RegTech*

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Abstract

Financial institutions' compliance-driven investments in technology—or "RegTech"—have grown rapidly in recent years. To understand these investments, we study how certain financial institutions respond to new internal control requirements. First, we show that affected firms make significant investments in enterprise resource planning, data management, and hardware. We then show that these investments allow for complementary expenditures on customer relationship management tools that rely upon information quality and availability. As a result, affected firms experience a decline in customer complaints, particularly those most easily detected by technological monitoring. Finally, we find evidence that RegTech investments increase labor market concentration. Our results illustrate how regulation can have direct and indirect effects on technology adoption, that in turn affect non-compliance functions and labor market structure.

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1. Introduction

In their compliance efforts, financial institutions (FIs) are increasingly investing in information technology and hiring technological experts, a development industry participants refer to as "RegTech." In 2019, public U.S. FIs spent nearly $10 billion on RegTech investments compared to just $2.2 billion on auditing, and RegTech expenditures are forecast to grow at 35% per year (Juniper 2021). Additionally, FIs report using RegTech investments not only for compliance purposes, but also as an important part of their operations management and strategy (Thomson Reuters 2021).

Despite these developments and growing interest in FinTech (Goldstein, Jiang, and Karolyi 2019), we lack evidence on firms' RegTech investments and their effect on operations. Few settings permit researchers to observe technological investments at individual firms. When data are available, studying technology adoption is inherently difficult: adoption decisions are typically endogenous, and in cases where adoption is driven by regulation, one must be able to observe both affected and unaffected firms.

In this paper, we examine regulation adding new internal control requirements for a subset of U.S. Broker-Dealers (BDs) to investigate firms' RegTech investment response, and explore how these investments affect operations. To do so, we assemble a novel dataset covering multiple aspects of technological investment and operations at both affected and unaffected BDs. We track software and hardware investments and IT budgets using the Aberdeen Computer Intelligence Database (Bloom, Sadun, and Van Reenan 2012; Graetz and Michaels 2018), website technology adoption data using BuiltWith (Koning, Hasan, and Chatterji 2019), and IT-related labor demand using Burning Glass Technologies (BGT) (Hershbein and Kahn 2018; Acemoglu et al. 2020). For operations data, we examine customer complaints involving individual employees, publicly reported on the BrokerCheck website.

BDs with available data are responsible for the majority of the assets and employment in the industry, and include both publicly and privately held FIs.

Our findings are twofold. First, the regulation had direct and indirect effects on technology adoption at affected BDs. These BDs increase their IT budgets, add data management and enterprise resource planning (ERP) software tools that directly aid compliance with the amendment, and add servers and computers. They also increase job postings mentioning compliance and ERP skills. We then show regulation indirectly affects technology adoption by requiring new data investments that can be leveraged for non-compliance purposes (e.g., enables adoption of customer relations [CRM] tools and website technologies that require high quality data). Second, as a result of these technological investments, affected BDs experience a decline in customer complaints, particularly those most easily detected by technological monitoring.

The regulatory changes we study followed the discovery of large Ponzi schemes in the late 2000s, when the SEC sought to improve safeguards for BD custody of customer securities and funds. Accordingly, the 2014 amendments to Securities Exchange Act Rule 17a-5 (henceforth "Rule 17a-5" or "amendment") require certain BDs to report on their internal controls over compliance with rules concerning capitalization and separation of customer and firm assets (Kowaleski et al. 2018). Specifically, BDs must maintain controls for and documentation demonstrating *moment-to-moment* compliance with requirements to hold adequate net capital and to segregate customer assets. While the amendment mandates internal control attestation only for carrying BDs—those who maintain custody of customer assets—all BDs must publicly disclose financial statements, employee records, and complaint details, providing a control group for our analyses.

Before the amendment, many BDs used "systems and technology that have been built in-house many years ago… and as a result, [BDs] have found it difficult to provide report logic

details and report parameters to their auditors for testing." (Deloitte 2015). After the amendment, 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" (EY 2019).

Our first set of tests examines technological investments after the amendment. We compare investments across carrying and non-carrying BDs, while controlling for BD and location-by-year fixed effects, as well as the BD's size and employees' tenure and complaint history. These controls account for time-invariant BD features, local economic conditions, and the BD's scale, expertise, product offerings, and service quality. We find that after the amendment, carrying BDs increase their IT budgets by 63%. They employ 12% more unique data management programs, 10% more ERP programs, 44% more servers, and 24% more computers. They also increase job postings mentioning compliance and ERP skills by over 6%.

We then investigate complementary software investment. This analysis is motivated by the idea that data and information systems are non-rivalrous goods: multiple functions can simultaneously use them without detracting from their compliance role (Jones and Tonetti 2020). Because of this non-rivalrous property, RegTech investments can increase the marginal return on complementary assets (Teece 1986; Brynjolfsson and Hitt 2000; Hughes and Morton 2006). To illustrate, customer analytics and employee monitoring tools can help firms reduce customer complaints, but adopting these tools requires having sufficiently developed information quality and availability. From this perspective, RegTech investments can render the necessary expenditures on these input factors sunk.

Consistent with this hypothesis, we find that carrying BDs increase the number of CRM and business intelligence software programs by over 13% following the amendment. They also

increase the number of distinct technologies employed on their websites by over 11%.[1] In placebo tests, we find no increase for other software programs less pertinent to the amendment, indicating our findings do not follow from unrelated events driving technological investment of all types at carrying BDs.

To understand the operational effects of these technological investments, our second set of tests examines customer complaints in the eight-year window around the 2014 amendment. Common complaints relate to unsuitable investment recommendations, excessive trading, and commissions—grievances unrelated to the amendment itself but conceivably prevented by monitoring via the BD's internal information processes. At carrying BDs, the complaint likelihood declines by 2.3 percentage points, the number of complaints falls by 3.5%, and the customer-alleged damages per employee drop by 29%. These effects are meaningful compared to regulatory and individual factors studied in the literature (Charoenwong, Kwan, and Umar 2019; Egan, Matvos, and Seru 2019; Kowaleski, Sutherland, and Vetter 2020). We find parallel complaint trends across affected and unaffected BDs beforehand. Additionally, instrumental variable analyses point to the complaint declines happening through the technological investments studied in our first tests.

The complaint decline is not uniform across all complaint types, BDs, or even locations of the same BD. Declines are concentrated in incidents more easily detected by technological monitoring and improved record-keeping. Additionally, we find declines only in non-headquarters locations, consistent with an improvement in the monitoring environment. The decline is also greater when the person affirming the financial statements is a senior officer with decision authority to direct technological investments. Collectively, the complaint declines are concentrated where the effects of technological investments should be greatest.

[1]As examples, ThreatMetrix provides real-time fraud detection and transaction security, Pardot automates marketing and sales engagement, and goMoxie allows live chat between the customer and BD,.

An alternative explanation is that these results stem from fundamental differences in carrying and non-carrying BDs, or from other regulatory forces. However, we find similar results in a coarsened exact matching analysis that balances the treatment and control samples based on a range of business model controls, including size and product offerings.[2] Our inferences also remain if we control for size- and product offering-specific trends. Finally, we find no evidence that auditors, regulator attention, or other regulatory changes (e.g., Dodd-Frank) explain complaint declines.

From an individual BD's standpoint, these complaint declines alone do not appear to warrant major investment in data architecture. Using complaint-level data on sanctions and settlements, we estimate the savings from avoided complaints at the average carrying BD to be roughly $60,000, far less than the estimated $1-10 million RegTech investment cost described in Section 4.2.3. From this perspective, our results suggest that RegTech vendors help firms comply with regulation and identify ways to economize (albeit incompletely) on their compliance expenditures by leveraging technology for other purposes, reinforcing our complementarity interpretation.

