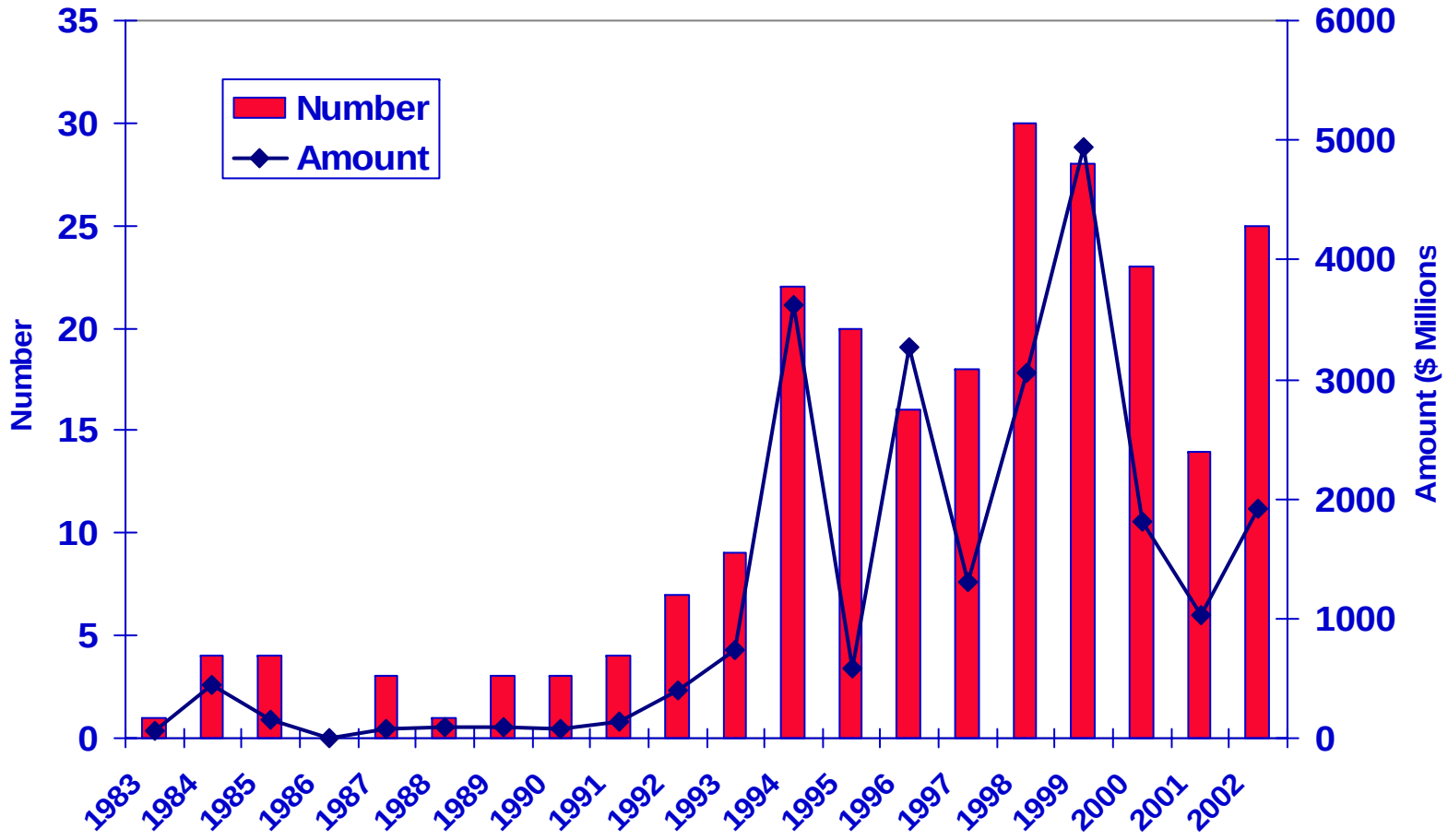
Wharton
University of Pennsylvania

Operational Loss Events: US Banks



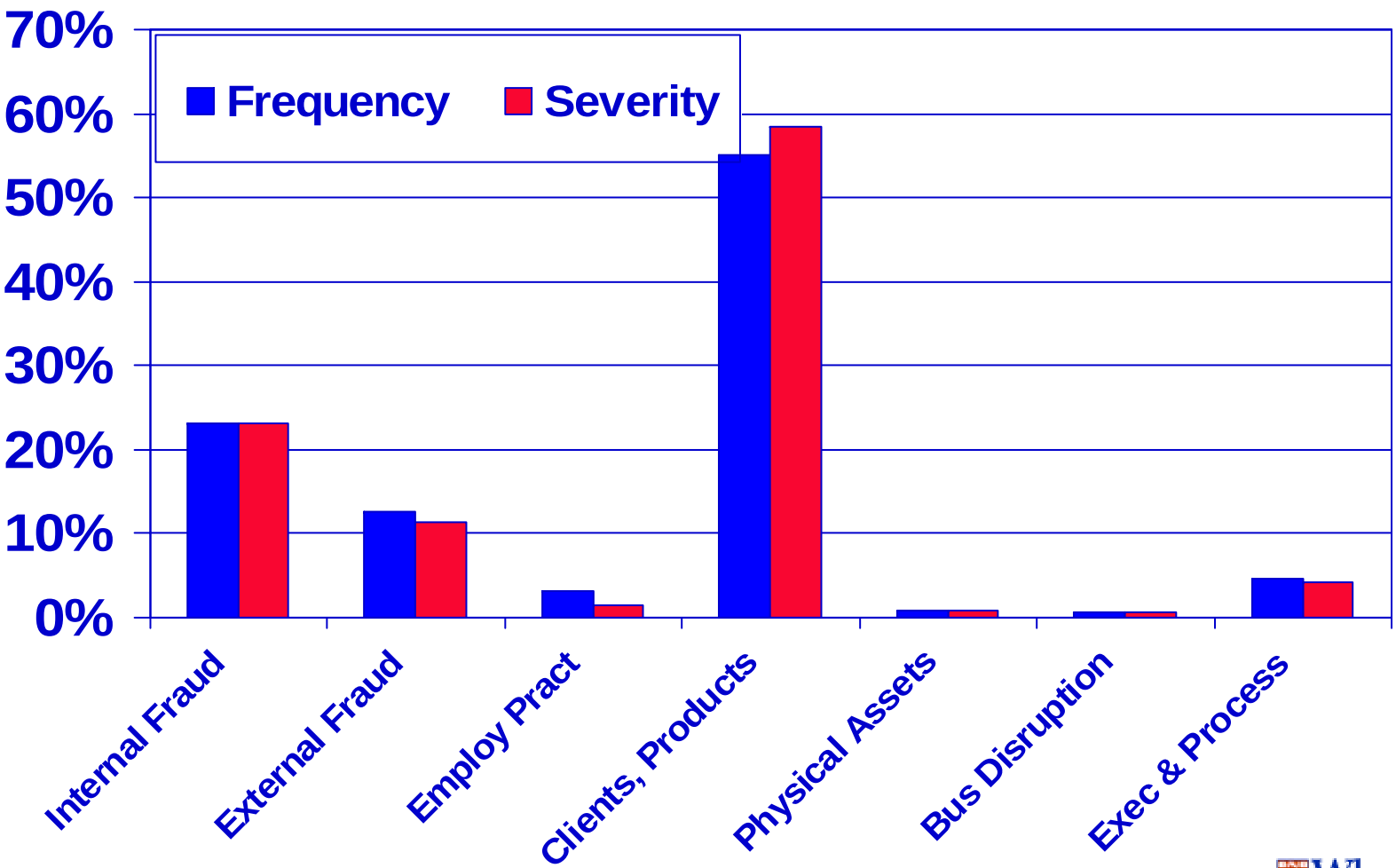
Wharton
University of Pennsylvania

Operational Loss Events: US Insurers



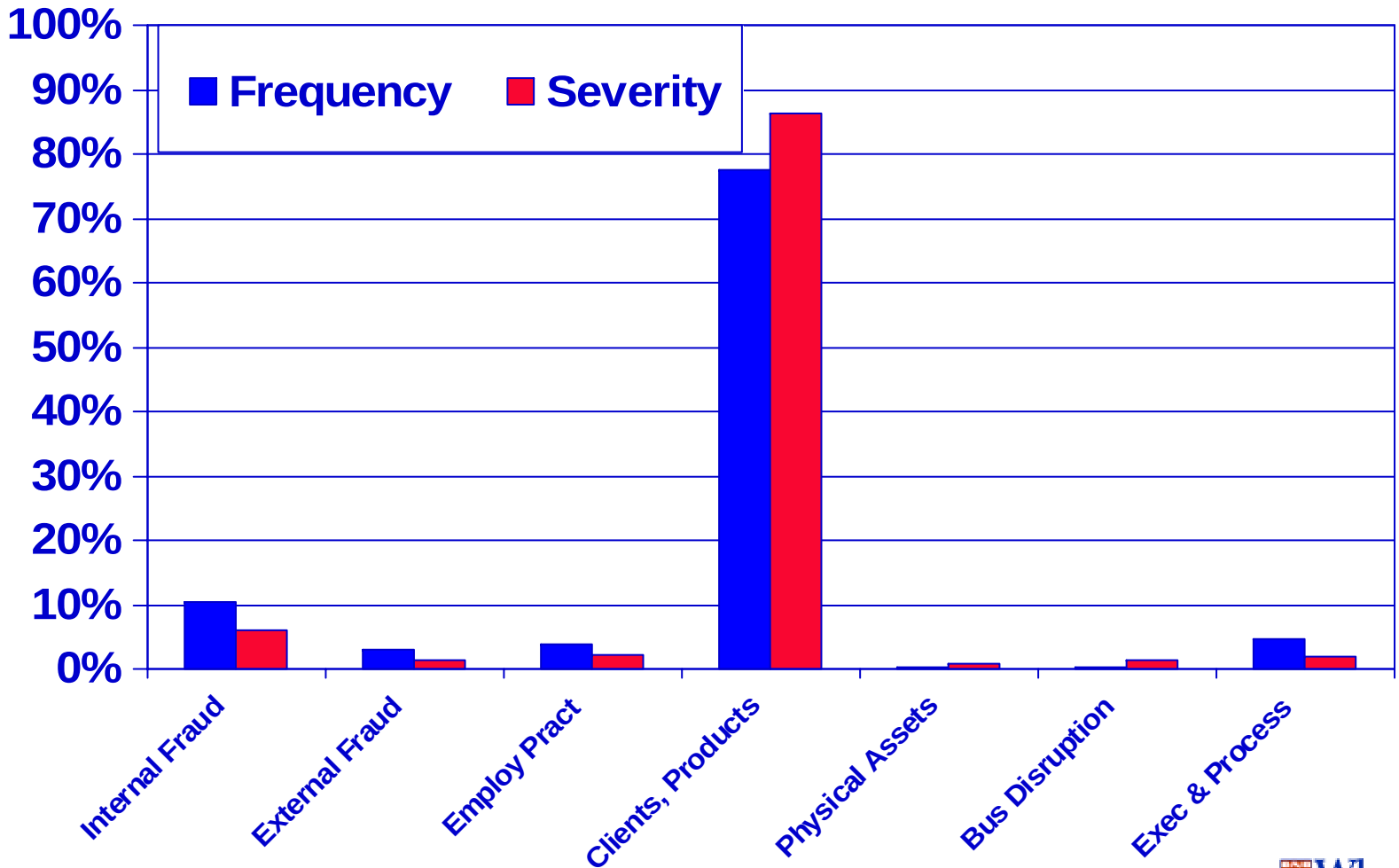
Wharton
University of Pennsylvania

Events by Event Type: US Banks



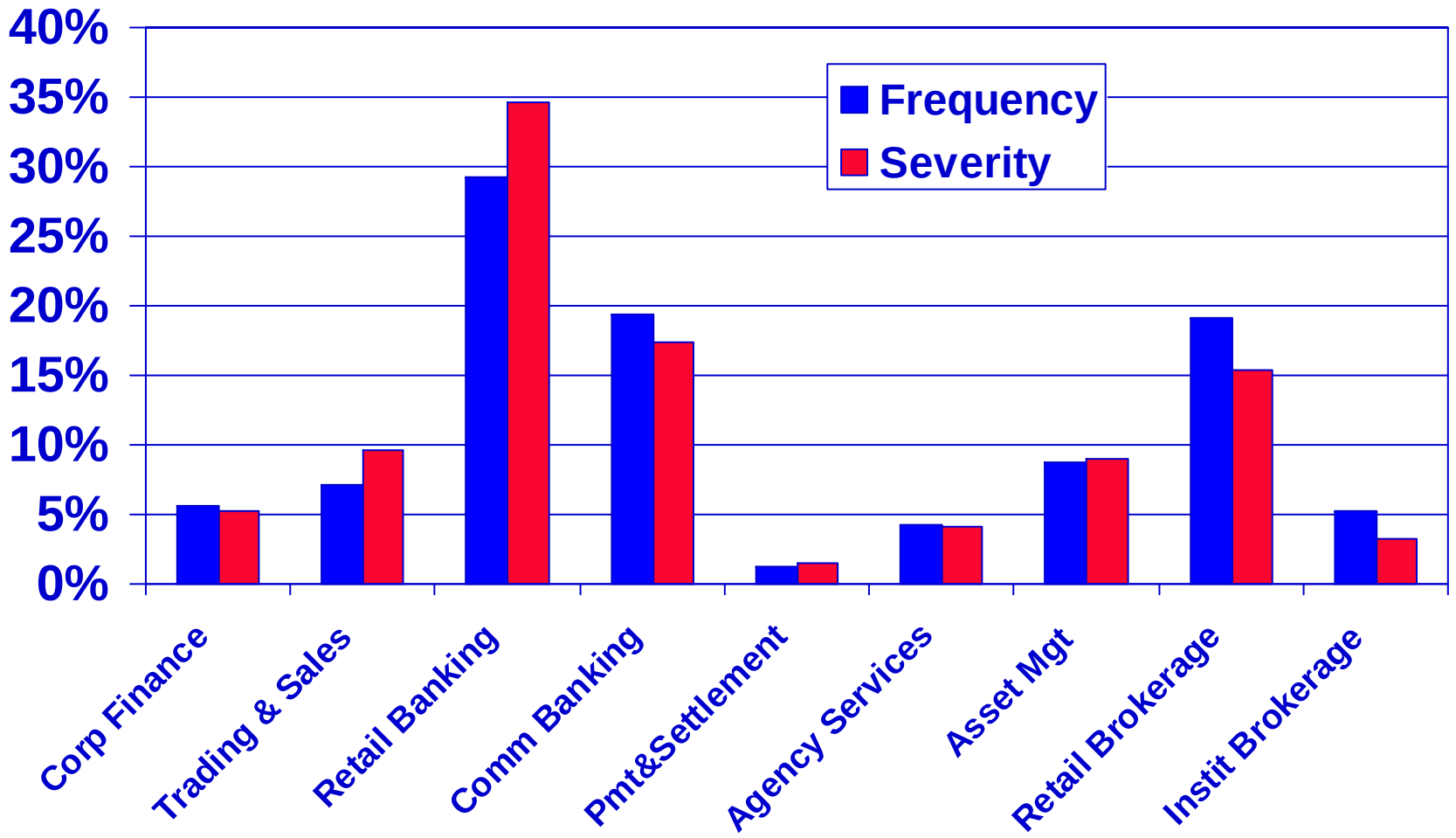
Wharton
University of Pennsylvania

Events by Event Type: US Insurers



Wharton
University of Pennsylvania

Events by Business Line: US Banks



Wharton
University of Pennsylvania

