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

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Implementing AMA For Operational Risk
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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
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

  - 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.
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
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.
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

\[ R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \]

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

\[
CAR_{(T_1, T_2)} = \sum_{t=T_1}^{T_2} AR_{jt}
\]

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

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

\[
CAR_{(T_1, T_2)}^i = \sum_{All \ j \in \text{Portfolio} \ i} \frac{CAR_{(T_1, T_2)}^j}{N_i}
\]

- CARs then tested for significance (see paper for discussion)
Severity Distribution of Operational Losses

Percent of Loss:

- Banking
- Insurance

Loss Amount ($Millions):

- 0-50
- 50-100
- 100-150
- 150-200
- 200-250
- 250-300
- 300-350
- 350-400
- 400-450
- 450-500
- > 500

Wharton University of Pennsylvania
Operational Loss Events: US Banks
Events by Event Type: US Insurers

- Internal Fraud
- External Fraud
- Employ Pract
- Clients, Products
- Physical Assets
- Bus Disruption
- Exec & Process

Frequency vs. Severity

- Frequency bar (blue)
- Severity bar (red)
Events by Business Line: US Banks

- Corp Finance
- Trading & Sales
- Retail Banking
- Comm Banking
- Pmt&Settlement
- Agency Services
- Asset Mgt
- Retail Brokerage
- Instit Brokerage

Frequency
Severity

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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

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Banks</th>
<th>Insurers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Median</td>
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<tr>
<td>All Operational Losses</td>
<td>84.40</td>
<td>32.33</td>
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<tr>
<td>Number</td>
<td>691</td>
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<tr>
<td><strong>Summary Statistics for Event Study Samples:</strong></td>
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<tr>
<td>Operational Losses</td>
<td>69.53</td>
<td>32.33</td>
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<tr>
<td>Market Capitalization</td>
<td>29,469</td>
<td>11,818</td>
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<td>Book Value of Equity</td>
<td>12,115</td>
<td>6,150</td>
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<td>BV of Assets</td>
<td>208,253</td>
<td>133,381</td>
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<tr>
<td>BV Liab/BV Assets</td>
<td>92.1%</td>
<td>93.7%</td>
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<td>BV Equity/BV Assets</td>
<td>7.9%</td>
<td>6.3%</td>
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<td>Op Loss/MktCap</td>
<td>4.3%</td>
<td>0.6%</td>
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<td>Number</td>
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<tr>
<td>Window</td>
<td>Mean</td>
<td>VA Z-Score</td>
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<tr>
<td>-----------</td>
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<td>------------</td>
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<tr>
<td>(0,0)</td>
<td>-0.30%</td>
<td>-1.756**</td>
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<td>(-1,+1)</td>
<td>-0.60%</td>
<td>-3.901***</td>
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<td>(-2,+2)</td>
<td>-1.07%</td>
<td>-5.283***</td>
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<tr>
<td>(-3,+3)</td>
<td>-1.10%</td>
<td>-4.399***</td>
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<tr>
<td>(-5,+5)</td>
<td>-1.12%</td>
<td>-3.406***</td>
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<tr>
<td>(-10,+10)</td>
<td>-0.85%</td>
<td>-1.86**</td>
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<tr>
<td>(-15,+15)</td>
<td>-1.20%</td>
<td>-1.398$</td>
</tr>
<tr>
<td>(-20,+20)</td>
<td>-1.97%</td>
<td>-2.081**</td>
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### CARs by Window: US Insurers

