RegTech

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What is RegTech?

Perhaps the most understudied aspect of fintech

"Technology to improve the way businesses manage regulatory compliance"

- More broadly, helps managers keep track of data to gain visibility of the firm's operations
  - Applications: Risk management, regulatory reporting, capital requirements, consumer protection…

Compliance at public FIs:

- 2019: $10B on RegTech investments vs. $2.2B on auditing
- RegTech expenditures forecast to grow 35% per year (Juniper 2021)
- Tech is advancing, and little sign of major deregulation on horizon!!

Our Paper

Research questions:

1. How does regulation affect technology adoption?

   what factors influence what type of technology is adopted?

2. How does technology adoption affect operations and market structure (Philippon 2016)?

Problem: typically difficult to exogenize technology decisions

Setting: Rule 17a-5 Amendment

<u>What we do:</u>

Study 2014 amendments to Rule 17a-5 affecting certain broker-dealers (BDs)

- Follows large Ponzi schemes (Madoff, Allen Stanford) and bankruptcies (MF Global)

If a carrying broker, management must attest to internal controls over compliance with Financial Responsibility Rules

- Customer asset segregation
- Required capital
  - <u>Moment-to-moment compliance</u> (i.e., not just end of reporting period, as with banks, insurers)
- PCAOB-registered auditors must attest to operating effectiveness of controls

Came into effect <u>for carrying BDs</u> with FY ending June 2014 and thereafter

- But, non-carrying (unaffected firms) observable
- Carrying brokers are basically the same from the perspective of the customer and offer very similar services

Our Findings

1. How does regulation affect technology adoption?
   a) Direct: higher IT budgets, more servers and computers, Enterprise Resource Planning, and data mgt software to comply with Rule 17a-5
   b) Indirect: customer relations mgt and business intelligence software <u>unrelated</u> to compliance
      - Non-compliance investments relying upon info systems ("sunk cost" and data as a non-rivalrous good)

2. How does technology adoption affect operations and market structure?
   a) Fewer customer complaints and lower alleged damages
      - Especially in complaints detectable by technological monitoring
   b) More labor market concentration

Literature

- Why individuals and organizations adopt technology
  - Crouzet, Gupta, Mezzanotti (2022), Higgins (2022), Mishra, Prabhala, Rajan (2021)
  - Voluminous banking literature studying implications of tech

- What are the drivers of financial misconduct?
  - Egan, Matvos Seru (2019), Charoenwong, Kwan, Umar (2019), Kowaleski, Sutherland, Vetter (2019)

- SOX and internal audit
  - There is a large, large literature here.

Tech Adoption: Direct Channel

Before the amendment:

- **Deloitte**: Many BDs used "systems and technology that have been built in-house many years ago. These systems and reports may not have undergone periodic testing and as a result, [BDs] have found it difficult to provide report logic details and report parameters to their auditors for testing"

After the amendment:

- **EY**: BDs began to "invest in shoring up technology or data architecture to alleviate data-related concerns, including rationalizing data sources and centralizing data into a single data source… [thus establishing] increased accuracy and completeness of source data"

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Research Design

$$y_{i,t} = \alpha_i + \alpha_{f(i,t),t} + \beta Post_t \times Treated_i + \Gamma' X_{i,t} + \varepsilon_{i,t}$$

where i is firm, t is year, $f(i,t)$ is firm i's FINRA district

Main outcome variables (IHS):

– Software and hardware investments

– Labor demand for tech workers

– Customer complaints

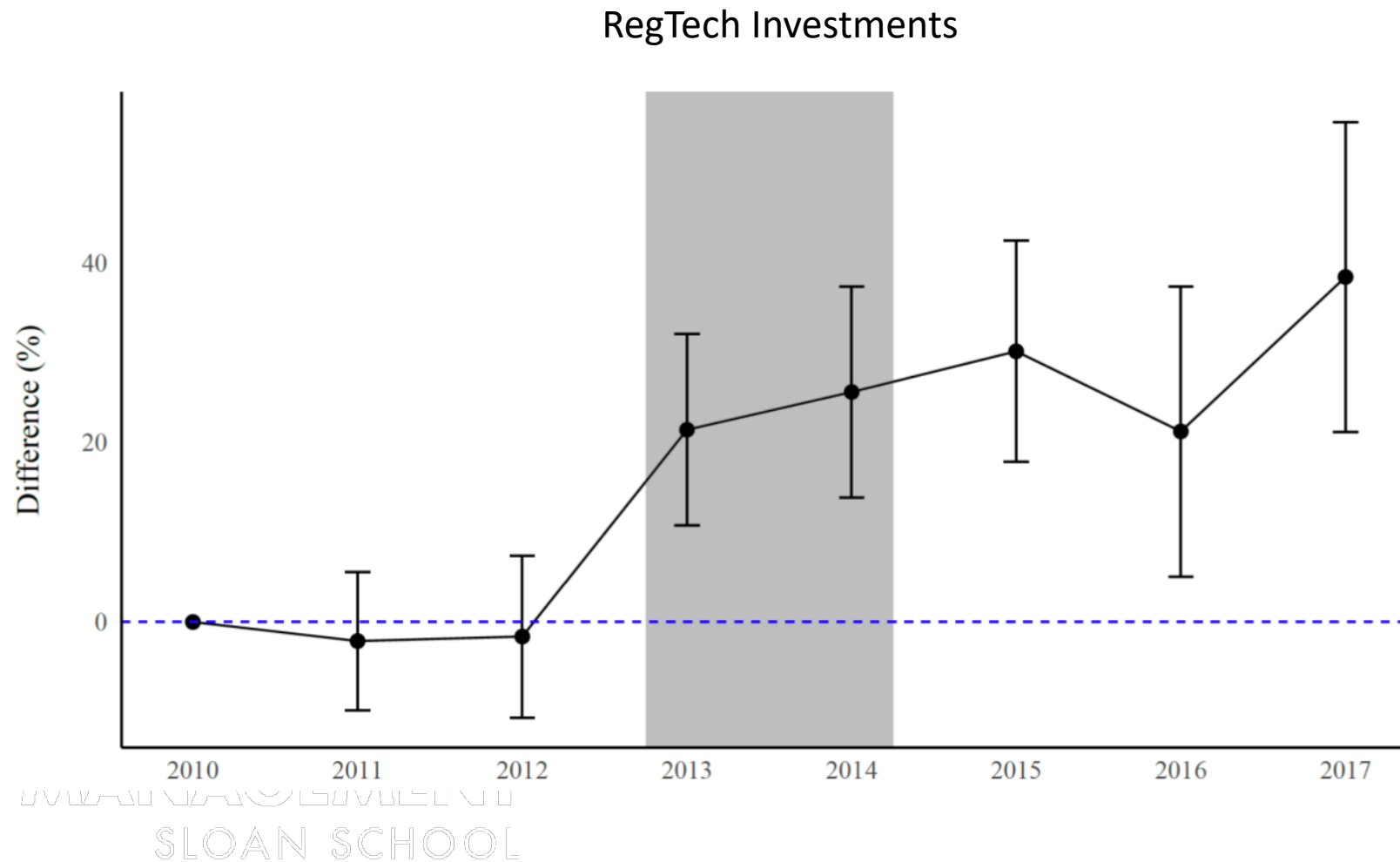Post=1 starting in 2013; Treated=1 for carrying BDs

FEs: BD Firm and FINRA district x year.

