

Data Security and Merger Waves

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Roadmap

- 1 Introduction
- 2 Data Breach Notification (DBN) Laws
- 3 Data
- 4 Empirical Results
- 5 Conclusions

Introduction

The world's most valuable resource is no longer oil, but data.

—The Economist (edition of May 6, 2017)

Data breaches are a very real business risk with bottom-line concerns.

—Tim Steinkopf, president of Centrifify

Introduction

- Existing research shows that shocks to the economic, technological, or regulatory environment drive merger waves (Gort 1969; Mitchell and Mulherin 1996; Harford 2005), and merger waves exhibit different patterns in different eras (Harford 2005).

In the current era of big data:

- First, data has become the new oil in the digital era (The Economist 2017; Forbes 2019). Accessing data has become strategically important for business to gain competitive advantages (Minelli, Chambers, and Dhiraj, 2013).
- Second, industries that are more likely to be data intensive (e.g., technology, consumer markets, medical) are the most active players in mergers and acquisitions (M&As) markets.

Introduction

- Current M&As are increasingly motivated by the acquisition of data. Data has become a core asset for many companies, and is increasingly acquired through M&As.

For example:

- Verizon acquired Yahoo in 2017 to promote its online advertising business, for which Yahoo's user data reveals users' online activities and preferences.
- Microsoft acquired LinkedIn in 2016 to draw on more social-network data to boost productivity.
- Facebook and IBM also emphasized the strategic importance of obtaining data in their acquisitions of WhatsApp and Truven Health Analytics, respectively.

Introduction

- The transaction of data through M&As involves a “**data lemon**” problem for acquirers (Chatterjee and Sokol 2019).
- If an acquirer does not conduct thorough due diligence in assessing the target’s cybersecurity, the acquirer may be left with a data lemon – exposed to a high risk of data breach, and resulting customer litigation, government penalties, reputation damage, and loss of trust and business.

Introduction

- Anecdotal evidence suggests that data breaches become more common in practice and acquirers increasingly take into account **the targets' cyber security and data quality.**

For example:

- Hospitality giant Marriot acquired Starwood in 2016 for \$13.6 billion, only to learn that its Starwood reservation system had been under cyberattack as far back as 2014. As the result, Marriot faces multiple lawsuits seeking billions of dollars in damages and at least a \$123 million fine issued by the U.K. data protection authority.
- Verizon discounted its initial offer price of Yahoo by \$350 million in 2017 after it learned two breaches of Yahoo's user data.
- Abbott Laboratories announced the acquisition of St. Jude Medical in 2016 before discovering that St. Jude's lax cybersecurity exposed its products to hacking risk a year later. Abbott ended up recalling half a million pacemakers.

Introduction

- In this paper, we provide systematic evidence on how target companies' cybersecurity affect M&A transactions.
- While industry practitioners stress the importance of identifying a target company's cybersecurity in M&A activities (e.g., Chatterjee and Sokol 2019), little academic research examines the extent to which acquirers consider target companies' data security in assessing an M&A transaction.
- To our knowledge, this is the first paper studying how cyber risk affects corporate acquisition decisions.
- Our paper contributes to the M&A literature. We also add to a growing body of research investigating the effects of data assets on corporate decisions and firm value (e.g., Tambe 2014; Kamiya et al. 2019).

Introduction

- We exploit the staggered adoption of Data Breach Notification Laws (DBN Laws) across U.S. states.

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DBN Laws

- According to the Privacy Rights Clearinghouse, the number of data breaches in U.S. increased from 157 in 2005 to 1,244 in 2018, nearly eightfold over the past decade.
- Data Breach Notification Laws were enacted in response to an escalating number of breaches of consumer databases containing personal information.
- The laws require that firms must immediately notify affected customers and other parties when there is a breach of sensitive personal information.

DBN Laws

- The laws define a data breach as an unauthorized acquisition of data that compromises an entity's security, confidentiality, or integrity of personal information.
- Personal information refers to information that can be used on its own or with other information to identify a person, e.g., social security number, driver's license number, state ID card, bank/financial account number, health insurance information, and biometric data.
- A firm that fails to comply with notification requirements will be liable for civil penalties. Civil penalties in Alabama legislations, for example, are as high as \$500,000 per breach.