<table>
<thead>
<tr>
<th>Window</th>
<th>Mean</th>
<th>VA Z-Score</th>
<th>CT t-Test</th>
<th>GS Z-Score</th>
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<tbody>
<tr>
<td>(0,0)</td>
<td>-1.10%</td>
<td>-1.578$$</td>
<td>-1.805$$</td>
<td>-0.902</td>
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<td>(-1,+1)</td>
<td>-1.22%</td>
<td>-1.638$$</td>
<td>-1.578</td>
<td>-0.69</td>
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<tr>
<td>(-1,+2)</td>
<td>-1.23%</td>
<td>-1.566$$</td>
<td>-1.356</td>
<td>0.158</td>
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<tr>
<td>(-1,+3)</td>
<td>-1.66%</td>
<td>-2.032**</td>
<td>-1.905$$</td>
<td>-1.539$$</td>
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<td>(-1,+5)</td>
<td>-1.74%</td>
<td>-1.645**</td>
<td>-1.724$$</td>
<td>-0.69</td>
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<td>(-1,+10)</td>
<td>-2.35%</td>
<td>-1.794**</td>
<td>-1.789$$</td>
<td>-0.69</td>
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<tr>
<td>(-1,+15)</td>
<td>-3.27%</td>
<td>-2.359***</td>
<td>-2.314*</td>
<td>-1.327$$</td>
</tr>
<tr>
<td>(-1,+20)</td>
<td>-4.12%</td>
<td>-2.645***</td>
<td>-2.700**</td>
<td>-1.327$$</td>
</tr>
</tbody>
</table>
CARs by Window: US Banks

(0,0)  (-1,+1)  (-2,+2)  (-3,+3)  (-5,+5)  (-10,+10)  (-15,+15)  (-20,+20)
CARs by Window: US Insurers

(0,0) (-1,+1) (-1,+2) (-1,+3) (-1,+5) (-1,+10) (-1,+15) (-1,+20)
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 = \((\text{market value of equity} + \text{book value of liabilities})/\text{book value of assets, quarter preceding event window}\)
  - Assets
  - Deceptive sales dummy variable
  - Time trend
### Regressions Results: US Banks

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Intercept</th>
<th>Loss Amt</th>
<th>Q Ratio</th>
<th>Decept Sales</th>
<th>Assets</th>
<th>Time</th>
<th>Adj R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV Loss</td>
<td>9094.0</td>
<td>-5.337</td>
<td>-1772.7</td>
<td>486.5</td>
<td></td>
<td>-0.217</td>
<td>0.045</td>
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<tr>
<td>(-5,+5)</td>
<td>2.705</td>
<td>-2.516</td>
<td>-2.368</td>
<td>0.968</td>
<td></td>
<td>-2.185</td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td>MV Loss</td>
<td>-2163.7</td>
<td>-3.597</td>
<td>-2769.2</td>
<td>458.8</td>
<td>-0.0066</td>
<td>0.168</td>
<td>0.145</td>
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<tr>
<td>(-5,+5)</td>
<td>-0.593</td>
<td>-1.767</td>
<td>-3.304</td>
<td>0.969</td>
<td>-6.758</td>
<td>1.508</td>
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<th>Assets</th>
<th>Time</th>
<th>Adj R²</th>
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<tr>
<td>MV Loss</td>
<td>2480.2</td>
<td>-2.666</td>
<td>-672.1</td>
<td>-1.7</td>
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<td>-0.046</td>
<td>0.073</td>
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<td>(-20,+20)</td>
<td>2.424</td>
<td>-2.039</td>
<td>-3.007</td>
<td>-0.030</td>
<td></td>
<td>-1.760</td>
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<tr>
<td>MV Loss</td>
<td>2945.7</td>
<td>-2.694</td>
<td>-653.2</td>
<td>33.3</td>
<td>0.00012</td>
<td>-0.061</td>
<td>0.069</td>
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<td>(-20,+20)</td>
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<td>0.406</td>
<td>0.817</td>
<td>-1.597</td>
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Regression Results: Discussion

- Market value loss in response to operational loss is significantly greater than 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 ($\tau_1$ and $\tau_2$), as well as the variance in the CAR, as follows.

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

$$Var[CAR(\tau_1, \tau_2)] = \frac{1}{N^2} \sum_{j=1}^{N} \hat{\sigma}_j^2(\tau_1, \tau_2)$$
CARs By Window: US Banks

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

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