We conclude by conducting exploratory analyses on the market structure consequences of RegTech. RegTech can affect concentration through the relative burden of compliance costs and the differential benefits of additional data. SEC comment letters discuss how the amendment's compliance costs have a sizable fixed component, and therefore larger BDs can more easily bear them (SEC 2013). In terms of benefits, large FIs make greater use of hard information in their operations (Stein 2002; Berger, Minnis, and Sutherland 2017). Additionally, with cross-selling and statistical modeling, gains from additional customer information can increase with firm size (Charoenwong et al. 2021). As one industry report

[2] More generally, we note that "back office" differences in carrying and non-carrying BDs have little to do with the customer complaints we study. Complaints involving individual advisers overwhelmingly relate to investment advice, and not their firm's custody or capitalization status.

explains, “Greater scale enables firms to increase these relatively fixed [technological] investments, and returns on those investments can increase significantly when they support a larger number of advisors and assets under management” (Martin 2021).

Consistent with this claim, we find that following the amendment, employees are more likely to move from unaffected to affected BDs. Switches from small unaffected to large affected BDs increase markedly. Accordingly, labor market concentration increases. While the welfare effects of concentration are complex (Carlton 2007; Covarrubias, Gutierrez, and Philippon 2020), our evidence illustrates how the effects of regulation that compels technology-driven compliance can depend on firm size.

We make three contributions. By offering the first empirical analysis of RegTech, we add to the growing literature on technology adoption at FIs (D’Acunto, Prabhala, and Rossi 2019; Crouzet, Gupta, and Mezzanotti 2021; Liberti, Sturgess, and Sutherland 2021) as well as the broader FinTech literature (Begenau, Farboodi, and Veldkamp 2018; Buchak et al. 2018; Fuster et al. 2019). FIs are increasingly relying on technology to demonstrate compliance with reporting, capital, consumer protection, and risk management regulations (Deloitte 2021). We illustrate how regulation can have both direct and indirect effects on technology adoption at FIs. The direct effect relates to significant improvements in data collection, data management, and information systems made for compliance purposes at affected firms. The indirect effect stems from these improvements rendering sunk the data infrastructure and information quality required to adopt customer and employee analytics tools in noncompliance functions.

Second, we add to the growing literature on complaints about individual employees at BDs (Dimmock and Gerken 2012; Charoenwong et al. 2019; Egan et al. 2019, 2021; Kowaleski et al. 2020). Complaints are relevant to trust and participation in the financial system (Guiso, Sapienza, and Zingales 2008; Giannetti and Wang 2016; Gurun, Stoffman, and Yonker 2018), have resulted in billions of dollars of settlements over the past decade, and are a major focus

of BDs' risk management activities. One challenge associated with monitoring complaints is that the advisory business is relationship-based (Dimmock, Gerken, and Van Alfen 2021; Gurun, Stoffman and Yonker 2021), and individual employees have discretion in how they advise clients. We document a role for technology in improving financial service quality by facilitating employee monitoring and client communications (see also Bachas et al. 2018 and Higgins 2021).

Finally, we add to research exploring direct and indirect benefits from improving internal controls in response to regulation (e.g., Feng, Li, and McVay 2009; Ellul and Yeramilli 2013; Baxter et al. 2013; Feng, Li, McVay, and Skaife 2015; Gallemore and Labro 2015; Miller, Sheneman, and Williams 2021). One implication of our findings is that technological advances creating new opportunities for data collection and monitoring will strengthen the linkages across compliance and non-compliance functions that depend upon customer and employee data.

2. Broker-Dealers and the Rule 17a-5 Amendments

2.1 U.S. Broker-Dealers

BDs trade securities for themselves and their customers. Their customers include individual households and institutions who invest in debt, equities, mortgage-backed securities, mutual funds, options, variable life insurance, and other securities. According to FINRA's latest industry snapshot (FINRA 2021), as of 2020, there were nearly 620,000 registered employees, with 182 (11) at the average (median) BD. There are 3,435 registered firms with over 150,000 branches, generating over $360 billion in revenue and $77 billion in income.

A key characteristic distinguishing BDs is whether they maintain custody of (or "carry") customer assets. Carrying BDs face tighter regulation because their direct control over customer assets creates opportunities for misappropriation and loss. To avoid this regulation, a non-carrying BD (or an "introducing" BD) must promptly transmit any customer assets it

receives to another firm. Carrying BDs typically maintain a back office custodial function that manages compliance and has its own employees separate from the customer-facing financial representatives and investment advisers involved in the complaints we study.[3] Economies of scale and having compliance expertise is amenable to being a carrying BD: carrying BDs tend to be large and switching between carrying and non-carrying status is exceedingly rare. Roughly five percent of BDs are carrying BDs.

Carrying and non-carrying BDs offer similar fee schedules to customers, typically based on the customer's portfolio size and trading frequency. Most customers are likely unaware of the distinction—it is difficult to find references to the BD's carrying status on their website or advertisements, for example. Instead, the websites typically promote the quality of advice provided, relationship building, and information about products and locations.

BDs and their financial representatives and advisers (henceforth, "employees") must register with the Financial Industry Regulatory Authority (FINRA), a self-regulatory enforcement agency tasked with protecting investors. FINRA develops and enforces rules, conducts firm exams, oversees firm and employee licensing, and maintains a website, "BrokerCheck," with profiles for every registered employee. The website includes each employee's licenses, registration status, employer (current and past), and detailed records of customer complaints, civil proceedings, and regulatory sanctions. BrokerCheck provides a description of each complaint and violation incident. Complaints can be reported by customers, regulators, or the firm. The most common incidents involve unsuitable investment recommendations (21% of incidents), misrepresentation (18%), unauthorized activity (15%), omission of key facts (12%), commission-related issues (9%), and investment fraud (8%) (these categories are not mutually exclusive) (Egan et al. 2019). This means the complaints we

[3] Maintaining custody and clearing trades allows a BD to keep more of the fees charged to their customer rather than outsourcing custodial requirements and sharing fees with another BD.

study predominately trace to employee-customer interactions and not firm-level issues of custody, capitalization, and regulatory reporting affected by the amendments or other financial reporting issues often studied in the literature.[4]

There are several reasons to believe most BDs wish to avoid complaints at their firms. First, complaints alienate customers, regularly result in financial damages, and attract unwanted attention. Second, serious violations can result in individuals and firms having their licenses revoked. Firms also commonly dismiss employees involved in complaints; these employees tend to be unemployed longer and their next job is usually at a less prestigious firm with lower pay (Egan et al. 2019). Of course, some firms may cater to unsophisticated customers and tacitly encourage employee transgressions, but our assumption is that such firms are the minority.[5]

2.2 Rule 17a-5 amendments

BD reporting is regulated under Rule 17a-5 of the 1934 Securities Exchange Act. Each year, BDs must furnish audited financial reports containing a full set of financial statements and accompanying regulatory schedules and reports. In 2014, the SEC amended Rule 17a-5 to increase focus on the regulatory schedules and reports. Specifically, the amendments newly require managers at carrying BDs to state that they have established and maintained internal controls that provide reasonable assurance that noncompliance with the Financial Responsibility Rules will be prevented or detected on a timely basis.[6] These Financial Responsibility Rules seek to manage the risk of customer losses from unexpected BD failures in three main ways. First, BDs must maintain a minimum level of safe and liquid assets to cover

[4] To confirm this, we reviewed LexisNexis for litigation against BD auditors. We found only two cases over the past 43 years involving the type of complaints we study.
[5] As described later, we develop our research design to account for aspects of BD's business model that relate to their complaint tolerance.
[6] See Kowaleski et al. (2018) and Kowaleski (2020) for a description of the BD audit environment, and a more comprehensive discussion on how the regulatory changes affect the audit.

firm obligations.[7] Second, BDs must segregate customer from firm assets. Third, BDs are required to perform a periodic security count to affirm company records and to send account statements to customers. Notably, the amendments require BDs to state that these controls are effective on a moment-to-moment basis throughout the reporting period, and not just at the end of the period.