DBN Laws

- We collect information on the effective date of DBN Laws across U.S. states from the Privacy Security group of Perkins Coie, a leading international law firm.
- California first legislated the data breach laws in 2003.
- By 2018, all 50 states and Washington DC had enacted the laws.

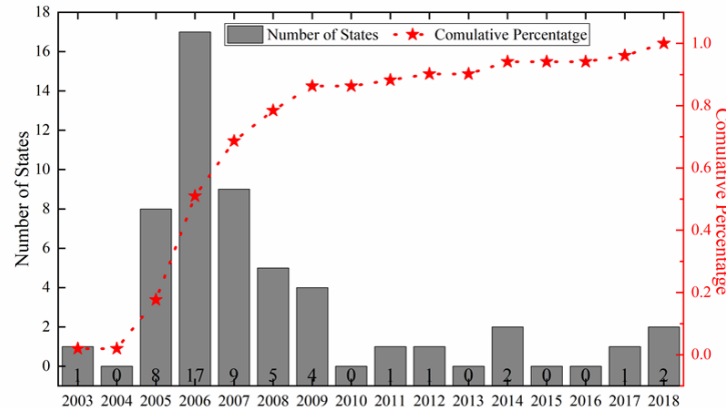


Figure 1: Distribution of Effective Years

DBN Laws

- The impact of DBN laws on M&As activities is separated.

For acquirers from states without DBN Laws:

- The disclosure of a data breach often causes reputation damages, loss of firm value and revenue, litigation and financing costs, and regulatory penalties (e.g., The Council of Economic Advisers 2018; Kamiya et al., 2019).
- For DBN Laws require mandatory disclosure of data breach events, it is obvious that the laws increase data breach costs for firms.
- As the data system is generally taken to be a centralized framework and data leakages are usually interrelated, the acquisitions with a target under the data breach laws would bring acquirers additional liabilities and exposure to potential breach costs.
- Therefore, the enactment of the laws will suppress M&As activities.

For acquirers from states with DBN Laws:

- If acquirers are already subject to the DBN Laws, they concern more about data lemon problems.
- As the laws facilitate screening of targets with real cyber risks (leakage incidents), the overall supply of lemons would be reduced after enactment of the laws.
- To the extent that the laws make data breaches more costly for firms, they would increase security investments and take other safety actions to strengthen data protection and increase cyber security in the wake of the laws.
- Therefore, the data breach laws in targets' states might promote M&A activities by mitigating the data lemon problem and reducing acquirers' concerns about the potential cyber risk of target companies.

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M&A Sample

Database: Securities Data Company's (SDC) U.S. Mergers and Acquisitions database

Criteria:

- 1 Deals with announcement date: 01/01/1998 to 31/12/2018
- 2 Deals coded as mergers, acquisitions of assets, or acquisitions of majority interest.
- 3 The acquisition is completed.
- 4 The bidder controls less than 50% of the shares of the target prior to the announcement and owns more than 50% of the target after the transaction.
- 5 The deal value disclosed in SDC is more than \$1 million

42,206 transactions meet our criteria

Measures of M&As Activities

- Our primary dataset (state-industry panel) includes 23,383 state-industry-year observations. We restrict to state-industries with at least one M&A deal over the sample period.

For each state-industry of the target companies in a year:

- ① **Log[1+ Total Number]:** the natural logarithm of one plus the total number of all M&A deals for which the targets operate in industry i from state s in year t .
- ② **Log[1+Total Dollar Value]:** the natural logarithm of one plus the total transaction value (in millions of dollars) of all M&A deals for which the targets operate in industry i from state s in year t .

Note: Target industry is defined at the two-digit SIC level

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Validity Tests

- As a validity test that mitigates reverse causality concerns, we first examine whether the timing of the law enactment in a given state is affected by the preexisting level of M&A activities in that state.
- Following existing research (e.g., Beck, Levine, and Levkov 2010), we use a hazard model assuming that the hazard rate follows a Weibull distribution.
- The analysis is at the state-year level. The dependent variable is the natural logarithm of expected time to the law change, i.e., survival time.