Important Events: US Banks

- Nasdaq “odd-eighths” trading scandal
  - In 1997, 37 brokerage firms paid $1 billion to settle anti-trust lawsuit
  - The brokers colluded between 1989 and 1994 to manipulate prices on Nasdaq
  - Collusion uncovered by academic researchers William Christie and Paul Schultz who noticed that odd-eighths quotes were virtually non-existent for Nasdaq stocks implying that spreads were fixed at $0.25 to inflate profits

Important Events: US Banks II

- Enron debacle (2002) – Brokerage firms including Merrill-Lynch and J.P. Morgan-Chase each pay $100 million for helping Enron falsify financial statements
- Brokerage conflict of interest scandal (2002)
  - 10 large brokers paid $1.4 billion
  - Gave investors biased advice to aid the firms' investment banking operations

Insurance Industry: Major Events

- California's Proposition 103
  - 1989 ballot initiative that reregulated insurance prices and enforced insurance price roll-back
  - In 1994 many insurers required by regulators to pay refunds to policyholders plus interest from 1989
- Life insurance industry market conduct
  - Insurance agents deceived policyholders about insurance policies to inflate sales
  - E.g., issued "vanishing premium" policies whose premiums did not vanish
  - Falsely claimed that policies were "pension plans"

Why the Market Conduct Problems?

- Prior to late 1970s, life insurance was a "safe, boring business, where incompetent insurers made money and smart insurers made lots of money."
- Spike in interest rates in late 1970s-early 1980s caused major disintermediation as investors borrowed against policies to invest in higher-yielding notes and bonds
  - Major liquidity crisis for insurers