BDs made significant investments to comply with the amendment (EY 2019). A prominent RegTech vendor notes that BDs have faced "robust review and scrutiny from both auditors and regulators following the amendment. As a result, investing in new technologies such as SaaS adoption, emphasizing strong controls around data quality as well as the soundness of the calculations has become the centerpiece of a thoughtful reporting solution" (Palaparthi and Sarda 2020).

2.3 Complaint monitoring via technology

BDs' RegTech investments in data collection and information systems following the amendment open the possibility of complementary investments. Because misconduct imposes costs on BDs, it is natural for them to evaluate and implement technologies that monitor employees' interactions with customers and identify problematic behavior. We note several applications of technology to employee-customer interactions oversight:

1. A leading software vendor describes how their technology helps BDs "identify bad actors quickly and accurately, preventing massive fines and company-debilitating crises."[8]

2. A law firm specializing in cases involving BD misconduct states that "In the vast majority of credible broker misconduct cases that we see, there is a direct line between the misconduct perpetrated by a broker and the failure to supervise on behalf of the brokerage firm." They further describe how some BDs rely on technology "to supervise their

[7] This requires BDs to document the investment haircuts and operational charges that reduce net assets when computing Net Capital, the aggregate indebtedness that raises the minimum required Net Capital, and the reliability of systems that produce the information.

[8] See https://www.behavox.com/products/compliance/asset-management

brokers' investments in order to ensure they are properly aligned with their clients' profiles, risk tolerances, and objectives."[9]

3. A FINRA white paper (FINRA 2018) discusses how:

   a. "Some [software] tools that seek to employ a more predictive risk-based surveillance model also focus on linking data streams previously viewed largely in isolation. For instance, the relationship between certain structured data (such as trade orders and cancels, market data, and customer portfolio) and unstructured data (such as emails, voice recordings, social media profiles and others communications) have historically been difficult to link together. However, [software] tools are being developed that would help to integrate these disparate data forms and then identify and track related anomalies that merit attention" (p. 4). To illustrate, Figure 1 provides a screenshot from a customer relationship management tool that allows BDs to track both investment activity and employee-customer communications.

   b. "In addition, some [software] tools monitor investor portfolios in changing market conditions and produce recommendations to better align the portfolio with the investor's risk profile" (p. 6).

   c. "The use of certain [software] tools could also assist in reducing the number of false alerts, thereby freeing up staff time to focus on alerts that warrant escalation. For example, during our research, one firm noted that false alerts of its employee surveillance system were reduced by 80% after the adoption of a [software] tool and that the escalation rate of its alerts went up significantly. Such tools have the potential to result in cost efficiencies, increase productivity and focus resources on heightened areas of risk" (p. 7).

4. More broadly, survey evidence summarized in Figure 2 highlights how firms use RegTech output in operations, and that RegTech adoption relies on both investment budgets and employee skillsets.

These applications illustrate two ways in which technology-based monitoring can reduce complaints. First, better monitoring reduces employees' ex-ante incentives to misbehave because the detection likelihood is greater (Becker 1968). Second, more comprehensive and timely information about employee-customer interactions provides supervisors with an early warning signal.

[9] See https://broker-misconduct.com/investor-fraud-failure-to-supervise

The amendment came into effect for carrying BDs with fiscal years ending on or after June 1, 2014. While we cannot directly observe the progression of IT investments within BDs or how operating functions evolve, several aspects of these investments point to a lagged effect on complaints. First, over 90% of BDs have December 31 fiscal year ends, and for these BDs, the first annual reports subject to the rule are filed in early 2015. Second, IT projects are costly, and like other large expenditures, financing needs to be arranged and bids solicited for the work. Third, once a vendor has been selected, industry publications and consulting guides suggest a typical ERP implementation spans approximately a year, and delays are common (McKinsey 2012; CFO Magazine 2019). Fourth, during implementation, the systems are not fully functional. Consistent with this, the PCAOB report on 2015 auditor inspections identifies widespread issues with ensuring accuracy and completeness of underlying information: "[BD] firms did not test controls over the accuracy and completeness of underlying information upon which the design and operating effectiveness of ICOC [internal controls over compliance] depended" (p. 35, PCAOB 2016). Fifth, once implementation is complete, installing complementary software and training staff takes time. Last, in most cases, there is a several-month lag between BD employee-customer interactions and when complaints get registered in the BrokerCheck database (Dimmock, Gerken, and Graham 2018; Charoenwong et al. 2019).

3. Empirical Methodology

3.1. Data and measures

We construct our sample from the intersection of several datasets. Firm-level registration data (Form BD) come from FINRA, and BD customer complaints data come from BrokerCheck. We obtain our baseline firm-year panel using the Audit Analytics Broker-Dealer module, which assembles all annual Rule 17a-5 reports filed with the SEC. Into this dataset, we merge the complaint and employee data to construct measures of the number and composition of employees at each BD. The sample for our complaint analysis includes 4,547

unique firms and 26,530 firm-year observations between 2010 and 2017. Our technology adoption analysis samples contain fewer observations, depending on variable coverage in Aberdeen, BGT, and BuiltWith (see Appendix A.1 for further detail).

To identify treated firms, we adapt Schnader et al. (2019) and ensure that the BD reports a required minimum level of Net Capital of at least $250,000 in all sample years.[10] We then review registration data filed under Form BD to identify BDs that report clearing trades for other BDs as well as those that report introducing arrangements. We use this information to distinguish between treated BDs and control BDs.[11]

Table 1, Panel A reports summary statistics for all BDs in our sample. The mean (median) BD has $1.1 billion ($707,000) of assets and $593 million ($298,000) of net capital. Carrying BDs comprise 5.4% of our sample, and 34.4% of our observations are from the *Post* period. The mean (median) firm has 145 (10) adviser and representative employees, and on average 4.2% of employees at a firm have a complaint on their record. We measure several characteristics of affirmers of the compliance report attached to the financial statements. We define high-ranking affirmers as those whose titles include either the terms "managing," "chief," or "principal." Additionally, we consider whether the affirmer is a Chief Compliance Officer. Half of all affirmers are high-ranking, and 4.3% are Chief Compliance Officers.

[10] Unfortunately, we are unable to retrieve Form Custody filings through the Freedom of Information Act from the SEC, due to the form being deemed confidential and protected from release pursuant to FOIA Exemption 4, 5 U.S.C. § 552(b)(4).

[11] 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.

The probability of a firm receiving any complaints in a year is 2.1%, while the average number of complaints is 0.132. Conditional on receiving at least one complaint, the average number is 6.394. The average alleged damages for complaints is $108,000 per BD-year.