Cluster std errors by BD firm

$X_{i,t}$: controls for size (assets and headcount) and employee traits (tenure and complaint history), linear trends for investments advisers

Tech Adoption in Event Time

RegTech Investments

Tech Adoption: Direct Channel (Software/Hardware)

Dep Var:	ERP	Data Management	RegTech
	(1)	(2)	(3)
Treated × Post	30.965***	17.760**	24.029**
	(9.212)	(8.770)	(9.603)
N	5,288	5,288	5,288
R^2	0.685	0.846	0.859
Mean Dep Var	46.9	104.4	121.5
SD Dep Var	90.1	127.5	137.4

Panel A: Intensive + Extensive Margins

Tech Adoption: Direct Channel(Budgets)

Panel A: Hardware Investments. IT Budget, and Profitability				
Dep Var:	Servers	PCs & Laptops	IT Budget	Profitability
	(1)	(2)	(3)	(4)
Treated × Post	39.115***	21.282***	39.824***	-4.674*
	(6.787)	(5.432)	(9.002)	(2.833)
N	11,352	11,352	11,352	8,760
R^2	0.926	0.954	0.897	0.716
Mean Dep Var	276.2	468.9	1,395.7	105.5
SD Dep Var	215.5	203.5	238.8	178.1

Tech Adoption: Indirect Channel
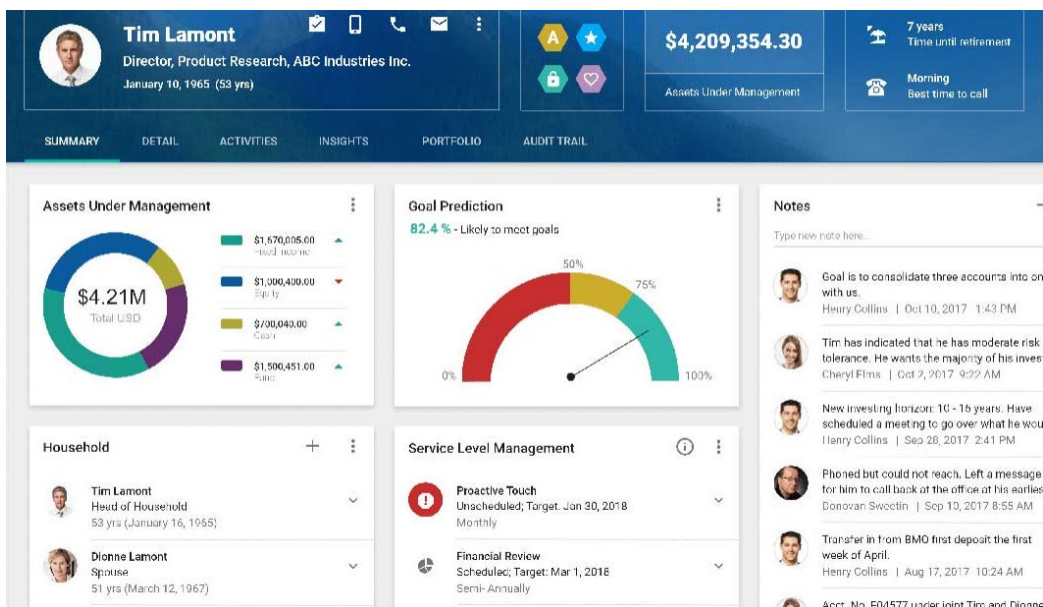
Tools: Portfolio analytics, profitability analysis, transaction monitoring, etc.

BUT: rely on first having underlying data and reporting infrastructure!
- Improving infrastructure for portfolio analysis, etc. <u>alone</u> is NPV<0
- RegTech infrastructure investment (sunk) renders NPV>0
  - <u>Non-rivalrous property</u> of data and IT systems

Tech Adoption: Indirect Channel

Website technologies… each relying on underlying data/info systems:

- ThreatMetrix: real-time fraud detection and transaction security
- Pardot: automates marketing and sales engagement
- goMoxie: allows live chat between the customer and BD

	Panel B: Complementary Investment		
Dep Var:	Document Communication Management	CRM Technologies	Premium Website Technologies
	(1)	(2)	(3)
Treated × Post	12.558***	27.189***	29.911***
	(5.559)	(5.726)	(5.862)
N	5,288	12,827	12,827
R²	0.835	0.780	0.787
Mean Dep Var	74.0	86.3	71.7
SD Dep Var	92.9	81.2	85.1

Tech Adoption: Indirect Channel (Placebo)

Panel C: Placebo

Dep Var:	Anti-Virus	Other Tech
	(1)	(2)
Treated × Post	4.550	-3.181
	(5.074)	(7.663)
N	5,288	5,288
R^2	0.873	0.892
Mean Dep Var	89.7	408.8
SD Dep Var	89.9	151.2