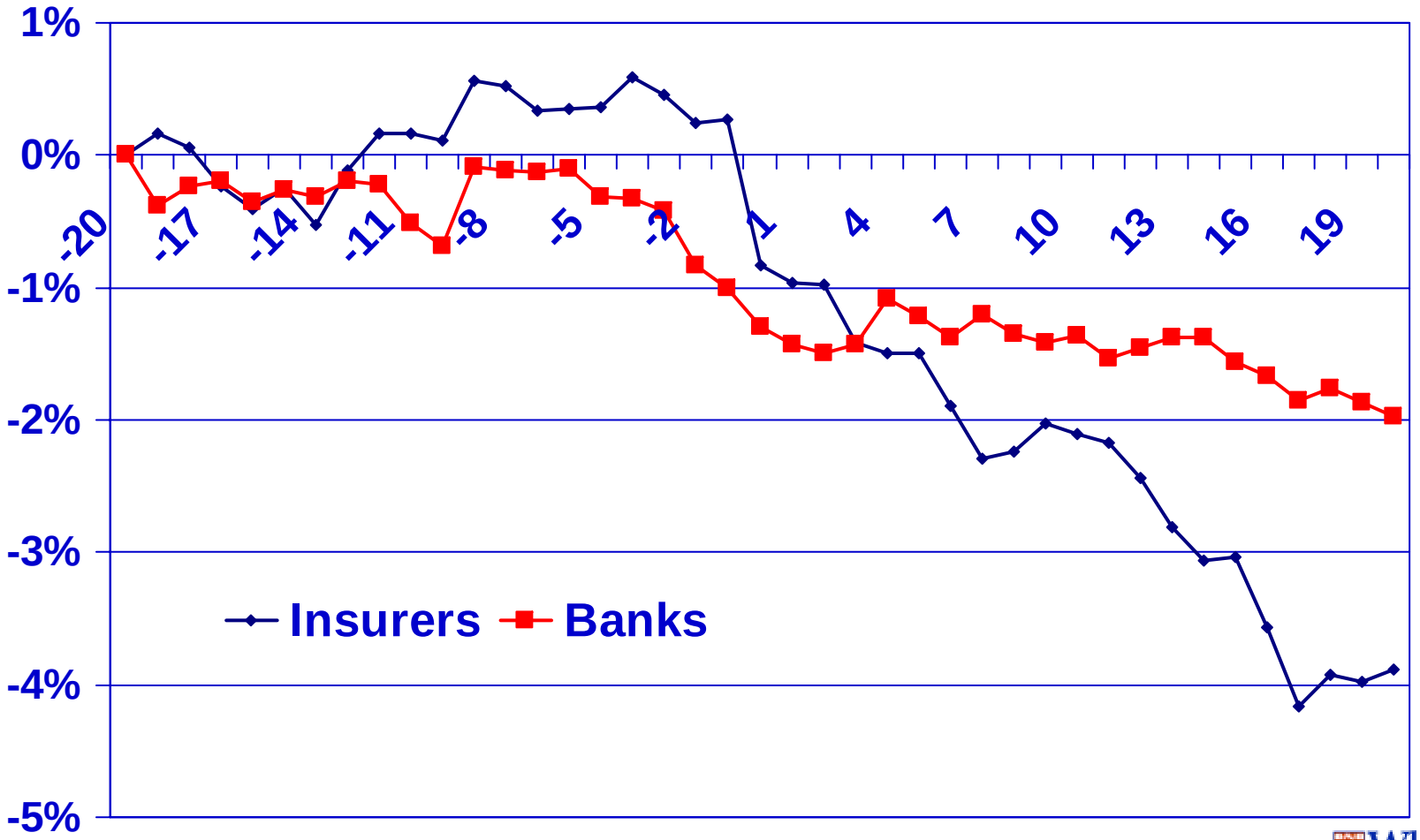
Why the Market Conduct Problems? II

- During the 1980s, mutual fund and equity investing became much more popular
- Also during the 1980s, Federal regulators permitted banks to sell annuities and life insurance
- Result – increased competition placed pressure on profit margins and led insurers to adopt more aggressive marketing practices

Event Study Sample: Summary Statistics

	Banks				Insurers		
Statistic	Mean	Median	Max	t-test[1]	Mean	Median	Max
All Operational Losses	84.40	32.33	2,532.39	***	99.75	33.63	2,256.75
Number	691				241		
Summary Statistics for Event Study Samples:							
Operational Losses	69.53	32.33	774.54		73.54	37.03	335.52
Market Capitalization	29,469	11,818	269,022	**	20,064	7,552	228,955
Book Value of Equity	12,115	6,150	84,106		10,241	5,184	79,059
BV of Assets	208,253	133,381	1,063,572	***	111,140	54,384	1,077,236
BV Liab/BV Assets	92.1%	93.7%	97.9%	***	83.0%	85.9%	97.6%
BV Equity/BV Assets	7.9%	6.3%	77.6%	***	17.0%	14.1%	62.9%
Op Loss/MktCap	4.3%	0.6%	94.5%		3.6%	0.8%	71.2%
Number	403				89		