3.2. Research design

Our empirical analyses use the following OLS specification:

$$y_{i,t} = \alpha_i + \alpha_{f(i,t),t} + \beta Post_t \times Treated_i + \Gamma' X_{i,t} + \varepsilon_{i,t}, \quad (1)$$

where i indexes BDs, t indexes years, and $f(i,t)$ is the FINRA district for firm i during year t. The dependent variable measures RegTech investments, complementary investments, or customer complaints as described in subsequent sections. $Post$ is an indicator variable equal to one beginning in 2015, and $Treated$ is an indicator variable equal to one for carrying BDs. The coefficient of interest β captures the differences in complaints between carrying and non-carrying BDs after the amendment. α_i are BD firm fixed effects that account for time-invariant BD features affecting complaints, including the customer base, tolerance of employee misconduct, and hiring practices. $\alpha_{f(i,t),t}$ are FINRA district-by-year fixed effects that account for local economic conditions as well as time- and location-varying changes in FINRA enforcement.[12] The BD firm and FINRA district-by-year fixed effects absorb the *Treated* and *Post* main effects, respectively. Our control variables $X_{i,t}$ consist of the log total assets, the lagged number of employees, the fraction of employees with a previous complaint, and the lagged log average BD employee tenure. We winsorize all continuous dependent and independent variables at the 1% level.

4. Empirical Results

4.1 Technology adoption

[12] There are 11 FINRA districts, named for the location of their primary office: San Francisco, Los Angeles, Denver, Kansas City, New Orleans, Dallas, Atlanta/Boca Raton, Chicago, Philadelphia/Woodbridge, Long Island/New York, and Boston.

In this section, we examine two types of technology adoption: RegTech and complementary investment.

4.1.1 RegTech

We study BDs' RegTech investments in software, hardware, and personnel. We access Aberdeen's Computer Intelligence Database ("CiTDB"), which has been used to study digitization, technology adoption, and investment (Bloom, Sadun, and Van Reenan 2012; Graetz and Michaels 2018; Tuzel and Zhang 2021). Aberdeen collects data from several sources. Each year, they contact senior IT executives and conduct surveys about software and hardware usage. Additionally, they conduct systematic data collection efforts, including web-scraping job postings and purchasing customer lists from vendors to identify software choices.

Our analysis uses two CiTDB datasets. One reports establishment-level software usage categorized by type, allowing us to study specific software investments around the amendment as proxied by the adoption of a new software type. A second dataset tracks and estimates the total IT budget for software, hardware, and staff as well as the number of personal computers, laptops, and servers at over three million establishments. Specifically, Aberdeen combines survey responses on budgets and hardware with imputed values based on Dun & Bradstreet figures on firm age, industry, revenue, employment, and location.[13] During our sample window, we can match 4,415 BD-year observations to the software dataset and 10,996 BD-year observations to the hardware dataset.

To study personnel decisions, we gather data on BD labor demand from Burning Glass Technologies ("BGT") (Hershbein and Kahn 2018; Acemoglu et al. 2020). BGT provides comprehensive coverage of job boards and company job listings in the United States since 2007. From these job postings, BGT distills an employer name, location, and title, as well as

[13] Unfortunately, the dataset does not separate survey from estimated values. While we are not aware of reasons why estimation errors would be correlated with the amendment, we interpret our results with caution and study other datasets (CiTDB software and BGT) that do not rely on imputation.

any required job skills. BGT tracks nearly 17,000 skills and groups them into smaller sets of skill clusters. Our matched BD-BGT sample includes 1,799 BD-year observations.

The RegTech investments in software that we consider include data management and ERP tools that enable the firm to develop, maintain, and report the information required to demonstrate moment-to-moment compliance with Rule 17a-5. Specifically, data management software centralizes, consolidates, and helps maintain proper version histories of information pertaining to customer accounts and transactions. ERP software integrates a company's financials, reporting, operations, and human resource activities. We count the number of unique software programs in a given category. In addition, we study whether BDs seek to hire more personnel with related RegTech experience. We measure the number of BD job postings referencing either "compliance" or "enterprise resource planning" skill requirements (the Aberdeen and BGT categories do not fully overlap).

Summary statistics for these variables are reported in Table 1, Panel B. For context, note that the median BD with non-missing data in the software (IT budget and hardware) sample has 43 (21) employees. On average, BDs have 1.04 types of data management program and 0.648 types of ERP program. The median BD has four servers, 25 personal computers and laptops, and an IT budget of approximately $290,000. At the average BD, each year there are 1.25 (0.043) job postings mentioning compliance (ERP) skill requirements.

Table 2 models these RegTech investments using equation (1). In column 1 (2) of Panel A, we find an 12% (10%) greater increase in software related to data management (ERP) for carrying than non-carrying BDs. We then study hardware. Column 3 shows a 44% increase in the number of servers, and column 4 shows a 24% increase in personal computers and laptops. Column 5 studies IT budgets and finds a 63% increase. As for personnel investments, in Panel B, we find that carrying BDs increase job postings with compliance skill requirements by 14% more (column 1) and ERP skill requirements by 6% more (column 2) than non-carrying BDs.

Thus, our evidence corroborates the claims from RegTech vendors, regulators, auditors, and BDs that the amendments compelled significant technological investments and hiring.

Repeating these tests using a coarsened exact matching analysis that balances the treatment and control samples based on size and employee characteristics produces similar results (not tabulated for brevity). Figure 3, Panel A models RegTech investments in event time using an indicator for BDs with high investment. The red line marks the Rule 17a-5 amendment (June 2014). The holdout year is 2014. We find a significant investment increase after the amendment, and parallel trends across treatment and control BDs before.

4.1.2 Complementary investments

We study two types of complementary technology adoption. First, we examine software investments using CiTDB. Specifically, CRM systems like SalesForce or HubSpot allow for the tracking of all customer contacts and communications, automated customer reporting, and information control. Such tools can be linked with data management software for data storage, safekeeping, and backup. We also examine business intelligence tools such as SAP's BusinessObjects Business Intelligence or Tools for Brokers that enable monitoring through customer and portfolio analytics and visualization. Both types of software tools build and rely upon data management and ERP systems, i.e., Table 2 RegTech investments.

For the second type of complementary investment, we access data on firms' website technologies. Our analysis of website technologies is motivated by the fact many BDs maintain online portals for customers, and these portals are used by advisers to communicate information to clients. In turn, the portals can help customers identify issues with, for example, the securities they own, the advice they have been provided, or the commissions they are charged. Sophisticated websites may be more pleasing for customers to access, but can require richer databases and better cybersecurity, webpage development, and overall infrastructure.

We access data from BuiltWith, a competitive intelligence firm that compiles data on website technology adoption patterns (Koning et al. 2019). BuiltWith scrapes a substantial fraction of the internet, and each time it visits a webpage, it logs the presence of a technology or tool. For example, BuiltWith may track whether the website uses a cookie to track visitors, has a chat function or fraud prevention tool, or has integrated social media such as Twitter or Facebook. Some of these technologies are classified as premium, in that they are purchased.

Table 3, Panel A reports summary statistics for these variables. On average, BDs have 1.80 types of CRM software, 1.48 types of business intelligence software, 26.7 website technologies, and 2.0 premium website technologies.

Table 3, Panel B studies complementary investments using equation (1). Columns 1 and 2 find that following the amendment, carrying BDs expand CRM (business intelligence) software 13.3% (13.8%) more than non-carrying BDs. Similarly, column 3 finds an 11.1% increase in the number of unique technologies and a 27.7% increase in premium technologies embedded in the BD's website.

Further supporting a complementary investment interpretation, Table A.2 links the RegTech and complementary investments. Column 1 shows BDs making RegTech investments (i.e., they invest in either data management or ERP software) are over 30% more likely to invest in CRM or business intelligence software. Similarly, firms employ more website technologies when they make RegTech investments or have more computers and larger IT budgets (column 2), and when they employ CRM software (column 3).

