

Introduction

In the current era of big data, data has become a core asset for many companies, and is increasingly acquired through M&As. The transaction of data through M&As involves a “data lemon” problem for acquirers (Chatterjee and Sokol 2019). Anecdotal evidence suggests that data breaches become more common in practice and acquirers increasingly take into account the costs of targets’ data breaches.

In this paper, we provide systematic evidence on how target companies’ cybersecurity affect M&A transactions. To our knowledge, this is the first paper studying how cyber risk affects corporate acquisition decisions.

We exploit the staggered adoption of Data Breach Notification Laws (DBN Laws) across U.S. states. Specifically, the DBN laws stipulate that when a data breach that involves a breach of sensitive personal information occurs, a company that acquires or uses the information must notify affected individuals and regulatory agencies about the breach in a timely manner. Companies that fail to comply with the notification requirements mandated by the laws are subject to penalties.

1. For acquirers in states without data breach laws in place: 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. In this regard, the enactment of the laws will suppress M&As activities.

2. For acquirers in states with data breach laws in place: They concern more about data lemon problems. For one thing, 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. More importantly, the laws also rise a deterrence effect. 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.

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.

Table 1. Timing of Data Breach Laws and Preexisting M&As: Hazard Model

	(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

Data Breach Laws and M&A Intensity, Baseline

We conduct our core analyses at the state-industry-year level, using a panel dataset of state-industries (i.e., the units) over the period from 1998 to 2018. For each industry i in state s in a year t , we compute (a) the total number of all M&A deals with target firms in industry i from state s , (b) the total dollar value of all deals with target firms in industry i from state s

Table 2. 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> (1)	<i>Log[1+ Total Dollar Value]</i> (2)	<i>Log[1+ Total Number]</i> (3)	<i>Log[1+ Total Dollar Value]</i> (4)	<i>Log[1+ Total Number]</i> (5)	<i>Log[1+ Total Dollar Value]</i> (6)	<i>Log[1+ Total Number]</i> (7)	<i>Log[1+ Total Dollar Value]</i> (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)
<i>Asset Turnover</i>		-0.011 (0.009)		-0.066 (0.045)		0.003 (0.009)		0.024 (0.039)
<i>Market Leverage</i>		-0.006 (0.034)		0.007 (0.163)		-0.113*** (0.034)		-0.460*** (0.131)
<i>Book to Market</i>		-0.000 (0.003)		0.006 (0.013)		-0.010*** (0.003)		-0.042*** (0.013)
<i>Sales Growth</i>		-0.002 (0.006)		-0.011 (0.025)		0.008 (0.006)		0.006 (0.030)
<i>R&D</i>		0.020*** (0.007)		0.096*** (0.031)		-0.035*** (0.010)		-0.116*** (0.039)
<i>ROA</i>		-0.015** (0.007)		-0.054** (0.024)		0.014*** (0.004)		0.045** (0.018)
<i>Sales Margins</i>		0.000 (0.001)		-0.001 (0.005)		0.001 (0.001)		0.005 (0.005)
<i>Log[# of Listed Firms]</i>		-0.085*** (0.019)		-0.475*** (0.086)		0.252*** (0.022)		0.828*** (0.077)
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

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.

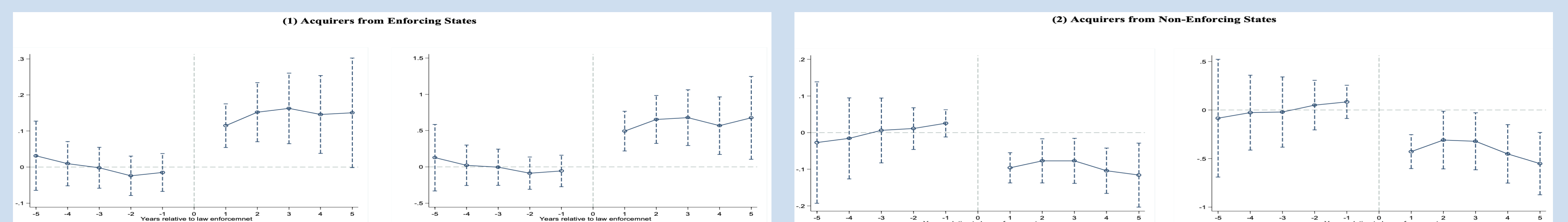


Figure 1. Dynamic Effects of DBN Laws on M&As

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.

Table 3. DBN Laws and M&As: Differentiate by Cyber Security

Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	<i>Log[1+ Total Number]</i> (1)	<i>Log[1+ Total Dollar Value]</i> (2)	<i>Log[1+ Total Number]</i> (3)	<i>Log[1+ Total Dollar Value]</i> (4)	<i>Log[1+ Total Number]</i> (5)	<i>Log[1+ Total Dollar Value]</i> (6)	<i>Log[1+ Total Number]</i> (7)	<i>Log[1+ Total Dollar Value]</i> (8)
<i>DBN Laws × 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

Table 4. DBN Laws and M&As: Alternative Differentiators

Panel A: Differentiate by Technology								
Dep. Var	Acquirers from Enforcing States				Acquirers from Non-enforcing States			
	<i>Log[1+ Total Number]</i> (1)	<i>Log[1+ Total Dollar Value]</i> (2)	<i>Log[1+ Total Number]</i> (3)	<i>Log[1+ Total Dollar Value]</i> (4)	<i>Log[1+ Total Number]</i> (5)	<i>Log[1+ Total Dollar Value]</i> (6)	<i>Log[1+ Total Number]</i> (7)	<i>Log[1+ Total Dollar Value]</i> (8)
<i>DBN Laws × 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			
	<i>Log[1+ Total Number]</i> (1)	<i>Log[1+ Total Dollar Value]</i> (2)	<i>Log[1+ Total Number]</i> (3)	<i>Log[1+ Total Dollar Value]</i> (4)	<i>Log[1+ Total Number]</i> (5)	<i>Log[1+ Total Dollar Value]</i> (6)	<i>Log[1+ Total Number]</i> (7)	<i>Log[1+ Total Dollar Value]</i> (8)
<i>DBN Laws × 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

We measure industry-specific technology intensity based on the growth of R&D expenses (Hsu, Tian, and Xu 2014). Intangibility equals the amount of intangible assets as a proportion of total sales.

Heterogeneous Effects of Data Breach Laws on M&As

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. **Table 5.** Heterogeneous Effects of DBN Laws on M&As, Market Competition

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)	

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. The data intensity score equals the proportion of firms with data-related keywords (e.g., “customer data”, “consumer data”, “personal data”, “data security”, or “data protection”) in 10-K filings in each industry-year, averaged over the sample period from 1998 through 2018.

Table 6. Heterogeneous Effects of DBN Laws on M&As, Data Intensity

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) Data Intensive	(2) Non-Intensive	(3) Data Intensive	(4) Non-Intensive	(5) Data Intensive	(6) Non-Intensive	(7) Data Intensive	(8) Non-Intensive
<i>DBN Laws × 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)	

Likelihood of Being 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.

The dependent variable, *Target*, is a dummy variable that equals one if a firm becomes a target in a year, and zero for matched targets that from control groups.

Table 7. DBN Laws and the Likelihood of Becoming Targets

Dep. Var	Target (0/1)			
	Acquirers from Enforcing States		Acquirers from Non-enforcing States	
	(1)	(2)	(3)	(4)
<i>DBN Laws × 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

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. 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. Overall, our findings highlight the importance of cybersecurity in the era of big data and digital economy.