Mean CARs: Banks and Insurers



Wharton
University of Pennsylvania

CARs By Window: US Banks

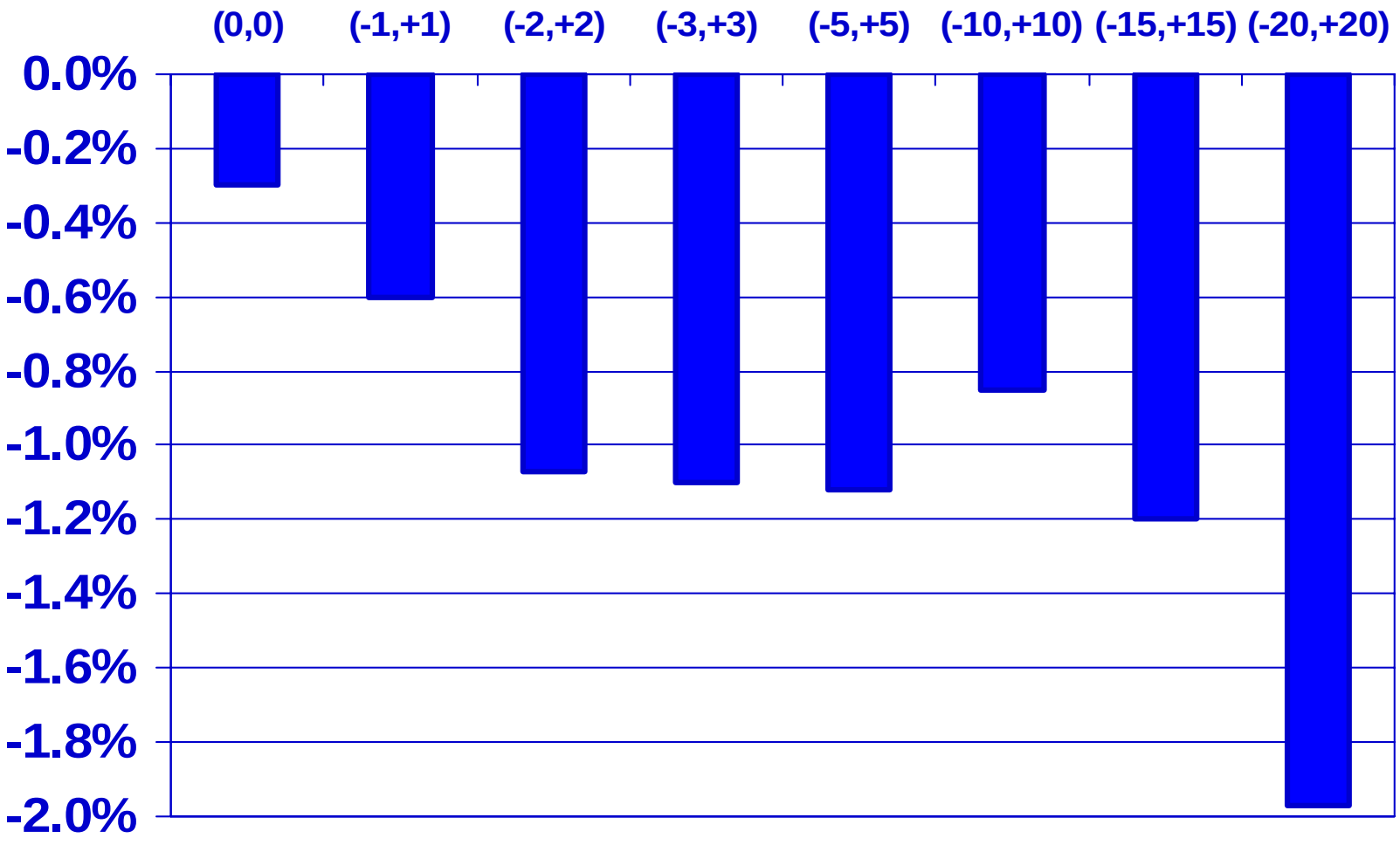
Window	Mean	VA Z-Score	CT t-test	GS Z-Score
(0,0)	-0.30%	-1.756**	-0.858	-5.530***
(-1,+1)	-0.60%	-3.901***	-2.331*	-3.835***
(-2,+2)	-1.07%	-5.283***	-3.875***	-3.835***
(-3,+3)	-1.10%	-4.399***	-2.964**	-3.138***
(-5,+5)	-1.12%	-3.406***	-2.743**	-1.742*
(-10,+10)	-0.85%	-1.86**	-0.779	-0.147
(-15,+15)	-1.20%	-1.398$	-0.169	-0.845
(-20,+20)	-1.97%	-2.081**	-0.665	-2.141*

CARs by Window: US Insurers

Window	Mean	VA Z-Score	CT t-Test	GS Z-Score
(0,0)	-1.10%	-1.578$	-1.805$	-0.902
(-1,+1)	-1.22%	-1.638$	-1.578	-0.69
(-1,+2)	-1.23%	-1.566$	-1.356	0.158
(-1,+3)	-1.66%	-2.032**	-1.905$	-1.539$
(-1,+5)	-1.74%	-1.645**	-1.724$	-0.69
(-1,+10)	-2.35%	-1.794**	-1.789$	-0.69
(-1,+15)	-3.27%	-2.359***	-2.314*	-1.327$
(-1,+20)	-4.12%	-2.645***	-2.700**	-1.327$

