Ahead of the Breach: Anticipatory Approaches to Mitigating Ex-post Costs of Cyber Breaches

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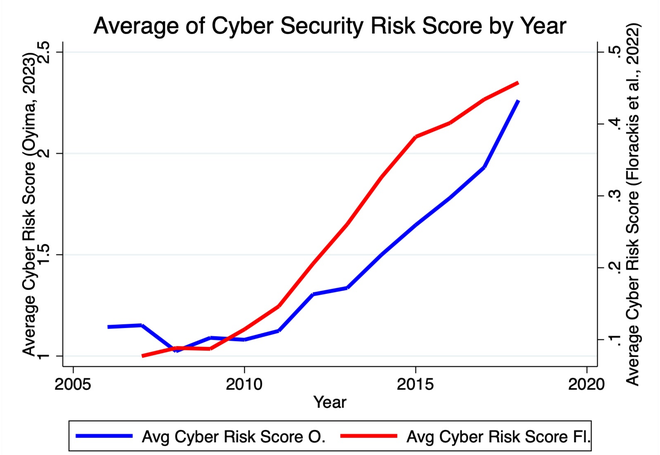
Abstract

This study critically evaluates the proactive cybersecurity strategies of managers in publicly traded companies, leveraging a unique dataset of actual cybersecurity risk measures from a leading cybersecurity scores company. I find that managers exhibit an awareness of their cybersecurity risks and engage in preemptive actions to either enhance their cyber defenses, acquire cyber insurance, or increase cash reserves before a breach or some combination of these actions. This investigation reveals that while some firms bolster their cyber defenses, others opt for cyber insurance and increased cash reserves as precautionary measures. The findings indicate that cyber insurance does not complement but rather substitutes for investment in cyber defense mechanisms. This substitution raises concerns about the cyber insurance market's adverse selection and moral hazard problems.

A Look at Cyber Risk Profiles Over the Years



Research Question

How do companies manage cyber risks before they materialize, and what is the role of cyber insurance in this context? Does it enhance corporate cybersecurity, or could it undermine it by providing a false sense of security?

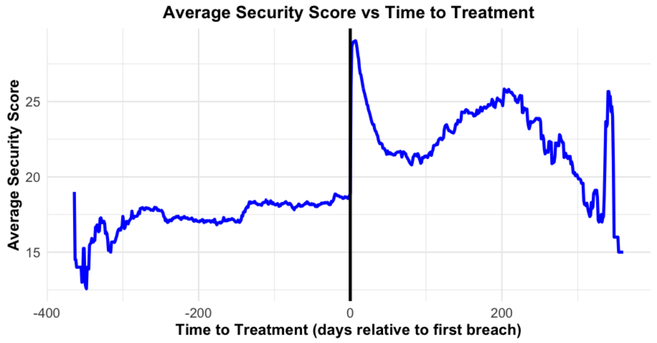
Main Findings

- Firms with cyber insurance tend to increase their cash holdings as the likelihood of facing a breach rises.
- On the other hand, companies that lack cyber insurance do not increase or, in some cases, decrease their cash reserves in response to heightened cyber risks.
- A discerning self-selection pattern in procuring cyber insurance; firms possessing cyber insurance appear more attuned to their cyber risks. This awareness influences both their cash management strategies and decisions to procure insurance, underscoring prevalent adverse selection issues in the cyber insurance market.

Data Summary

Table 1. Summary statistics of the variables.

Variables	Mean	SD	Min	Max
Cyber Insurance (dummy)	0.35	0.48	0.00	1.00
Probability Breach	0.03	0.05	0.00	0.42
Security Score	19.14	9.15	1.00	64.02
Cyber Risk Score (Florackis et al., 2022)	0.37	0.19	0.00	0.65
Cyber Risk Score (Oyima, 2023)	1.42	1.95	0.00	11.10



Results

Table 2.

Ex-Ante Analysis

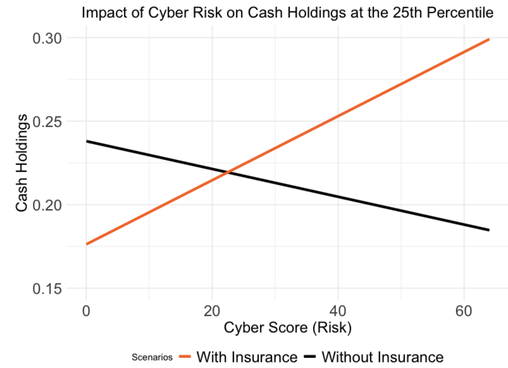
Regressions Analysis - Quarterly

Quantileth	None	25th	50th	75th
VARIABLES	Cash$_t$	Cash$_t$	Cash$_t$	Cash$_t$
Security Score$_{t-1}$	-0.000366	**-0.000832****	-0.000474	6.15e-05
	(0.000537)	(0.000393)	(0.000477)	(0.000744)
Cyber Insurance$_{t-1}$	**-0.0515****	**-0.0617*****	**-0.0539*****	-0.0422
	(0.0208)	(0.0159)	(0.0186)	(0.0281)
Security Score$_{t-1}$ × Cyber Insurance$_{t-1}$	**0.00208****	**0.00275*****	**0.00224*****	0.00147
	(0.00110)	(0.000832)	(0.000957)	(0.00146)
Constant	**0.382*****	**0.238*****	**0.349*****	**0.515*****
	(0.0408)	(0.0310)	(0.0372)	(0.0566)
Observations	1,354	1,354	1,354	1,354
Controls	Yes	Yes	Yes	Yes
R-squared	0.486			
Industry fixed effects	Yes	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes	Yes

Robust Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

A Visualization of the results



Logit Regression Analysis	
VARIABLES	Breach
Security Score	-0.000464
	(0.0198)
Cyber Insurance	**0.961****
	(0.474)
Observations	547
Controls	Yes
Industry Fixed Effects	Yes
Year-Quarter Fixed Effects	Yes
Cluster Std Error	Firm

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3. **Unexpected Scope**: Measures the positive deviation from the historical average scope or severity. Defined as: Unexpected Scope$(+) = ABS(\max(\text{Current Scope} - \text{Mean of Prior Breaches}, 0))$. Unexpected Scope$(-) = ABS(\min(\text{Current Scope} - \text{Mean of Prior Breaches}, 0))$

Ex-Post Analysis

	CAR$(-1,+1)$	CAR$(-3,+3)$	CAR$(-5,+5)$
VARIABLES	(2)	(4)	(6)
Unexpected Scope $(-)$	-0.00254	-0.00630	-0.0100
	(0.00335)	(0.00432)	(0.00614)
Unexpected Scope $(+)$	**-0.000343*****	**-0.000383*****	-0.000262
	(6.01e-05)	(9.07e-05)	(0.000170)
Cyber Insurance	0.00300	-0.000988	0.00204
	(0.00549)	(0.00975)	(0.0140)
Unexpected Scope $(-)$ × Cyber Insurance	0.00399	0.00477	0.00610
	(0.00555)	(0.00827)	(0.0110)
Unexpected Scope $(+)$ × **Cyber Insurance**	**-0.00135*****	**-0.00132*****	-0.000401
	(0.000178)	(0.000355)	(0.000483)
Constant	-0.0285***	-0.0279	-0.0349
	(0.0102)	(0.0171)	(0.0223)
Observations	344	344	344
Controls	Yes	Yes	Yes
R-squared	0.225	0.223	0.212
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Firm Cluster Std. Error	Yes	Yes	Yes

Robust standard errors in parentheses