Validity Tests

	(1)	(2)
<i>Log[1+ Total Number]</i>	0.047 (0.106)	
<i>Log[1+Total Dollar Value]</i>		-0.008 (0.042)
<i>Asset Turnover</i>	0.137 (0.134)	0.133 (0.133)
<i>Market Leverage</i>	-0.115 (0.876)	-0.145 (0.873)
<i>Book to Market</i>	-0.208 (0.145)	-0.221 (0.148)
<i>Sales Growth</i>	-0.354* (0.195)	-0.354* (0.204)
<i>R&D</i>	-0.087** (0.041)	-0.089** (0.040)
<i>ROA</i>	0.155 (0.205)	0.153 (0.200)
<i>Sales Margins</i>	-0.002 (0.024)	-0.004 (0.023)
<i>Log[# of Listed Firms]</i>	-0.100 (0.083)	-0.053 (0.060)
Observations	590	590

- As shown, neither $\text{Log}[1+ \text{Total Number}]$ nor $\text{Log}[1+ \text{Total Dollar Value}]$ of M&As in a state enters significantly, suggesting that preexisting acquisition intensity do not predict the timing of a state adopting the laws.

DBN Laws and M&A Intensity, State-Level Tests

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	Log[1+ Total Number]		Log[1+Total Dollar Value]		Log[1+ Total Number]		Log[1+Total Dollar Value]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>DBN Laws</i>	0.482*** (0.165)	0.412** (0.169)	0.784** (0.343)	0.667* (0.343)	-0.639*** (0.161)	-0.602*** (0.184)	-1.481*** (0.313)	-1.523*** (0.328)
<i>Asset Turnover</i>		0.150 (0.163)		0.660* (0.349)		0.046 (0.205)		-0.093 (0.358)
<i>Market Leverage</i>		0.546 (1.382)		3.352 (2.812)		-1.069 (1.062)		-2.831 (2.163)
<i>Book to Market</i>		-0.127 (0.092)		-0.187 (0.164)		0.016 (0.126)		0.027 (0.232)
<i>Sales Growth</i>		-0.220 (0.154)		-0.173 (0.378)		0.012 (0.124)		-0.261 (0.386)
<i>R&D</i>		0.280** (0.114)		0.388** (0.187)		-0.278** (0.119)		-0.376** (0.182)
<i>ROA</i>		0.071 (0.102)		-0.046 (0.270)		-0.141 (0.120)		-0.059 (0.396)
<i>Sales Margins</i>		-0.020 (0.018)		-0.027 (0.030)		0.043** (0.019)		0.024 (0.045)
<i>Log[# of Listed Firms]</i>		0.436 (0.264)		0.880* (0.472)		-0.068 (0.342)		0.770 (0.548)
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,071	1,071	1,071	1,071	1,071	1,071	1,071	1,071
Adj. R ²	0.870	0.876	0.864	0.867	0.867	0.872	0.773	0.775

- DBN Laws is a dummy variable that equals one in a state for the years after adopting the laws, and zero otherwise. Each unit refers to a state.
- Following existing literature (e.g., Harford 2005), we consider a number of controls to capture economic shocks.

DBN Laws and M&A Intensity, State-Level Tests

Group 1: For acquirers from states with DBN Laws

- *DBN Laws* enters **positively** and statistically significantly, suggesting that both the total number and the dollar volume of M&A deals **increase** more after a targets' states enacted the data breach notification laws.
- The results suggest that improved targets' cyber security resulting from the passage of data breach laws **facilitates** the acquisition of these targets.

Group 2: For acquirers from states without DBN Laws

- *DBN Laws* enters **negatively** and statistically significantly, suggesting that both the total number and the dollar volume of M&A deals **decrease** more after a targets' states enacted the data breach notification laws.
- The results suggest that improved liabilities and potential litigation costs resulting from the passage of data breach laws **hinder** the acquisition of these targets.