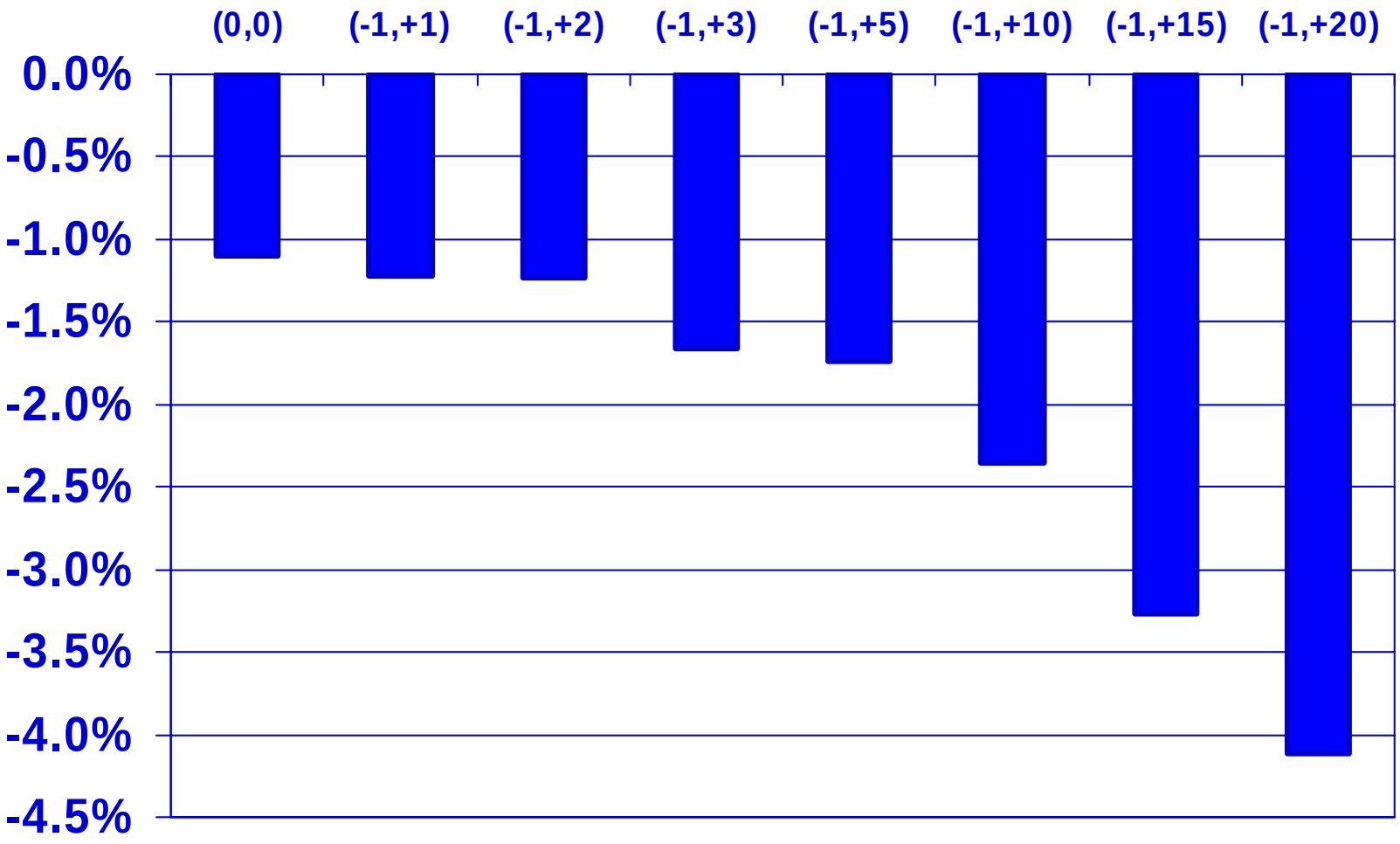
Wharton
University of Pennsylvania

CARs by Window: US Banks



Wharton
University of Pennsylvania

CARs by Window: US Insurers



Wharton
University of Pennsylvania

Why Is Insurers' Response Stronger?

- Operational risk events in the sample were more "unexpected" for insurers
  - Banks have long been susceptible to operational events such as fraud and trading abuses
  - Bank management and regulators have given more attention to operational risk
  - Insurance events such as market conduct were nearly non-existent prior to the 1990s
- Insurer market value loss larger than for banks – some support for Hypothesis 4

Why Is Insurers' Response Stronger?

- Operational risk events are "worse news" for insurance customers
  - Bank depositors protected by Federal deposit insurance
  - Protection for policyholders of failed insurers is much weaker (not government backed)
  - Federal bank regulation is higher quality than US insurance regulation

Why Is Insurers' Response Stronger?

- Option convexity rationale –
  - Equity of a firm can be viewed as a call option, which is convex in the capital to asset ratio
  - Insurers have higher capital-to-asset ratios than banks (17% versus 8% on average in our sample)
  - Therefore, other things equal, insurer stocks will drop by more in response to an event
- We compute Black-Scholes call option values and show that insurer stocks are more sensitive than bank stocks

Regression Analysis: Variables

- Dependent variable = market value loss over window $(-T_1,+T_2)$
- Independent variables
  - Loss amount
  - Q ratio = (market value of equity + book value of liabilities)/book value of assets, quarter preceding event window
  - Assets
  - Deceptive sales dummy variable
  - Time trend

Regressions Results: US Banks

Dependent	Intercept	Loss Amt	Q Ratio	Decept Sales	Assets	Time	Adj R^2
MV Loss	9094.0	-5.337	-1772.7	486.5		-0.217	0.045
(-5,+5)	2.705	-2.516	-2.368	0.968		-2.185	
	***	**	**			**	
MV Loss	-2163.7	-3.597	-2769.2	458.8	-0.0066	0.168	0.145
(-5,+5)	-0.593	-1.767	-3.304	0.969	-6.758	1.508	
		*	***		***		

Wharton
University of Pennsylvania

Regressions Results: US Insurers

Dependent	Intercept	Loss Amt	Q Ratio	Decept Sales	Assets	Time	Adj R^2
MV Loss	2480.2	-2.666	-672.1	-1.7		-0.046	0.073
(-20,+20)	2.424	-2.039	-3.007	-0.030		-1.760	
	**	**	***			*	
MV Loss	2945.7	-2.694	-653.2	33.3	0.00012	-0.061	0.069
(-20,+20)	2.149	-2.080	-2.838	0.406	0.817	-1.597	
	**	**	***				