Consequences of Tech Adoption
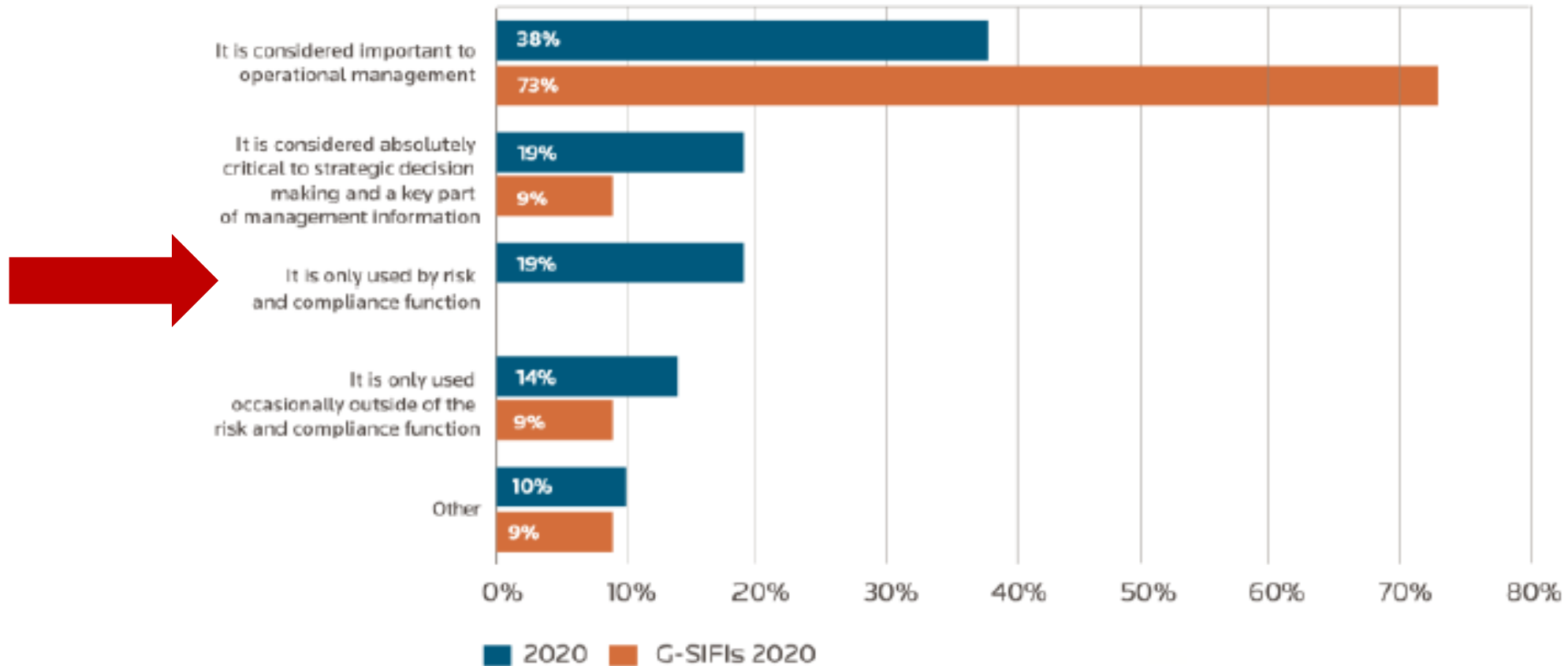
Source: Thomson Reuters Regulatory Intelligence: Fintech, Regtech and the Role of Compliance in 2021, by Susannah Hammond and Mike Cowan

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Consequences of Tech Adoption

"Tools could also assist in reducing the number of false alerts, thereby freeing up staff time to focus on alerts that warrant escalation… One firm noted that false alerts of its employee surveillance system were reduced by 80% after the adoption of a [software] tool. Such tools have the potential to result in cost efficiencies, increase productivity and focus resources on heightened areas of risk"
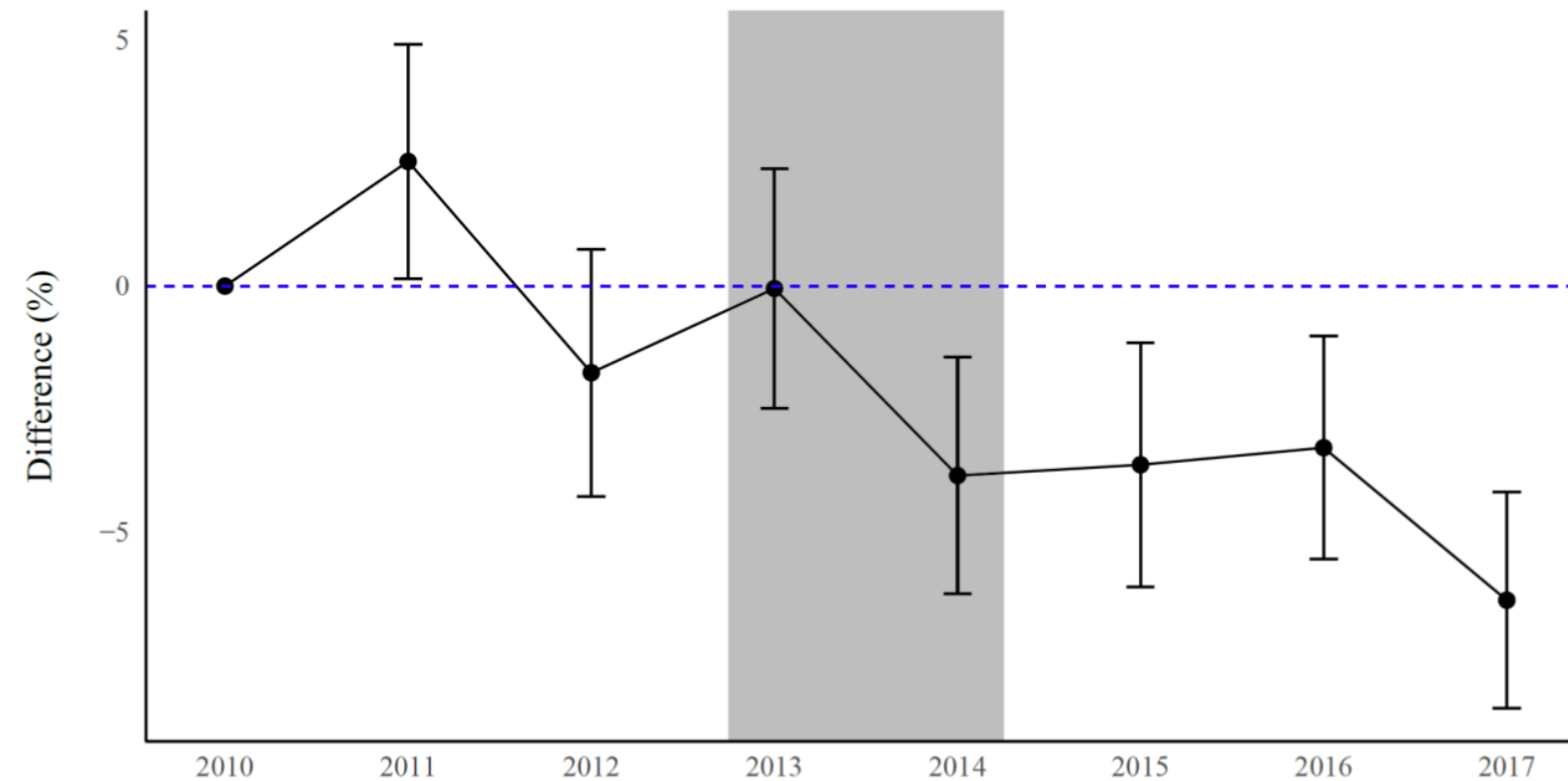
Our technology helps BDs "identify bad actors quickly and accurately, preventing massive fines and company-debilitating crises"

