Economic Aspects of Information Security

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Stream of Research by Lawrence A. Gordon and Martin P. Loeb on Economic Aspects of Information Security

**Common Themes**

- Cyber Risk Management
- Economic Effect of Information Security Breaches
- Economic Impact of Government and Industry Partnerships
- Real Options View of Information Security Investments

Information Security

Economics

Managerial Accounting
Stream of Research by Lawrence A. Gordon and Martin P. Loeb on Economic Aspects of Information Security


Stream of Research by Lawrence A. Gordon and Martin P. Loeb on Economic Aspects of Information Security (continued)


Definition: Management Accounting

MANAGEMENT ACCOUNTING: Design and use of information system for managerial planning and control

INFORMATION

DECISION MAKING
Risk Management/Information Security and Cyber Insurance

Assess Risk

Reduce Risk to an Acceptable Level

Reduce Risk of Security Breaches to an Acceptable Level (e.g., use of firewalls, encryption, and access control)

Reduce Resulting Residual Financial Risk via Cyber Insurance

Maintain Risk at Acceptable Level

**MOTIVATION**

- Information Security (IS) Breaches are Ubiquitous (e.g., Love Bug, Denial of Service)
- Conflicting Views about Economic Impact of Such Breaches
  - Significant losses (e.g., Kedrosky, 2000; Power 2002)
  - Nuisance (e.g., Anders, 2000; Smith, 2000) especially in terms of long-run impact – i.e., firms protect their most significant information assets

Empirical research on economic impact is largely descriptive in nature (i.e., primarily surveys and some case studies) and has focused on “direct” financial cost of IS breaches
HYPOTHESES

H1₀: There is no stock market reaction to public reports of corporate information security breaches.

H2ₐ: There is no stock market reaction to public reports of corporate information security breaches involving unauthorized access to confidential information.

H2ₜ: There is no stock market reaction to public reports of corporate information security breaches that do not involve unauthorized access to confidential information.
METHODOLOGY

Sample Selection

- Public announcements in highly visible newspaper – WSJ, NY Times, Washington Post, FT & USA Today
- We wanted a powerful test for a stock market reaction
- 1/1995 to 12/2000
- 43 events affecting 38 firms
  (Search Terms: IS Breach, Computer System Security, Hacker, Cyber Attack, Computer Attack and Computer Virus)

- Sample partitioned by confidentiality of event as: Confidential (11) or Non-Confidential (32)
RESEARCH DESIGN

Event Study, where event is public announcement of IS Breach

Standard Ordinary Least Squares (OLS) Methodology based on CAR

- OLS assumes error terms are independent, normally distributed, zero-mean and homoskedastic. However, IS Breaches cluster by day/industry and some contemporaneous cross-sectional correlation and/or heteroskedasticity.

Seemingly Unrelated Regressions (SUR) Methodology, which is a form of Generalized Least Squares (GLS) Methodology
Standard Market Model

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

Where: \( R_{it} \) = return for firm \( i \)'s stock on day \( t \), net of the risk-free rate;
\( R_{mt} \) = return for the market on day \( t \), net of the risk-free rate;
\( \alpha_i, \beta_i \) = market model intercept and slope parameters, respectively, for firm \( i \); and
\( \epsilon_{it} \) = disturbance term.

The abnormal returns (AR)

\[ AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \]

**Time Line**

- **Estimation Period**: 120 days
- **Test Window**: 3 days
\[ \text{CAR} \]

\[ \text{CAR}_i = \sum_{t_{i1}}^{t_{i2}} \text{AR}_{it} \]

Where: \([t_1, t_2] = \text{the event interval.}\)
The mean announcement effect:

\[ \text{CAR} = \frac{1}{N} \sum_{i=1}^{N} \text{CAR}_i \]

Where: \(N = \text{the number of events.}\)

\[ \text{SUR} \]

\[ R_{1i} = \alpha_i + \beta_{1} R_{mt} + \gamma_i D + e_{1i}, \]
\[ R_{2i} = \alpha_2 + \beta_{2} R_{mt} + \gamma_2 D + e_{2i}, \]
\[ \vdots \]
\[ \vdots \]
\[ R_{Ni} = \alpha_N + \beta_N R_{mt} + \gamma_N D + e_{Ni}, \]

Where: \(D = 1 \text{ if within the 3 day event period } [-1, +1], \text{ and 0 otherwise.}\)
## Table 4

### CAR Results
3 day window [-1,+1]

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean CAR</th>
<th>Z-stat</th>
<th>p-value</th>
<th>% negative CARs</th>
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<tbody>
<tr>
<td><strong>Panel A (full sample)</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Full Sample</td>
<td>43</td>
<td>-0.0188</td>
<td>-1.4783</td>
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<tr>
<td><strong>Panel B (sample partitions)</strong></td>
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<td></td>
</tr>
<tr>
<td>Confidential Events</td>
<td>11</td>
<td>-0.0546</td>
<td>-2.7830</td>
<td>0.0053</td>
<td>63.64</td>
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<td>Non-Confidential Events</td>
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<td>-0.0065</td>
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<td></td>
<td>Jt. Hypothesis (all coeff = 0)</td>
<td>Avg. Hypothesis (avg. coeff = 0)</td>
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<tr>
<td><strong>Panel A (Full Sample)</strong></td>
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<tr>
<td>F-value</td>
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<td>1.51</td>
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<tr>
<td>Pr&gt;F</td>
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<td>0.2192</td>
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<tr>
<td><strong>Panel B (Confidential Event Sub-Sample)</strong></td>
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<tr>
<td>F-value</td>
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<tr>
<td>Pr&gt;F</td>
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<tr>
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<tr>
<td><strong>Panel (Non-Confidential Event Sub-Sample)</strong></td>
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<td>5160</td>
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</table>
Summarized Results of Study

- Overall negative stock market reactions to IS Breaches
- Partitioned Sample
  - Highly significant reaction for confidentiality breaches
  - Non-significant reaction for non-confidentiality breaches
An Example

- Firm has tentatively budgeted next year’s expenditures for information security in the amount of $2,500,000.
  - First $1.5 million is earmarked for basic information security activities (e.g., basic access controls, firewalls and physical protection of the firm’s computers).
  - CSO is already authorized to use these funds for this purpose.
  - The remaining $1 million is considered discretionary, and needs the firm’s CFO’s approval before any final commitments can be made to spend this money.
  - Most likely use of the remaining $1 million is to hire an outside firm that specializes in enhancing the information security operations of major organizations.
  - The outside company’s policy is to contract for one fiscal year, or any part thereof, at a cost of $1 million. In addition, once the contract is signed, it is not reversible for the remainder of the year (or part thereof).
Option Value Example

Contract Now

\[
Savings = 12 \times 40,000 = 480,000 \\
Costs = 1,000,000 \\
p = 0.5
\]

\[
Savings = 12 \times 200,000 = 2,400,000 \\
Costs = 1,000,000 \\
p = 0.5
\]

\[
EV = \frac{1}{2} \left( 12 \times 40,000 - 1,000,000 \right) = -560,000
\]

Do Not Invest

\[
EV = \frac{1}{2} \left( 11 \times 40,000 - 1,000,000 \right) = -560,000
\]

Invest

\[
EV = \frac{1}{2} \left( 11 \times 200,000 - 1,000,000 \right) = 600,000
\]

Option Value = 600,000 - 440,000 = 160,000
Current Research

- Information Sharing
- Business Case Development