Panel C conducts placebo tests to evaluate the possibility that we are merely capturing an investment expansion that is unrelated to the amendment. Specifically, we study investments in anti-virus and other technologies (aside from the data management, ERP, CRM, and business intelligence tools we study prior). Columns 1 and 2 find no difference in carrying and non-

carrying BD investments for these software types. Thus, our results support the inference that RegTech expenditures incentivized complementary investments.

4.2. Customer complaints

Our second set of tests study complaints using equation (1). Our complaint measures are 100 times (a) an indicator variable for whether the firm's employees receive a customer complaint that year, and (b) the inverse hyperbolic sine of the number of complaints, similar to the log of one plus the value. Following Charoenwong et al. (2019), our tests consider all types of customer complaints regardless of ultimate resolution, and exclude disclosures involving off-the job criminal activity and personal bankruptcies.[14]

Column 1 in Panel A of Table 4 shows that after the amendment, carrying BDs have a 2.3 percentage-point lower probability of having a registered complaint compared to non-carrying BDs. Economically, this decline represents 16% of a standard deviation in the probability of receiving complaints. Column 2 studies the number of complaints and finds a similar decline (three percentage points, equivalent to 12% of a standard deviation). This evidence points to the amendment having an economically important effect on customer complaints.

Figure 3 presents event time plots based on equation (1), for the incidence (Panel B) and number (Panel C) of complaints. The plotted coefficients are the difference between carrying and non-carrying BD complaints yearly. Two aspects of the plots support a causal role for the amendment explaining complaint declines. First, the complaint difference between the two types of BDs is never significant in the pre-amendment period. Second, both panels show that the treatment effect manifests in 2016 and is sustained thereafter. Recall from Section 2.3 that the overwhelming majority of sample BDs became subject to the amendment at the end of

[14] Our results are similar if we study all disclosures or only those considered "misconduct" (Egan et al. 2019).

2014 and that IT projects of the sort compelled by the amendment take many months. Thus, a sustained decline in complaints beginning in 2016 is consistent with the amendment causing BDs to undertake IT investments that aid complaint monitoring.

We then trace the complaint decline to complementary investments using an instrumental variables analysis. Specifically, we construct an indicator variable *High Inv* which equals one for BDs with a) RegTech or complementary software (data management, ERP, CRM, or business intelligence), and b) above-median number of website technologies or premium website technologies, and c) above-median IT budgets or above-median number of personal computers and laptops. The indicator is recorded as zero for BDs not meeting these three criteria or missing data from any of the three datasets. The benefit of our approach is that it is holistic: it considers multiple aspects of BDs' technological expenditure response, while allowing us to develop a sufficient sample for an instrumental variables analysis (our standalone Aberdeen and BuiltWith samples do not fully overlap).[15]

Panel B presents the results. In the first stage, we find a significantly positive relation between *Treated* × *Post* and *High Inv*, and the first-stage clustered F-statistic is 10.742. Then, columns 2 and 3 find that BDs making high RegTech investments due to the amendment are 10% less likely to experience complaints and have 19% fewer complaints.

4.2.1 Complaints and technological investment

According to our hypothesis, complaint declines should be concentrated in complaint types most easily detected using technology, and in cases where the BD had less information and ability to monitor. We investigate this in four ways.

First, we separate complaints into two categories based on their relevance to technology-based monitoring. Easy-to-detect complaints are those most readily identified

[15] We also obtain similar results under a variety of alternative approaches to defining *High Inv*, including, among others, a count version that sums the three components of our indicator variable, or considering only hardware and RegTech software.

through timely, detailed transaction monitoring and record-keeping. We conduct textual analysis of our 128,829 complaint descriptions and categorize those referring to the following phrases or their variants as easy-to-detect: "activity," "authorization," "churn," "commission," "excessive," "falsify," "fee," "fiduciary," "forge," "fraud," "suitability," "theft" or "trade." Our review of several hundred randomly chosen descriptions indicates such complaints typically pertain to commissions, trading without the customer's permission, or investments not suited to the customer's stated investment objectives. The remaining hard-to-detect complaints primarily involve misrepresentation, omission of key facts, and negligence—disputes that are context-specific and more difficult to prevent or identify based on transaction monitoring and record-keeping alone. Table 5 shows that our results are driven by declines in easy-to-detect complaints using transaction monitoring and better record-keeping (*Treated* × *Post* is only significantly negative in column 1).

Second, we measure complaints at headquarters and non-headquarters locations for each BD-year. Our hypothesis is that information quality and availability improvements are more important to non-headquarters locations because they are more difficult to monitor. Columns 1 and 2 of Table 6 show the complaint declines are concentrated in non-headquarters locations (the *Treated* × *Post* coefficients are also statistically different from each other).

Third, for BDs whose business model already requires superior controls and strict oversight, the amendment should have less effect on complaints. To proxy for this, we measure whether the BD had a Chief Compliance Officer (CCO) and this CCO affirms the financial statements in 2011 before the amendment was even proposed. Table 6, column 3 shows the complaint decline is concentrated in BDs without a CCO in 2011. Those with a CCO in 2011 experience no incremental complaint change (*Treated* × *Post* + *Treated* × *Post* × *Affirmer Quality* is indistinguishable from zero). We find a similar pattern of results if we instead base the test on the firm already having a high level of technological investment in 2011.

Finally, we study the seniority of the financial statement affirmer. We define high-ranking affirmers as those whose job title includes the words "Managing," "Chief" (but not "Chief Compliance Officer," given the column 3 tests), or "Principal," once again measuring in 2011 before the amendment was proposed. We presume high-ranking affirmers possess the authority to fund and direct investment in internal controls. Affirmers have the incentive to do so because of the legal liability and reputational risk that comes with signing the firm's financial statements. Column 4 in Table 6 shows that carrying BDs with high-ranking affirmers experience a larger complaint drop, while those without high-ranking affirmers experience no change in complaints.

4.2.2 Robustness and alternative explanations

In this section, we investigate whether developments unrelated to the amendment could explain our results.

4.2.2.1 Business model differences

Carrying and non-carrying BDs are fundamentally different, for example, in their size or product offerings, and therefore their complaints may have evolved differently even absent Rule 17a-5. Thus, although we include a range of business model controls in equation (1), the functional form may not fully account for the differences.

Therefore, we first develop a coarsened exact matched sample based on all control variables plus the number of product offerings, splitting continuous variables into six subclasses and matching with replacement.[16] This procedure eliminates the imbalance in covariates (primarily in size), as shown in Figure A.1. Column 1 in Table 7 shows our results are the same using the matched sample.

[16] The product offerings include investment advice, mutual funds, variable life insurance, debt products, mortgage backed securities, private placements, and derivatives.

We then model size trends directly by introducing an interaction term *Size* × *Post* in column 2. We find a lower incidence of complaints at larger firms in the post-amendment period. However, column 3 shows that the amendment has an effect distinct from this size trend. Finally, in column 4 we measure the number of complaints per employee and continue to find a negative interaction coefficient.[17]

In terms of product offerings, Panel B of Table A.3 shows that our results are similar if we include a control for the interaction between *Post* and a) the number of product types the BD offers, b) an indicator for having retail-facing products, or c) an indicator for having sophisticated products. Together, these analyses suggest that size or product offering-specific trends alone cannot explain our complaint findings.

A related concern is that selection into carrying or non-carrying type explains the complaint declines we document. However, switching from being a carrying to a non-carrying BD is quite rare, and requires a costly transition from proprietary back-office infrastructure to that of a new custodian, with whom the BD must now share fees. Figure A.2 further suggests that BDs did not switch type to avoid the new regulation as we find the distribution of BDs' Net Capital changes little after the amendment.