Consequences of Tech Adoption: Complaints Decline

Panel B: Complaint Probability

Consequences of Tech Adoption: Complaints Decline

			Panel A: OLS		
Dep Var:	Complaint	*f*(Complaints)	Misconduct	*f*(Misconduct)	Complaint >\$5000 Damages
	(1)	(2)	(3)	(4)	(5)
Treated × Post	-4.393***	-9.545***	-3.386**	-9.617***	-4.465***
	(1.319)	(2.721)	(1.693)	(3.723)	(1.380)
N	26,871	26,871	26,871	26,871	26,871
R^2	0.682	0.859	0.786	0.925	0.679
Mean Dep Var	10.1	86.3	10.0	18.6	9.2
SD Dep Var	30.1	81.2	30.0	63.0	28.9

Consequences of Tech Adoption: Complaints Decline

IV analysis: complaint declines coming through RegTech investments

Cross-section:
- Stronger for firms which serve retail customers
- Weaker effect when the company already had a chief compliance officer

Robustness: CEM, size and product specific trends, regulator/auditor attention, dropping bank affiliated BDs…

Cost/Benefit of Tech Adoption

Implied savings from complaint decline: ~$60,000 for the average carrying BD

Estimated Cost: $1M-$10M (Momoh 2015; ERP pricing guides)

- Other considerations: reputation penalty, damages skew, indirect costs…

- Gains from fewer complaints alone do not justify broad data investment
  - BDs have incentives to get this tradeoff right
  - Supports complementarity interpretation

Implications: Concentration

1. Fixed costs are easier to bear for large competitors
   - SEC Comment letters: "The costs could disproportionately impact smaller broker-dealers due to the fixed cost components"

2. Large FI business model relies on hard information (Stein 2002)

3. Scale/network effects (Begenau, Farboodi, Veldkamp 2018)
   - Data is more valuable to larger FIs (cross-selling, analytics)
   - Greater scale enables firms to increase these relatively fixed investments and returns on those investments can increase significantly when they support a larger number of advisors and assets under management… in one of (our) most recent surveys, technology was tied for the top spot among the factors most frequently cited by advisors as influencing their decision to join a BD."

Conclusion

Regulation compels technology adoption…

- Direct: sweeping internal information process improvements aimed at compliance
- Indirect: alters NPV of employee and customer monitoring tools that rely on internal information processes (complementary investment)

Leads to…

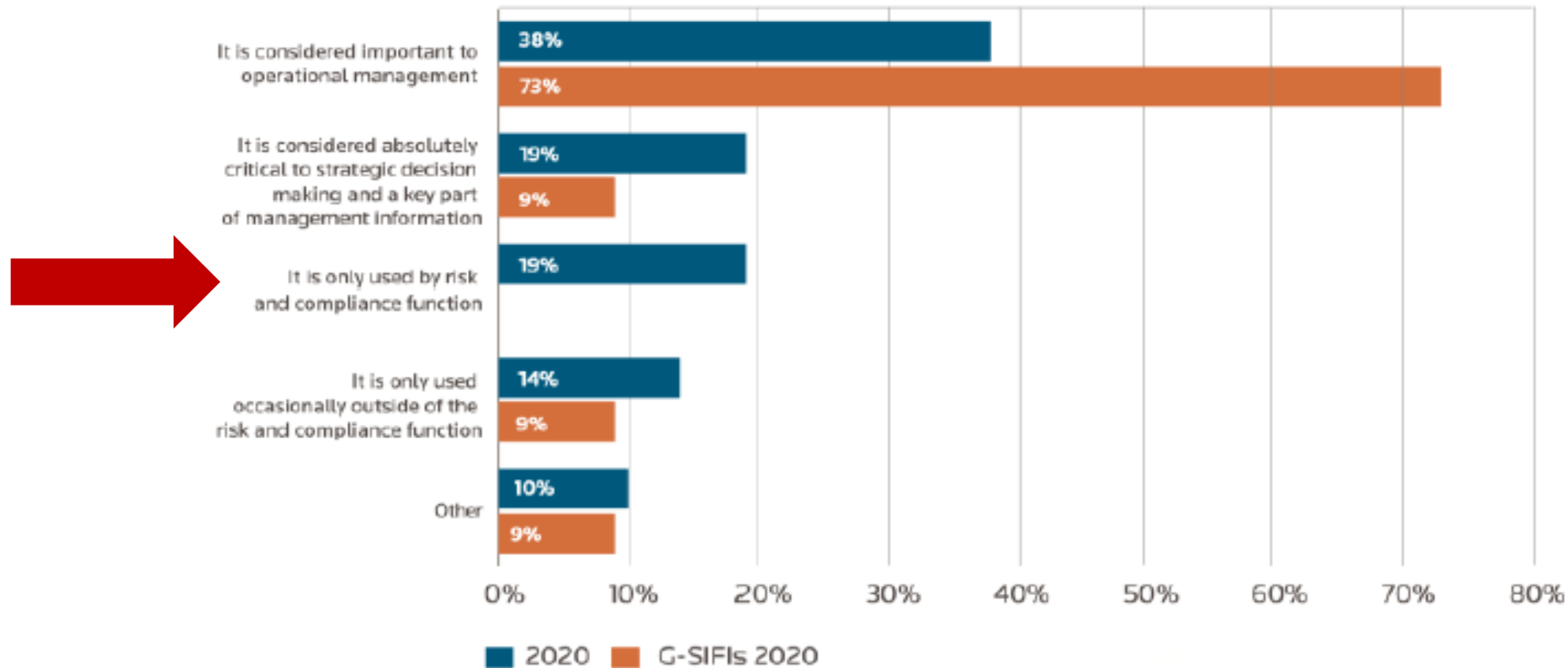- Fewer complaints and lower alleged damages
- More market concentration

RegTech implications…

- Strengthens link between compliance and non-compliance functions
- Role for tech in investor protection
- Given fixed costs and scalable benefits, favors large FIs?

Thank You!

How is RegTech Used? Survey Evidence

Source: Thomson Reuters Regulatory Intelligence: Fintech, Regtech and the Role of Compliance in 2021, by Susannah Hammond and Mike Cowan
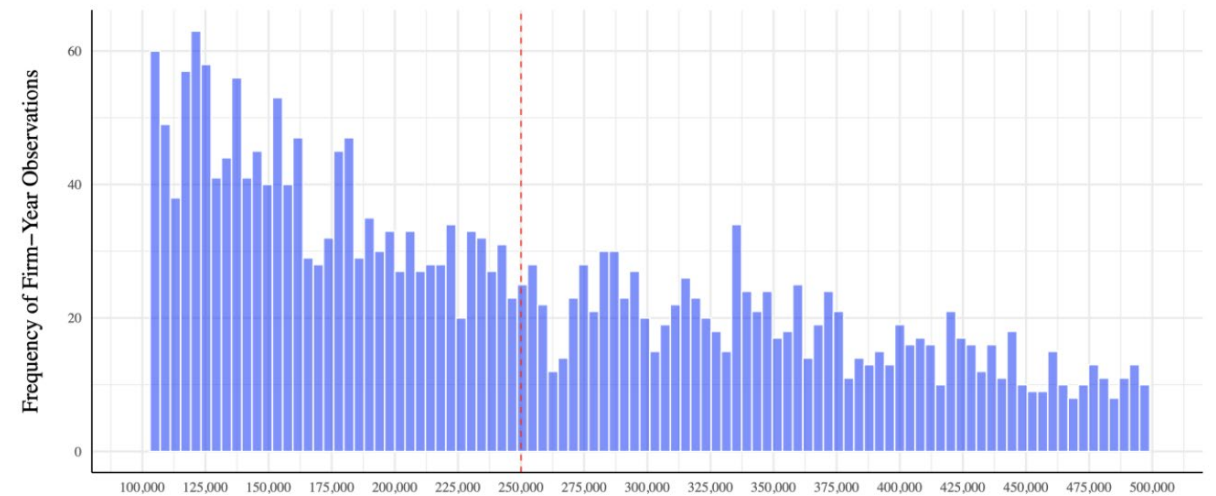
SLOAN SCHOOL

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Avoidance?

