

# Corporate Innovation in the Cyber Age

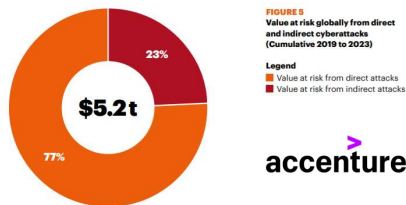
Gabriele Lattanzio<sup>1</sup>, Yue Ma<sup>2</sup>

<sup>1</sup> Monash University, Australia

<sup>2</sup> Steed School of Accounting, University of Oklahoma, USA

## Motivation

- Cyber risk has evolved to be one of the most significant risks for corporations in the age of information.
- Corporate intellectual properties are especially at risk in face of the increasing cyber threats.



## Introduction

- Our paper construct, develop, and validate a text-based measure to firms' ex-ante exposure to cybersecurity risk
- The rise of cyber threats is redesigning corporate innovation and appropriation strategies.
- As cybersecurity risk increases, managers' reliance on trade-secrets declines, as they seek to protect their firm's intellectual capital under patent and intellectual property laws.
- we show that this strategic adjustment is not costless, as it causes firms' returns to R&D investments to decline significantly.

## Method

- We scan 10-K filings of all firms from 2001 to 2018, looking for disclosure containing keywords related to cybersecurity.
- We use a glossary of keywords developed by the National Initiative for Cybersecurity Careers and Studies, and those used in Gordon et al. (2010)
- We include high-dimensional fixed effects capturing state-year, industry-year, and firm specific variation
- Our measure serves as a valid proxy for ex-ante cybersecurity risk

## Cyber Risk and Innovation

- Investment in innovation is not associated with cyber score.
- A one-standard-deviation increase in the cybersecurity score is associated with a 6.04% rise in patenting activity (log number of patents). We reach similar conclusion when we use value or citation-weighted patents.

VARIABLES	(1)	(2)	(3)
	Patent Count <sub>t</sub>	Citation Weighted Patents <sub>t</sub>	Value Weighted Patents <sub>t</sub>
Cybersecurity Score <sub>t-1</sub>	0.5632*** (0.1572)	0.4461** (0.2185)	1.2274*** (0.3725)

## Shift of Technology Appropriation Strategy and Its Cost

- A one-standard-deviation increase in cybersecurity risk is associated with an 8.32% decline in firms' average patenting time, signifying firms shift to file patents at early stage of research and development.
- A one-standard-deviation increase in Cyber score is also associated with a 0.75% decline in returns to R&D investments, the strategy of over patenting is shown to be sub-optimal
- The results remain robust to including control for insurance for cyber incidents

VARIABLES	(1)	(2)
	Average Patenting Time <sub>t</sub>	Returns to R&D Investments <sub>t</sub>
Cybersecurity Score <sub>t-1</sub>	-365.49*** (141.81)	-0.0830*** (0.0108)

## Subsample Analyses

- We study a set of carefully selected subsamples in which the documented substitution between trade secrets and patents should be the most (least) evident.
- The identified effects are the most pronounced in high-tech industries (Hall and Vopel, 1996) and for firms that are closer to the default threshold
- Our findings are the strongest for firms incorporated in states offering the lowest degree of the legal protection of trade secrets Png (2017a)

## References

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Gabriele Lattanzio  
Gabriele.lattanzio@monash.edu



Yue Ma  
Markyuema@ou.edu