DBN Laws and M&A Intensity, State-Industry-Level Tests

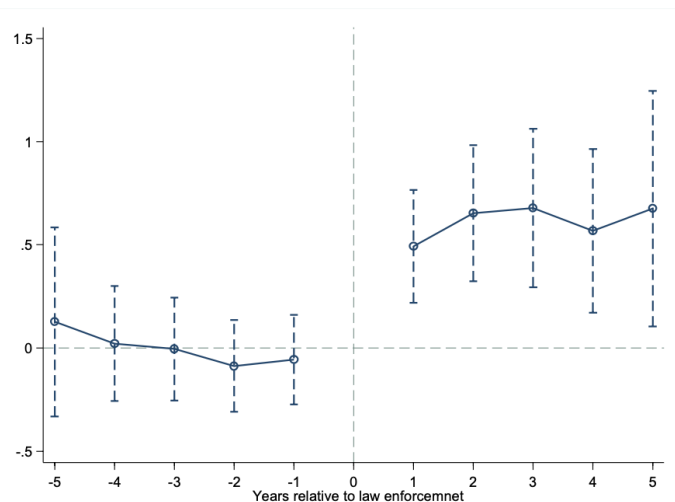
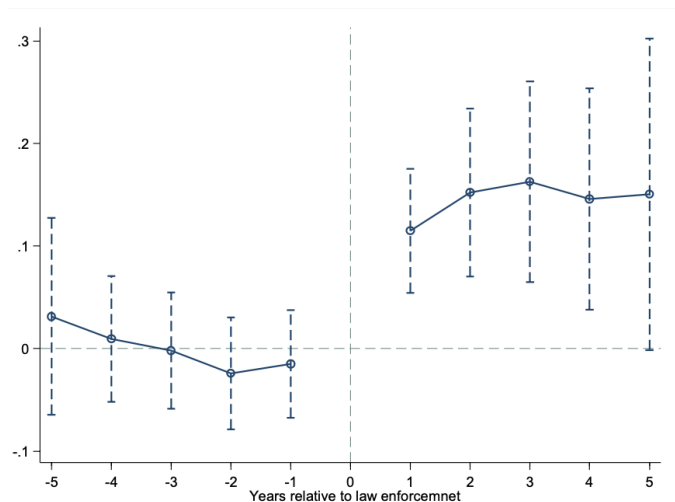
Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	<i>Log[1+ Total Number]</i>		<i>Log[1+Total Dollar Value]</i>		<i>Log[1+ Total Number]</i>		<i>Log[1+Total Dollar Value]</i>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>DBN Laws</i>	0.120*** (0.044)	0.120*** (0.044)	0.512*** (0.168)	0.511*** (0.165)	-0.088*** (0.030)	-0.088*** (0.030)	-0.379*** (0.135)	-0.377*** (0.136)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,383	23,383	23,383	23,383	23,383	23,383	23,383	23,383
Adj. R ²	0.472	0.474	0.399	0.401	0.468	0.481	0.402	0.409

- Each unit refers to a state-industry.

Dynamic Effects of DBN Laws on M&As

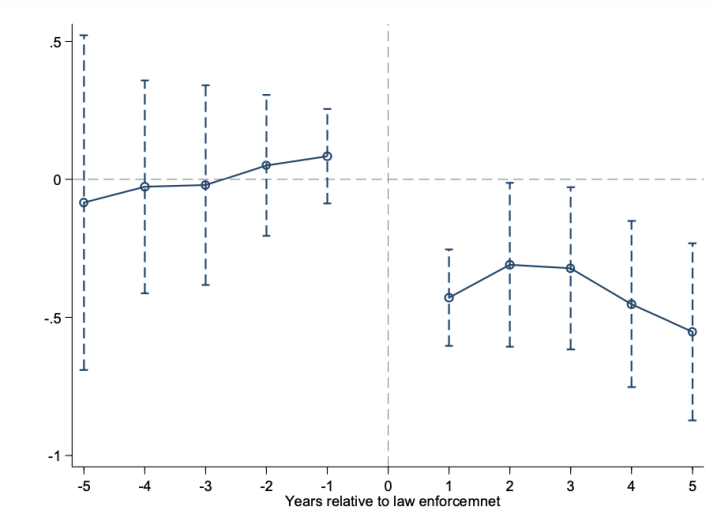
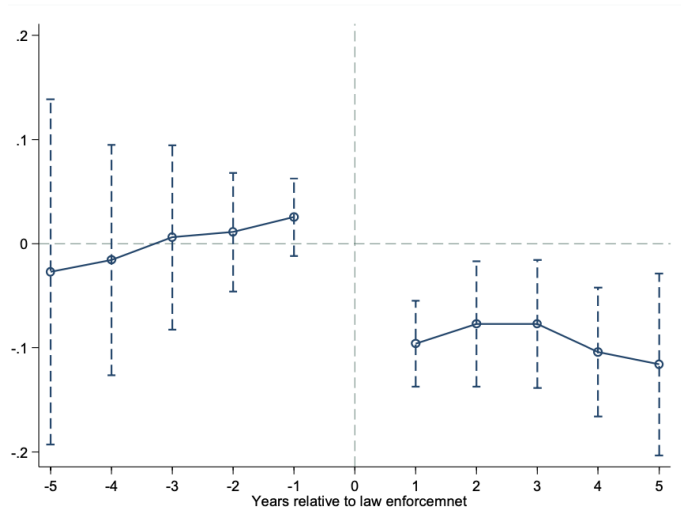
- We use the same specification with the exception of replacing *DBN Laws* with $\sum_{t=-5}^{t=+5} DBNLaws$. That is, a 10-year window spanning from 5 years before to 5 years after the enforcement year is used in the estimation.
- The years when the laws are enforced are excluded and serve as the benchmark. The dashed lines indicate the estimation for 95% confidence interval.