Histogram of Firm-level Net Capital – Pre Period (From 2010 Until 2014) and Histogram of Firm-level Net Capital – Post Period (From 2015 Until 2018)
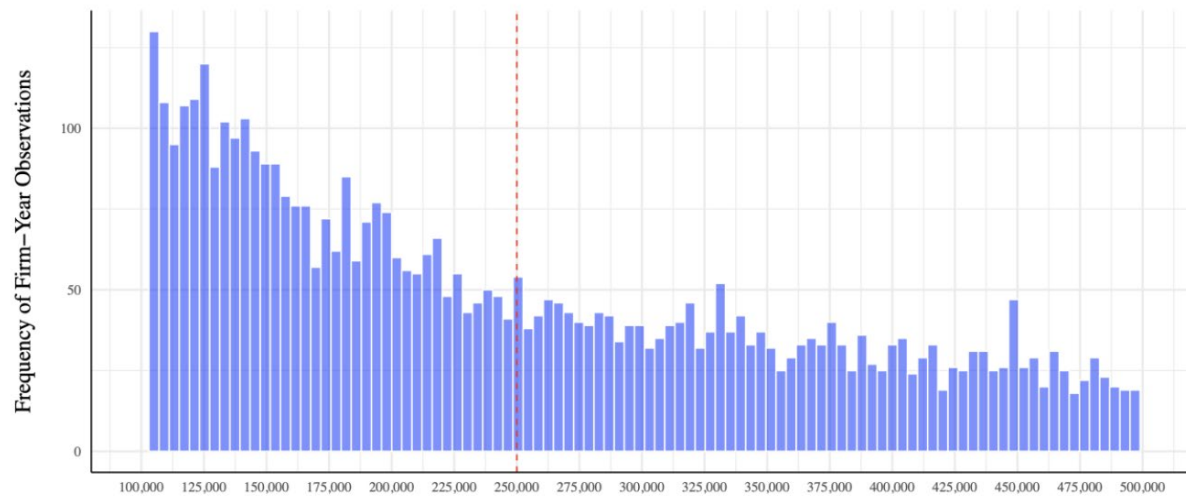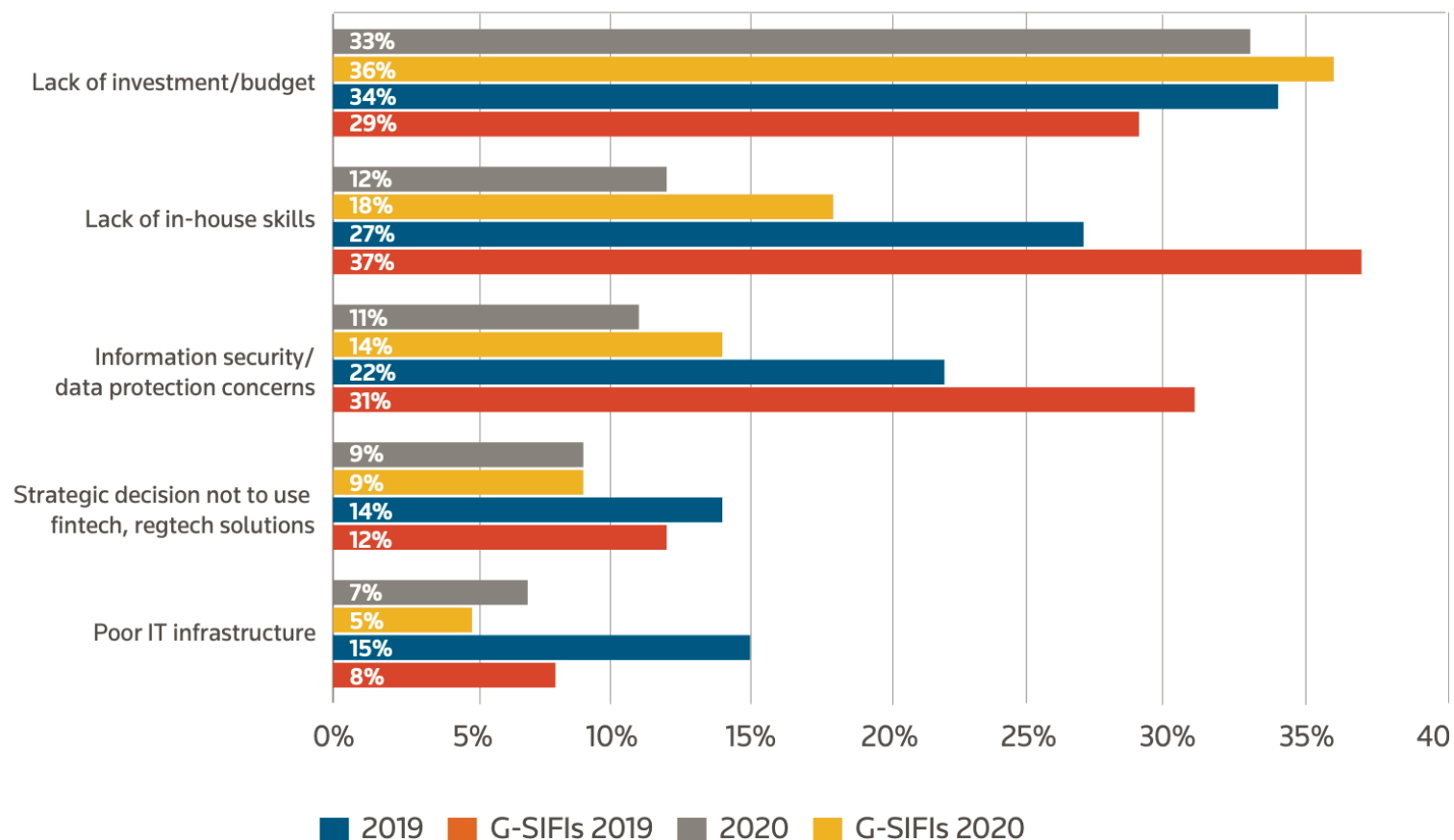
Carrying vs. Non-Carrying

Company	Assets (billions)	Carrying?
Goldman Sachs & Co	$501	Yes
JP Morgan Securities	$390	No
Morgan Stanley	$369	No
Barclays Capital	$309	Yes
Credit Suisse Securities	$292	Yes
Citigroup Global Markets	$253	No
Deutsche Bank Securities	$240	Yes
UBS Securities	$150	Yes
RBS Securities	$129	No
Mizuho Securities	$54	No

What Prevents RegTech Adoption?