Wharton
University of Pennsylvania

Regression Results: Discussion

- Market value loss in response to operational loss is significantly greater than 1 for 1 for both banks and insurers
  - Therefore, operational risk lead to significant reductions in expected cash flows
  - Supports Hypothesis 1
- Q-ratio is inversely related to MV loss
  - Therefore, firms with higher growth prospects are more severely affected
  - Supports Hypothesis 2

Regression Results: Discussion II

- Market value loss is not significantly different for deceptive sales events than for other types of events for banks or insurers
  - Therefore, no support for Hypothesis 3

- Asset size is inversely related to market value loss for banks but not significant for insurers
  - Suggests big banks more susceptible to operational loss due to complexity of operations – operational risk events are “worse news” for big banks

Regression Results: Discussion III

- Coefficient of loss amount in insurance regressions is less than for the bank regressions, contrary to option convexity argument
  - Therefore, contradictory evidence on Hypothesis 4
- Possible explanations
  - Convexity only 1 factor that determines the coefficient magnitude
  - Convexity difficult to measure in a linear regression
  - Insurance results generally noisier than bank results due to sample size

Operational Risk: Conclusions

- The number and value of operational risk events accelerated beginning in the 1990s
- The most significant event type for both banks and insurers is “clients, products, and business practices”
  - However, internal and external fraud are much more important for banks than for insurers

Operational Risk: Conclusions II

- Bank stocks respond less strongly to operational risk events than insurance stocks
  - Bank stock price response occurs in a shorter window: (-5,+5) vs. (-20,+20) – operational risk events "more surprising" than bank events and information emerges slowly
  - Bank stock price response is about half of insurance response on average – rationale:
    - » "Surprise factor" greater for insurers
    - » Banks have deposit insurance and better regulation
    - » Option convexity – insurers more highly capitalized

Operational Risk: Conclusions III

- Stock price response of both banks and insurers is > 1 for 1
  - Op risk events convey adverse information about future cash flows that extends beyond the amount of the loss itself
- Firms with better growth prospects have larger market value response to op risk events
  - Consistent with having to forego favorable NPV projects because of depletion of internal capital
- No evidence that market conduct events lead to high MV losses than other event types

Conclusions IV

- Overall conclusions:
  - Operational risk poses significant threat to market value for financial institutions providing a rationale for operational risk management
    - » Therefore, op risk management is a core competency for financial institutions
  - Market response to op risk shows that market discipline can be a powerful tool for regulators in controlling operational risk
    - » Regulators should require disclosure of operational risk events

Data and Methodology VII

- We compute the cumulative average abnormal returns (CAR) for the N securities across two time periods (τ_1 and τ_2), as well as the variance in the CAR, as follows.

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N} \sum_{j=1}^{N} \overline{AR}(\tau_1, \tau_2)$$

$$Var[\overline{CAR}(\tau_1, \tau_2)] = \frac{1}{N^2} \sum_{j=1}^{N} \hat{\sigma}_j^2(\tau_1, \tau_2)$$

CARs By Window: US Banks

Window	Mean	Median	VA Z-Score	CT t-test	GS Z-Score
(0,0)	-0.30%	-0.53%	-1.756**	-0.858	-5.530***
(-1,+1)	-0.60%	-0.94%	-3.901***	-2.331*	-3.835***
(-2,+2)	-1.07%	-1.30%	-5.283***	-3.875***	-3.835***
(-3,+3)	-1.10%	-1.10%	-4.399***	-2.964**	-3.138***
(-5,+5)	-1.12%	-0.85%	-3.406***	-2.743**	-1.742*
(-10,+10)	-0.85%	-0.42%	-1.86**	-0.779	-0.147
(-15,+15)	-1.20%	-1.62%	-1.398$	-0.169	-0.845
(-20,+20)	-1.97%	-1.77%	-2.081**	-0.665	-2.141*

CARs by Window: US Insurers

Window	Mean	Median	VA Z-Score	CT t-test	GS Z-Score
(0,0)	-1.10%	-0.35%	-1.578$	-1.805$	-0.902
(-1,+1)	-1.22%	-0.39%	-1.638$	-1.578	-0.69
(-2,+2)	-1.44%	-0.38%	-1.72**	-1.454	-0.266
(-3,+3)	-2.01%	-0.56%	-2.024**	-1.848$	-0.478
(-5,+5)	-1.85%	-0.63%	-1.382$	-1.294	-0.266
(-10,+10)	-2.27%	-0.63%	-1.252	-1.209	-0.266
(-15,+15)	-2.62%	-1.46%	-1.214	-1.113	-0.69
(-20,+20)	-3.88%	-2.37%	-1.546$	-1.592	-1.114