(1) Acquirers from Enforcing States



Dynamic Effects of DBN Laws on M&As

(2) Acquirers from Non-Enforcing States



DBN Laws and M&As: Differentiate by Cyber Security

- We further estimate how the number and dollar value of M&A transactions change after the enactment of data breach laws in the targets' state among high vs. low cyber risk industries.
- Following Kamiya et al., (2019), we classify industries with SIC code between 7000-8999 (Services) or 6000-6700 (Finance, Insurance, and Real Estate) as industries with a high risk of data breaches.

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	<i>Log[1+ Total Number]</i>		<i>Log[1+Total Dollar Value]</i>		<i>Log[1+ Total Number]</i>		<i>Log[1+Total Dollar Value]</i>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>DBN Laws</i> × <i>Cyber Risk</i>	0.219*** (0.021)	0.222*** (0.021)	0.774*** (0.099)	0.782*** (0.099)	-0.209*** (0.018)	-0.211*** (0.018)	-0.682*** (0.076)	-0.689*** (0.074)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,383	23,383	23,383	23,383	23,383	23,383	23,383	23,383
Adj. R ²	0.501	0.502	0.420	0.421	0.507	0.515	0.430	0.434

DBN Laws and M&As: Alternative Differentiators

- In Panel A, we measure industry-specific technology intensity based on the growth of R&D expenses (Hsu, Tian, and Xu 2014). *High Tech* indicates whether an industry has a technology intensity score that is above the sample median value.
- In Panel B, *Intangibility* equals the amount of intangible assets as a proportion of total sales. We set *Intangibility* as one if an industry has a score that is above the sample median value.

Panel A: Differentiate by Technology

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	Log[1+ Total Number]		Log[1+Total Dollar Value]		Log[1+ Total Number]		Log[1+Total Dollar Value]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>DBN Laws</i> × <i>High Tech</i>	0.119*** (0.023)	0.115*** (0.025)	0.484*** (0.107)	0.452*** (0.109)	-0.178*** (0.023)	-0.156*** (0.022)	-0.534*** (0.088)	-0.465*** (0.088)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,383	23,383	23,383	23,383	23,383	23,383	23,383	23,383
Adj. R ²	0.495	0.495	0.417	0.418	0.506	0.512	0.428	0.432

Panel B: Differentiate by Intangibility

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	Log[1+ Total Number]		Log[1+Total Dollar Value]		Log[1+ Total Number]		Log[1+Total Dollar Value]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>DBN Laws</i> × <i>Intangibility</i>	0.118*** (0.018)	0.115*** (0.018)	0.587*** (0.072)	0.571*** (0.071)	-0.191*** (0.021)	-0.179*** (0.020)	-0.705*** (0.079)	-0.668*** (0.077)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,383	23,383	23,383	23,383	23,383	23,383	23,383	23,383
Adj. R ²	0.495	0.495	0.418	0.419	0.506	0.513	0.431	0.434

Heterogeneous Effects of DBN Laws on M&As, Market Competition

- We test the heterogeneous effects of the data breach laws on M&A activities, while differentiating by market competition. We use HHI for assets to measure market competition and partition the sample by HHI score.