If your firm has not yet deployed fintech or regtech solutions, what is holding you back?

Lack of investment/budget
- 33% (2020)
- 36% (G-SIFIs 2020)
- 34% (2019)
- 29% (G-SIFIs 2019)

Lack of in-house skills
- 12% (2020)
- 18% (G-SIFIs 2020)
- 27% (2019)
- 37% (G-SIFIs 2019)

Information security/data protection concerns
- 11% (2020)
- 14% (G-SIFIs 2020)
- 22% (2019)
- 31% (G-SIFIs 2019)

Strategic decision not to use fintech, regtech solutions
- 9% (2020)
- 9% (G-SIFIs 2020)
- 14% (2019)
- 12% (G-SIFIs 2019)

Poor IT infrastructure
- 7% (2020)
- 5% (G-SIFIs 2020)
- 15% (2019)
- 8% (G-SIFIs 2019)

Legend: ■ 2019 ■ G-SIFIs 2019 ■ 2020 ■ G-SIFIs 2020

Source: Thomson Reuters Regulatory Intelligence: Fintech, Regtech and the Role of Compliance in 2021, by Susannah Hammond and Mike Cowa

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Data Source
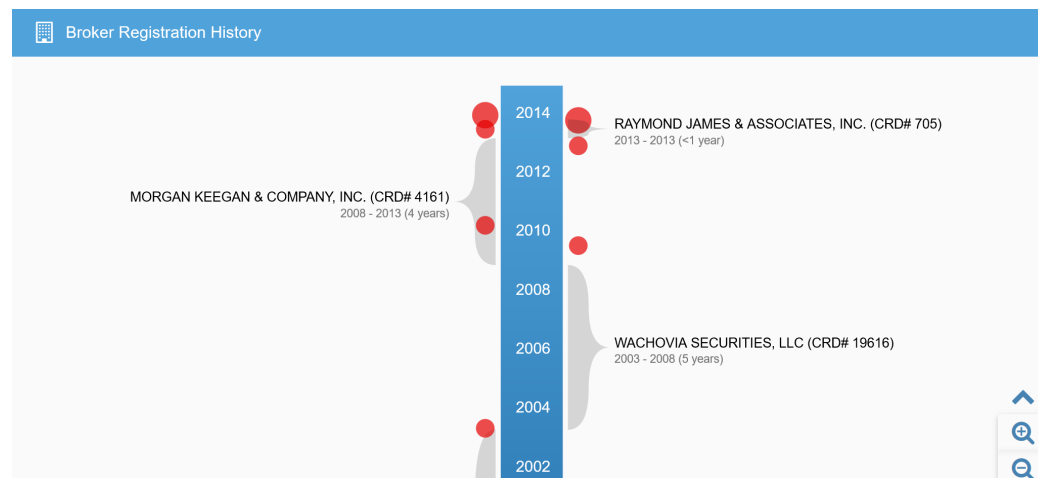
Complaint Examples

"Client alleges that the rep did not properly inform her of the market risk involved in variable annuities and mutual funds"

"Customer alleged the advisor misrepresented the features of a variable annuity purchased in May 2014"

"The allegations were unauthorized trading, breach of fiduciary duty, churning, and negligence"

"[Rep] had entered into a secret agreement that the manager would forward to him substantially all of the commissions from the entity's bond trading, which netted him approximately $1.1 million. This commission arrangement and the resulting material conflict of interest were not disclosed to the entity's clients"

Summary Stats: Firm Characteristics

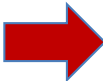| Variable	Mean	SD	P25	Median	P75
Firm Characteristics:					
Total Assets (1000's)	1,120,000	15,500,000	152	707	5,010
Total Net Capital (1000's)	593,000	85,700,000	61.2	298	1,930
Treated	0.054	0.227	0.000	0.000	0.000
Post	0.344	0.475	0.000	0.000	1.00
Lag Num. Employees	145	994	4	10	34
Lag Avg. Tenure (years)	6.14	5.43	2.40	4.88	8.01
Fraction of Employees with Complaint History	0.042	0.100	0.000	0.000	0.030
Affirmer is High-Ranking	0.503	0.500	0.000	1.00	1.00
Affirmer is the CCO	0.043	0.202	0.000	0.000	0.00
Complaint Measures:					
1(Complaints > 0)	0.021	0.142	0.000	0.000	0.000
f(Num. Complaints)	0.035	0.284	0.000	0.000	0.000
Num. Complaints	0.132	3.375	0.000	0.000	0.000
Alleged Damages	108,000	10,400,000	0.000	0.000	0.000

Summary Stats: RegTech and Complementary Investments

Panel B: RegTech Investments					
Aberdeen Software:					
Data Management	1.042	2.150	0	0	1
Enterprise Resource Planning	0.648	2.831	0	0	3
Aberdeen Hardware:					
Servers	241	1,590	2	4	24
PCs & Laptops	382	2,370	11	25	97
IT Budget (1000's)	13,000	94,800	90	290	1,600
BGT Skill Demand:					
Compliance	1.25	10.1	0	0	0
Enterprise Resource Planning	0.043	0.420	0	0	0
Panel C: Complementary and Placebo Investments					
Aberdeen Software:					
Customer Relationship Management	1.80	5.35	0	0	1
Business Intelligence	1.48	3.58	0	0	1
Anti-Virus	2.03	3.56	0	1	3
Other Technologies	84.1	122	16	34	99
BuiltWith Website Technologies:					
Technologies	26.7	26.0	10	20	34
Premium Technologies	2.03	3.26	0	1	2

RegTech Response

1. Complementary Investments: Bundling

Dep Var:	CRM or Business Intelligence Software	Website Technologies	Website Technologies
	(1)	(2)	(3)
RegTech Software	0.300***		
	(0.032)		
High PC/ IT Budget or Software		5.355***	
		(1.561)	
CRM			39.780***
			(11.200)
N	4,415	10,114	4,112
R^2	0.859	0.525	0.782
Mean Dep Var	0.584	23.2	36.5
SD Dep Var	0.493	38.8	43.4