A final question relates to the economic significance of our results. One might worry that the IT improvements caused by the amendment prevent only minor complaints, leaving the most costly incidents unaffected. To evaluate this, we consider two alternative specifications. Table 7, Column 5 measures the inverse hyperbolic sine of the total alleged damages for that firm-year, and finds a 29% decline. Column 6 examines the probability of customer complaints that result in compensation, and finds a 2.5% decline.

4.2.2.2 Auditor and regulator attention

[17] Further, in Panel A of Table A.3 we a) include cubic controls for total assets and headcount, b) interact each of our control variables with our treatment variable, and c) omit firms with fewer than 100 employees because the probability of a complaint is lower at smaller firms. Our inferences are similar across all specifications.

Some complaints involve employee behavior that might draw scrutiny from auditors and plausibly relate to their work. To investigate this, we follow Cook et al. (2020) and identify complaints with references to "forgery," "fraud," "theft," and variants of these phrases ("Auditor-Related Complaints"). Approximately 10% of all complaints in our sample are Auditor-Related Complaints. Our assumption is that the amendment leads to more involved audit engagements for affected firms, and the nature and seriousness of complaints referencing forgery, fraud, and theft will draw extra auditor attention. Thus, under an auditor attention-based explanation, we should see starker declines in Auditor-Related Complaints than those involving behavior less relevant to auditors (e.g., unsuitable investment advice or misrepresentation). However, Columns 1 and 2 of Table 8 show the opposite pattern: we find no economic or statistical change in Auditor-Related Complaints and a significant decline in Non-Auditor-Related Complaints. The point estimate of -2.248 for the Non-Auditor-Related Complaints is nearly identical to the -2.253 from our results from column 1 in Table 4.

A related explanation involves BDs switching auditors. The amendment may have compelled firms to switch auditors, and the new auditors could differ in their complaint tolerance. However, column 3 in Table 8 shows that our results persist when including BD-by-auditor relationship fixed effects.

Next, we consider regulator attention. Although the amendment focused on internal controls over compliance, it may have been enacted as part of a larger effort to improve customer protection, tighten enforcement, and reform BD-customer interactions. Under this explanation, however, we should find a common complaint decline across carrying and non-carrying BDs, contradicting our findings. We also note that equation (1) controls for FINRA district-by-year fixed effects, which account for time-varying unobservable enforcement differences within a region.

A more nuanced explanation involves regulator attention focusing on carrying BDs affected by the amendment. To investigate this, we study the party filing the complaint (customer, regulator, or firm). Column 4 in Table 8 shows no change in regulator-reported complaints. Additionally, in Table A.4 we study whether BDs located closer to the nearest FINRA office experience a significantly different complaint response. We find no evidence of regulator proximity contributing to our results.

We also consider whether changes in regulation unrelated to Rule 17a-5 could explain the complaint declines we find. For example, banks had staggered deadlines for adopting different provisions of Basel III. In Table 8, Column 5, we drop all BDs that are affiliates or subsidiaries of banks. Our results remain.[18] Regulation Best Interest (BI), effective in 2020, sets a new standard of conduct, effectively requiring BDs to act in the best interest of the customer (SEC 2019). BDs must also address conflicts of interest by establishing and enforcing procedures to identify and disclose conflicts of interest. Because BI applies to both carrying and non-carrying BDs, it is not clear how it could explain our particular complaint pattern. Likewise, Dodd-Frank affects only a subset of our BDs, and our analyses in Table A.5 show that our results are the same after eliminating them.

Together, the evidence in this section does not support auditor or regulator attention-based interpretations for our complaint results.

4.2.3 Exploratory cost-benefit analysis of RegTech investments

Under a complementarity explanation, complaint declines alone should not justify RegTech investments. Instead, complaint declines follow from complementary investments that rely upon data infrastructure and information quality improvements undertaken for compliance purposes.

[18] Our results strengthen if we drop all affiliated BDs (regardless of whether their affiliation is with a bank).

To examine this, we study settlements and sanctions detailed in individual complaints and implementation cost estimates from several sources. In terms of complaint costs avoided (i.e., the benefits), the average complaint filed against carrying BDs during our sample window resulted in $134,823 of settlements and sanctions. Our complaint results (Table 4, Panel A column 1) suggest a 2.3% decline in the complaint likelihood for carrying BDs. Assuming a 5% discount rate and that complaint declines persist, the implied savings for the average carrying BD are just over $60,000.[19]

As for expenditure costs, firms do not disclose what they spend on specific technological investments. Recall that the typical carrying BD is large (730 employees) and operates branches in 85 cities. A case study by Momoh (2015) reports that a similarly sized institution spent approximately $7.5 million on an ERP implementation; industry periodicals suggest a range between $1 million and $10 million and note that mergers and operational complexity (common in our setting) can raise costs significantly.[20] The costs are lower for smaller institutions with fewer software users, although implementation entails significant fixed costs including hardware and server infrastructure, training, support, testing, and customization.

For simplicity, we have abstracted away from other considerations. With this caveat in mind, the estimated implementation costs far exceed the benefits from complaint reductions, even allowing for reputation penalties avoided. Moreover, our estimated benefits would be much lower if we accounted for the skew in settlements and sanctions, and our estimated costs would be significantly higher if we considered management attention and business disruption required for implementation, ongoing license and support fees, or foregone revenue associated with tighter sales practices oversight. Finally, before the 2014 amendment, carrying BDs faced

[19] $134,823 x 2.253% / 5% = $60,751.
[20] See https://www.betterbuys.com/erp/erp-pricing-guide/

customer pressure to strengthen controls following the late 2000s Ponzi schemes and bankruptcies. Then, the additional investment we document after 2014 could be viewed as being beyond what BDs would have independently chosen absent the amendment. Overall, our rudimentary calculations support our complementarity interpretation.

5. RegTech and Market Concentration

Our final tests investigate the interaction between the amendment and the BD competitive environment, focusing on market concentration. Our motivation is threefold. First, because technological investments have a large fixed component, the amendment's burden falls more heavily on smaller BDs. The SEC's summary of and response to public comment letters on the amendment illustrate this concern, describing how "the costs could disproportionately impact smaller broker-dealers due to the fixed cost components… of compliance with these requirements" (SEC 2013).

Second, research illustrates how large FIs make greater use of hard information in their operations (Stein 2002; Berger, Minnis, and Sutherland 2017). Related, RegTech can create additional hard information, both by hardening soft information and by enabling measurement of previously unrecorded activity. Third, to the extent that RegTech investment complementarities are scalable, larger BDs may disproportionately gain. For example, larger firms have more customers and therefore more data to construct profitability, risk, and fraud prediction models. As a result, their models will be more accurate and can incorporate more nuances than those of smaller rivals with less data. Similarly, in virtue of their scale and scope, larger firms will have more investment, cross-selling, and synergistic opportunities.[21]

[21] Routledge (2018) discusses Amazon's acquisition of Whole Foods as an example: "The data Amazon extracts from Whole Foods has more value the larger is Amazon… Big data (and related processing) has larger impacts on large companies" (p. 90).

To illustrate, a recent industry report explains, "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*" (Martin 2021; emphasis added). Then, because the amendment compels technological investment at carrying BDs, it can lead to more advisors leaving non-carrying BDs for (larger) carrying BDs. Given the importance of advisors to firm size (advisors are the primary employee type and their client relationships drive assets under management), such turnover has direct implications for market concentration.