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	Log[1+ Total Number]		Log[1+Total Dollar Value]		Log[1+ Total Number]		Log[1+Total Dollar Value]	
	(1) High	(2) Low	(3) High	(4) Low	(5) High	(6) Low	(7) High	(8) Low
<i>DBN Laws × Cyber Risk</i>	0.232*** (0.030)	0.184*** (0.034)	0.768*** (0.127)	0.647*** (0.141)	-0.257*** (0.028)	-0.107*** (0.026)	-0.733*** (0.105)	-0.446*** (0.123)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,911	11,472	11,911	11,472	11,911	11,472	11,911	11,472
Adj. R ²	0.552	0.403	0.466	0.329	0.594	0.408	0.506	0.330
Diff t-test (P-value)	(0.254)		(0.450)		(0.001)		(0.078)	

Heterogeneous Effects of DBN Laws on M&As, Data Intensity

- We test the heterogeneous effects of the data breach laws on M&A activities, while differentiating by data intensity.
- *Data Intensive* is an indicator variable that equals one if the data intensity score of industry i is above the sample median, and zero otherwise. a

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	Log[1+ Total Number]		Log[1+ Total Dollar Value]		Log[1+ Total Number]		Log[1+ Total Dollar Value]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Data Intensive	Non-Intensive	Data Intensive	Non-Intensive	Data Intensive	Non-Intensive	Data Intensive	Non-Intensive
<i>DBN Laws</i> × <i>Cyber Risk</i>	0.270*** (0.026)	0.193*** (0.033)	1.102*** (0.115)	0.532*** (0.143)	-0.317*** (0.026)	-0.127*** (0.031)	-0.989*** (0.097)	-0.482*** (0.121)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,906	11,477	11,906	11,477	11,906	11,477	11,906	11,477
Adj. R ²	0.471	0.526	0.379	0.452	0.483	0.547	0.391	0.467
Diff t-test (P-value)	(0.065)		(0.001)		(0.000)		(0.002)	

DBN Laws and the Likelihood of Becoming Targets

- We focus on deals that have both public-listed targets and public-listed acquirers.
- For each deal, we assign each actual target with five potential targets using nn matching method for the firm size in a same industry-year.

Dep. Var	<i>Target (0/1)</i>			
	Acquirers from Enforcing States		Acquirers from Non-enforcing States	
	(1)	(2)	(3)	(4)
<i>DBN Laws</i> × <i>Cyber Risk</i>	0.186*** (0.053)	0.193*** (0.051)	-0.147** (0.063)	-0.142** (0.062)
<i>Firm Size</i>		-0.073 (0.061)		0.028 (0.029)
<i>Leverage</i>		-0.003 (0.054)		0.005 (0.045)
<i>B/M</i>		0.036*** (0.009)		0.003 (0.009)
<i>Sales Growth</i>		-0.035*** (0.010)		-0.004 (0.010)
<i>ROA</i>		-0.043 (0.046)		-0.069 (0.042)
<i>R&D</i>		0.042*** (0.007)		0.020* (0.012)
Deal FE	Yes	Yes	Yes	Yes
Unit FE	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes
Observations	5,150	5,150	5,443	5,443
Actual Targets	928	928	894	894
Matched (Industry, Size) Targets	4,222	4,222	4,549	4,549
Adj. R ²	0.324	0.333	0.341	0.344

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Conclusions

- Motivated by the increasing importance of data in recent business models, we investigate whether target companies' data security affects the intensity of M&A transactions by exploiting the staggered adoption of DBN Laws across U.S. states.
- We find that the intensity and likelihood of M&As increase (decrease) in states of targets after DBN law was adopted, when acquirers are from a state with (without) DBN Law in place. The increase of M&As was contributed by the mitigation of data lemon problems as a result of enhanced cyber security. The decrease of M&As was due to higher costs associated with potential data breaches. The effects are stronger among industries that are more competitive and data intensive.
- Our findings highlight the importance of cybersecurity in the era of big data and digital economy.

Thank you for your attention
All comments are welcome