Dodd-Frank

	1(Complaint>0)	f(Num. Complaints)	1(Complaint>0)	f(Num. Complaints)	1(Complaint>0)	f(Num. Complaints)
	(1)	(2)	(3)	(4)	(5)	(6)
Treated × Post	-2.109**	-4.400**	-2.413***	-4.701**	-1.102*	-2.027*
	(0.913)	(2.487)	(0.926)	(2.352)	(0.563)	(1.083)
Sample	Year>=2012		Exclude Dual-Registered		Exclude Conflicted Broker-Dealers	
N	19,337	19,337	26,079	26,079	25,185	25,185
R^2	0.606	0.729	0.568	0.685	0.551	0.711

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Software Investments

LHS= #unique programs in given software category. Examples:

- Data Management: Oracle, Microsoft SQL
- ERP: SAP, Workday Financial Management, Oracle Fusion Cloud ERP
- CRM: HubSpot, Salesforce

Sources:

- Surveys of IT executives re: software usage
- Web-scraping job postings
- Purchase customer lists from software vendors

Aberdeen Buyer Intent Data is Driven By:

39,998,968,000
INTENT SIGNALS / MONTH

405,295,000
DEVICES / MONTH

1,844,000
COMPANIES / MONTH

1,844,000
WEBSITES / MONTH

Labor Demand

Burning Glass Technologies

- Scans 40,000+ job boards and corporate websites daily
- Collects, parses, and removes duplicate postings

Identifying Treated BDs

For each BD that reports minimum required Net Capital of $250,000 in all sample years, we check the following: If a BD reports that it "Clears for other BDs," we code *Treated* as one. If not, we only code *Treated* as one when the BD reports that it does not engage in any of the following introducing arrangements:

1) Refers or introduces customers to any other broker or dealer;
2) Has an arrangement with any other person, firm, or organization under which any books or records of applicant are kept or maintained by such other person, firm or organization;
3) Has an arrangement with any other person, firm, or organization under which accounts, funds, or securities of the applicant are held or maintained by such other person, firm, or organization; or
4) Has an arrangement with any other person, firm, or organization under which accounts, funds, or securities of customers of the applicant are held or maintained by such other person, firm or organization.

2. Customer Complaints: Detection

Dep Var:	Easy-to-Detect Complaint	Hard-to-Detect Complaint
	(1)	(2)
Treated × Post	-2.087*	-1.631
	(1.178)	(1.210)
N	26,530	26,530
R^2	0.553	0.539

Keywords for Easy to Detect: "activity" "authori-" "churn" "commission" "excessive" "falsi-" "fee" "fiduciary" "forge" "fraud" "suitability" "theft" "trad-"

2. Customer Complaints: Location and Affirmer

Dep Var:	Complaint Not in HQ	Complaint in HQ	Complaint	
			Affirmer is a Chief Compliance Officer	Affirmer is High Ranking
2011 Affirmer Quality =	(1)	(2)	(3)	(4)
Treated × Post	-2.158**	-0.337	-2.303**	1.112
	(0.890)	(0.258)	(1.002)	(1.168)
Treated × Post × 2011 Affirmer Quality			3.767**	-4.791***
			(1.582)	(1.751)
N	26,530	26,530	22,940	22,940
R^2	0.568	0.207	0.561	0.561

Carrying vs. Non-Carrying BDs

Dep Var:	Complaint			Complaints/ Employees$_{t-1}$ × 100	f(Alleged Damages)	Non-Dismissed Complaint
	(1)	(2)	(3)	(4)	(5)	(6)
Treated × Post	-2.625**		-1.918**	-0.250**	-0.291**	-2.466**
	(1.177)		(0.922)	(0.100)	(0.115)	(1.021)
Size × Post		-1.232***	-1.097***			
		(0.334)	(0.337)			
Sample	Coarsened Exact Matching	Full	Full	Full	Full	Full
N	18,858	26,530	26,530	26,530	26,530	26,530
R^2	0.570	0.566	0.567	0.533	0.577	0.530

Carrying vs. Non-Carrying BDs

	Panel A: Size					
Dep Var:	Complaint	*f*(Complaints)	Complaint	*f*(Complaints)	Complaint	*f*(Complaints)
	(1)	(2)	(3)	(4)	(5)	(6)
Treated × Post	-2.504***	-4.799***	-2.504***	-4.752***	-2.066*	-3.503**
	(0.923)	(1.851)	(0.944)	(1.841)	(1.146)	(1.674)
Specification:	Cubic Size Controls		Interact Treatment with Control Variables		Num. Employees > Median	
N	26,530	26,530	26,530	26,530	13,249	13,249
R^2	0.568	0.663	0.567	0.660	0.572	0.621
	Panel B: Product Offerings					
Dep Var:	Complaint	*f*(Complaints)	Complaint	*f*(Complaints)	Complaint	*f*(Complaints)
Product Type =	Number of Product Offerings		Retail-facing Products		Sophisticated Products	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated × Post	-1.825**	-3.585**	-2.188**	-4.171**	-2.261**	-4.333**
	(0.869)	(1.765)	(0.908)	(1.845)	(0.913)	(1.844)
Product Type × Post	-0.276***	-0.449***	-1.047***	-1.743***	-0.441	-0.764
	(0.069)	(0.122)	(0.280)	(0.441)	(0.339)	(0.534)
N	26,530	26,530	26,530	26,530	26,530	26,530
R^2	0.574	0.624	0.567	0.666	0.575	0.626

Auditor Attention

Additional auditor attention reduces complaints (through effort or awareness)?

But:

- Auditors practically never sued for complaints we study (just two cases over past 43 years)
- Eliminate "auditor relevant" complaints
  - "Fraud", "theft", "misappropriation" (or variants thereof) in description
- Auditor x firm FEs (hold audit relationship constant)

Regulator Attention

Amendment part of broader regulator scrutiny of BDs?

But:

- Non-result for regulator-reported complaints
- Results do not vary with distance to FINRA office

Auditor / Regulator Attention

Dep Var:	Auditor Related Complaint	Non-Auditor Related Complaint	Complaint	Reg. Action	Complaint
	(1)	(2)	(3)	(4)	(5)
Treated × Post	0.152	-2.248**	-2.346**	0.353	-2.286**
	(0.601)	(0.924)	(1.057)	(1.503)	(0.941)
FE: Firm-Auditor	No	No	Yes	No	No
N	26,530	26,530	26,530	26,530	26,119
R^2	0.362	0.557	0.611	0.483	0.552

Regulator Attention

Dep Var:	Complaint	f(Num. Complaints)
	(1)	(2)
Treated × Post	-2.398**	-3.767***
	(0.988)	(1.453)
Post × Distance from FINRA Office	-0.117	-0.223
	(0.133)	(0.174)
Treated × Post × Distance from FINRA Office	-0.506	-1.013
	(0.434)	(0.622)
N	20,243	20,243
R^2	0.573	0.625

Concurrent Regulation

Dodd-Frank: same results if we drop bank BDs, BD/RIAs

Fiduciary Rule (first proposed in 2015) that became Regulation Best Interest (enacted 2020) do not predict different trend for carrying vs. non-timing, and timing doesn't align

What about SOX?