In Table 9, we model employee switches from one BD to another as a function of the origin and destination BD type (whether the origin and destination BD are carrying or non-carrying BDs), time (using our *Post* indicator), origin-by-destination BD pair fixed effects, and year fixed effects. The dependent variable is 100 times an indicator for whether any employee transitions from an origin BD to a destination BD in a particular year. As a baseline, the average annual probability of a switch from one specific BD to another is 20 basis points.

Column 1 of Panel A shows that after the amendment, the likelihood of an employee switching from a non-carrying to a carrying BD increases by six basis points, representing almost a one-third increase over the mean switching probability. Column 2 includes indicators for other types of matches. In the post period, we see the most sizable increase for switches between carrying BDs (*Joins Carrying, Left Carrying x Post* is 25 basis points), but we continue to find a sizable switching increase from non-carrying to carrying BDs.

Column 3 adds fixed effects for each origin BD (i.e., former employer) interacted with indicators for each year, such that we compare employee switches from the same BD in the same year to destination BDs of different types. Our results remain; moreover, we find the

propensity for employees to leave carrying for non-carrying BDs *declines*. Last, to further explore the role of scale, we add interactions with destination BD size, as proxied by having at least 100 employees in the prior year. We find the greatest transition increase from non-carrying to larger carrying BDs (*Joins Carrying, Left Non-Carrying x Post x* $Size_{t-1}$ is positive).

Panel B limits the sample to pairs where the origin BD has 100 or fewer employees. Our results are similar, with larger economic magnitude (for example, in columns 1-3 the coefficient of interest *Joins Carrying, Left Non-Carrying x Post* now represents half the subsample switching rate probability of 5 basis points). Together, these results illustrate how technological investment can influence employees to leave small non-carrying BDs and join carrying BDs, particularly large ones.

Finally, Table 10 studies market concentration at the MSA-year level. Following Gelman et al. (2021), we measure each BD's market share as the ratio of the total headcount across their branches in the MSA to total headcount across all branches from all BDs in the MSA. Studying the full set of BDs within an MSA allows us to measure concentration changes within a local market where households choose BDs, regardless of carrying status. We find significant concentration increases in the post-amendment period. The column 1 coefficient of 8.172 for *Post* indicates the Herfindahl-Hirschman Index increases by 9.3% in the post-amendment period, relative to the unconditional mean of 87.6. Columns 2 and 3 study the aggregate market share of the largest four and eight firms, respectively. We arrive at a similar inference: shares for the largest BDs increase post-amendment by between 2.5% and 3.0%. While we view this analysis as descriptive and cannot observe other dimensions of the competitive environment such as prices or profitability, our evidence at least suggests that the regulatory amendments had important effects on labor market structure.

6. Conclusion

Using amendments to internal control requirements at U.S. BDs, we show regulation has direct and indirect effects on technology adoption. The direct effect relates to data collection, data management, and information systems investments aimed at improving controls and record-keeping at affected firms. The indirect effect stems from these investments rendering sunk the information quality expenditures required to adopt CRM and business intelligence tools and more sophisticated websites. We then explore the operational effects of this technology adoption. We find carrying BDs subject to the amendment experience significant complaint declines. Complaint declines are concentrated in incidents most easily detected by technological monitoring and at non-headquarters locations. Our results cannot be explained by differences in size, product offerings, or regulator or auditor attention.

Though the BD setting has unique features, the nature of the regulation (internal control attestation) and response (IT investment) that we examine are common to other FIs. Our results point to two potential implications of the growth in RegTech investments in the financial sector. First, technological advances will strengthen the linkages between compliance and operating functions, especially as FIs increasingly rely upon RegTech solutions for compliance and more customer information is digitized. As our results illustrate, such linkages can have important effects on FI service quality. Second, when combined with large fixed compliance costs, complementarities of the type we document could increase the optimal size of FIs and lead to greater market concentration. Analyses of concentration are attracting significant attention (Philippon 2016), and our study motivates additional research on RegTech investments and market structure.

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Figure 1: Example Customer Relationship Management Tool

This figure presents excerpts from a CRM tool. Emphasis added (in yellow) for items referencing account activity tracking, audit trail, and notes and communications.

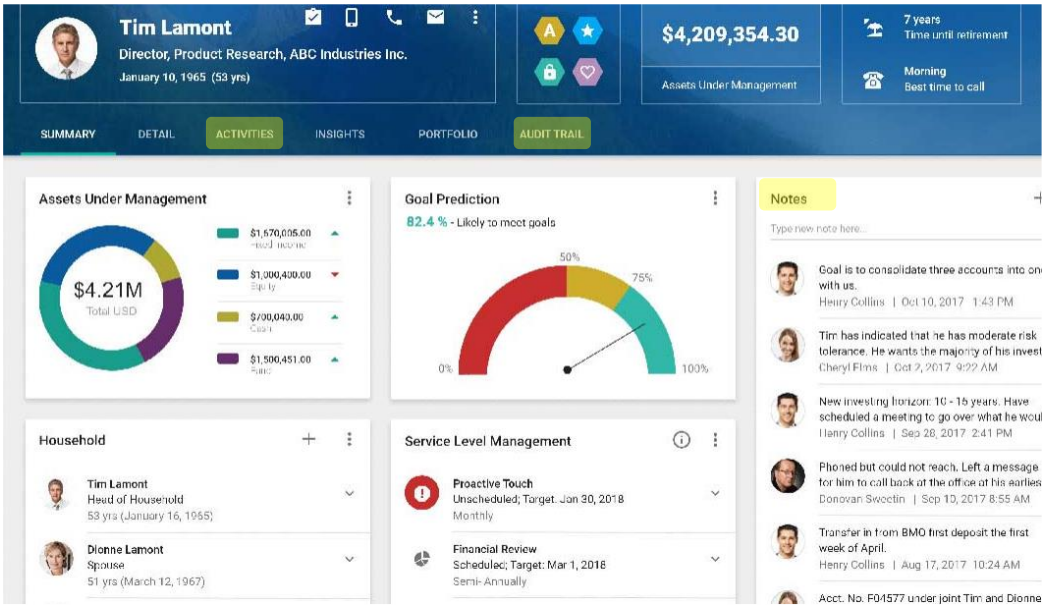
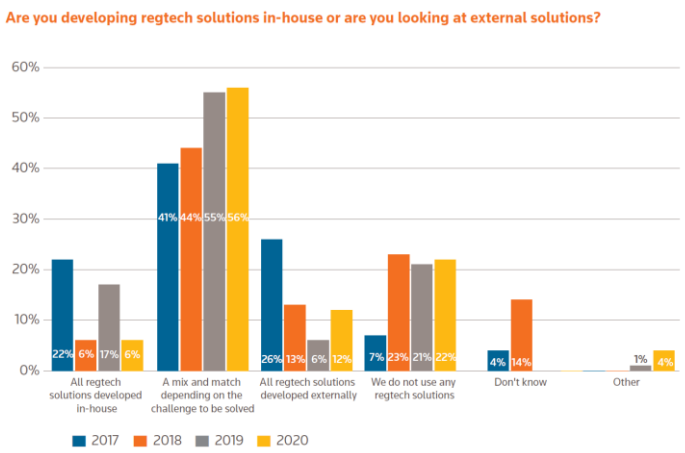
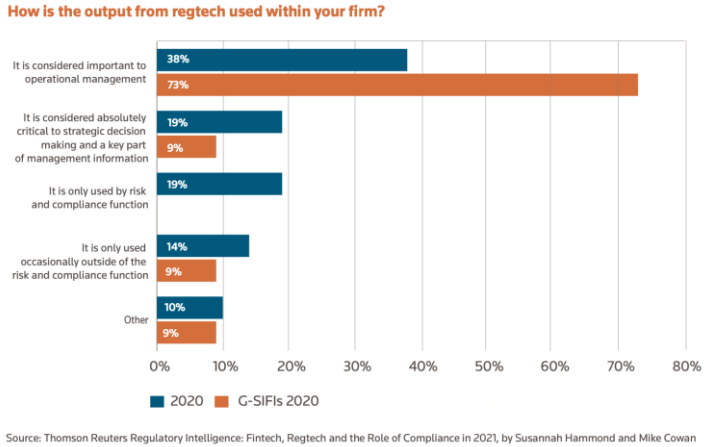