Leuz and Wysocki (2016): The Economics of Disclosure and Financial Reporting Regulation (JAR)
- Only 6 references to "techno…", none involving papers studying tech investment (instead, generic references to tech sector or tech advances)

Hart (2009): Regulation and Sarbanes Oxley (2009) (JAR)
- Zero references to "techno…"

Coates (2007): The Goals and Promise of the Sarbanes-Oxley Act (JEP)
- Only 3 references to "techno…", none involving papers studying tech investment (instead, defining control systems as "set of processes, practices, and technologies designed to control a company's assets")

Coates and Srinivasan (2014): SOX After Ten Years- A Multidisciplinary Review (Accounting Horizons)
- Reviews over 120 papers. Only 3 references to "techno…", none involving papers studying tech investment (instead, references to tech firm IPOs or audit firms' reviews of clients processes and technologies)
- "To date, however, most studies of SOX…have not used research designs well adapted for (causal inference), and instead use simple before-and-after comparisons that fail to control for contemporaneous changes in the objects of study" (pp. 660)

Simple Illustration: Market Power

- Two firms in a sector, A (big) and B (small)
- Regulator levies fixed cost $Y on each firm

- Levy strengthens A's competitive position (cost structure). A is happy…
- …But without levy, A doesn't want to burn $Y on its own

Tension? Technological Advances vs. Misconduct Rate

Moore's Law: The number of transistors on microchips doubles every two years
Our World in Data

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.
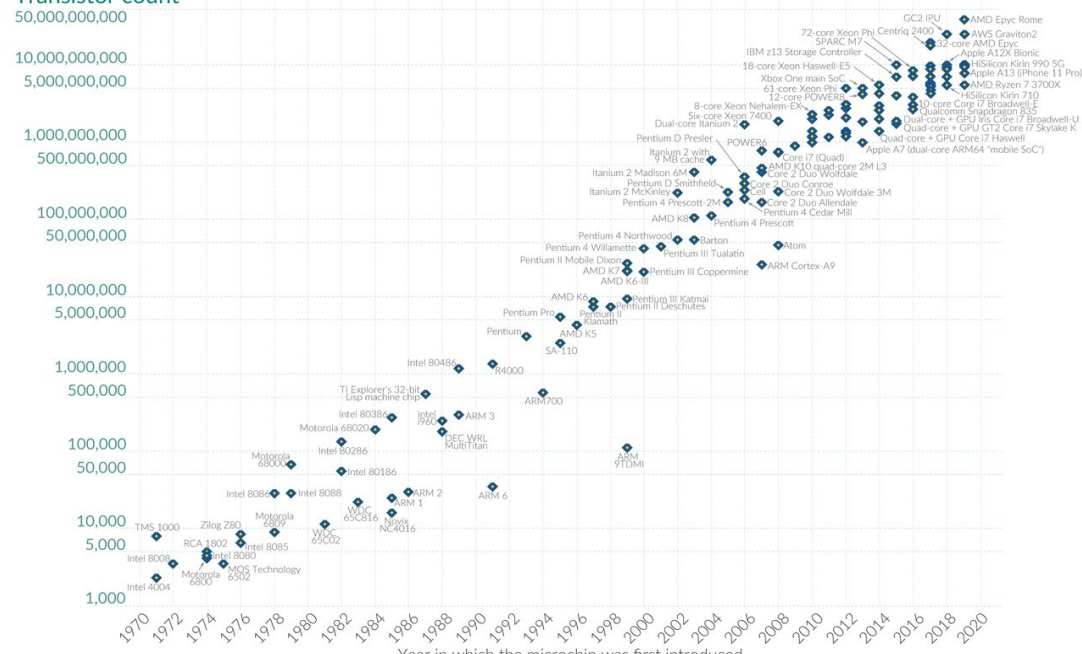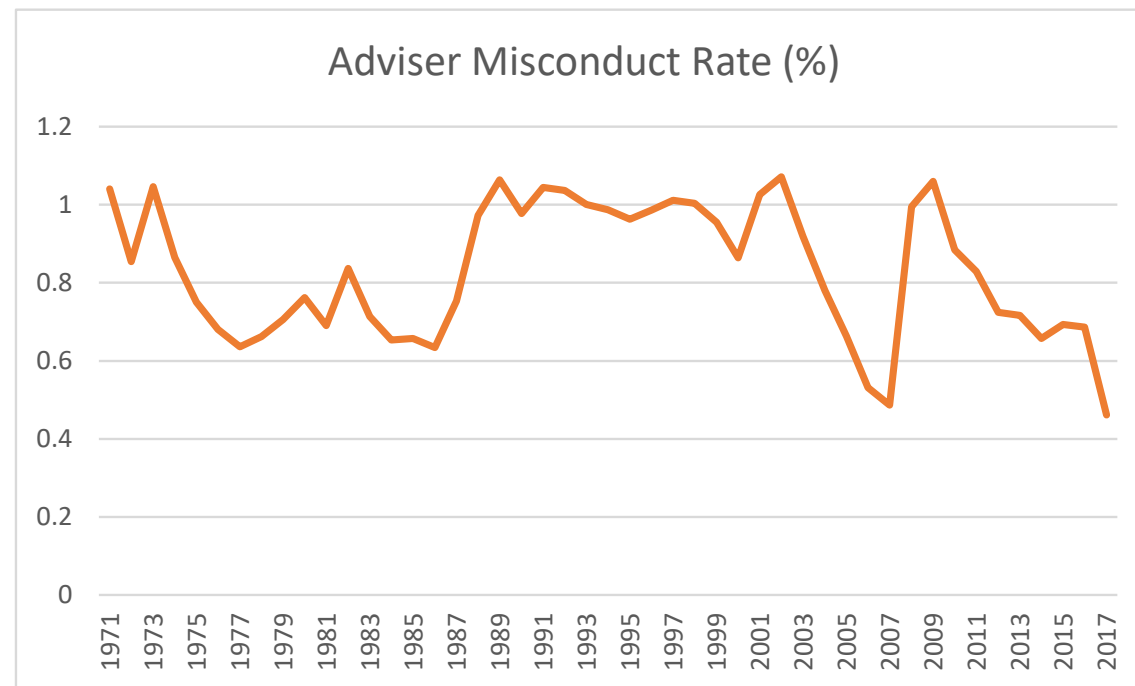
Data source: Wikipedia (wikipedia.org/wiki/Transistor_count)
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Adviser Misconduct Rate (%)

Punchline: **relation between technology adoption and misconduct is not so straightforward**
- Tech can help improve detection and enforcement of some types of crime…
- But can also lead to "innovation" in misconduct types and evasion techniques

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