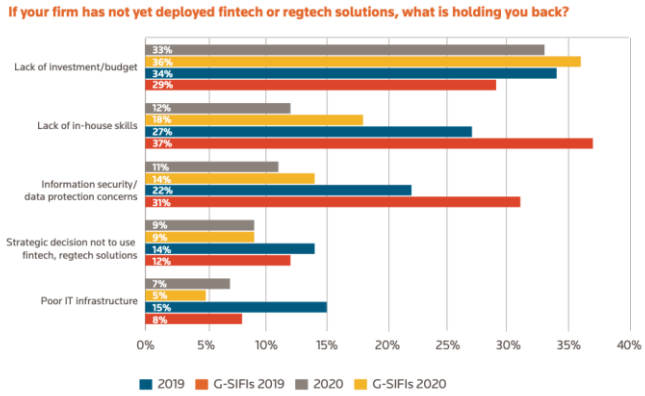
Figure 2: RegTech at U.S. Financial Institutions

This figure provides excerpts from the 2021 Thomson Reuters Regulatory Intelligence Survey (Thomson Reuters 2021). The acronym G-SIFI indicates a Global Systematically Important Financial Institution.

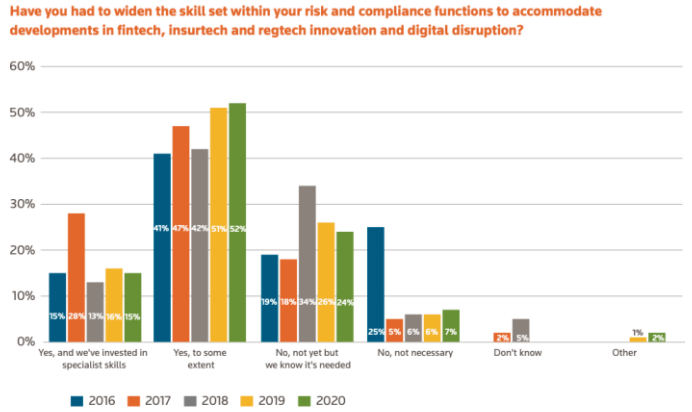




Source: Thomson Reuters Regulatory Intelligence: Fintech, Regtech and the Role of Compliance in 2021, by Susannah Hammond and Mike Cowan



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

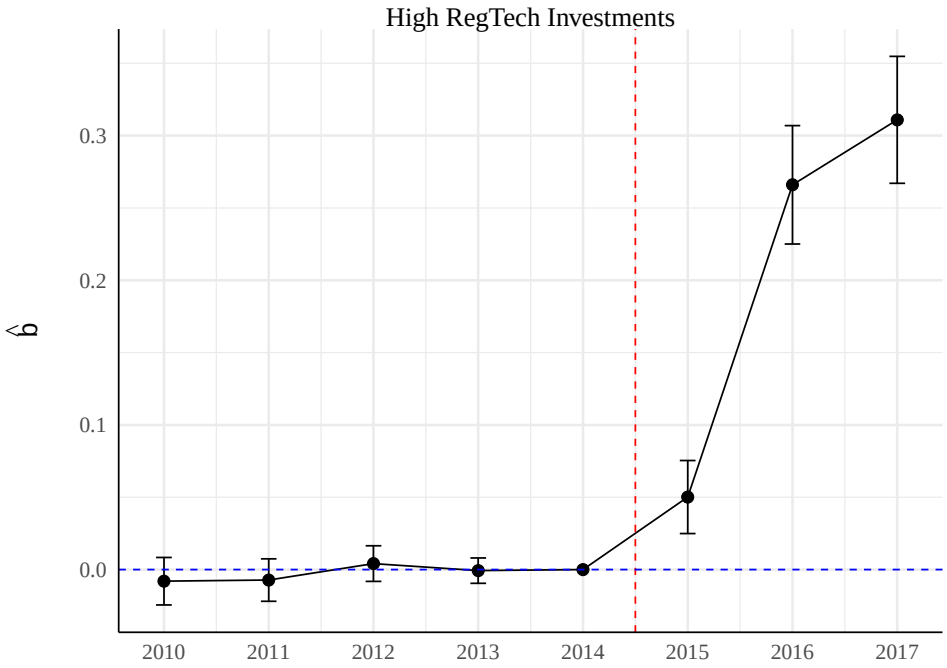


Source: Thomson Reuters Regulatory Intelligence: Fintech, Regtech and the Role of Compliance in 2021, by Susannah Hammond and Mike Cowan

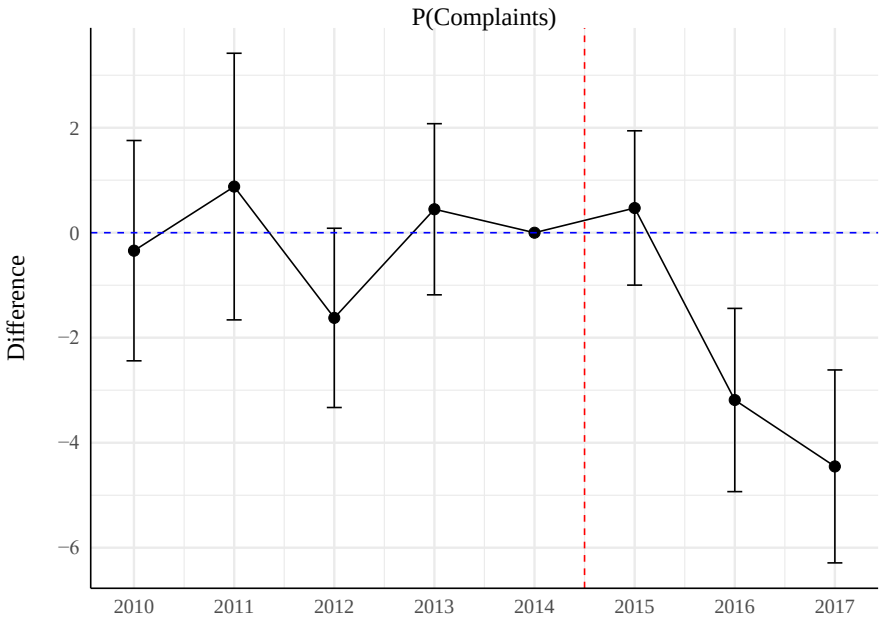
Figure 3: Event Time Plots

These figures plot coefficients from an event time version of equation (1). The holdout year is 2014. In Panel A, the dependent variable is an indicator for BDs with high RegTech investments. The indicator variable equals one for BDs with a) data management, ERP, CRM, or business intelligence software, and b) above-median number of website technologies or premium website technologies, and c) above-median IT budgets or above-median number of personal computers and laptops. In Panel B (C), the dependent variable is the difference between the probability of complaints at carrying and non-carrying BDs (difference between the inverse hyperbolic sine of the number of customer complaints at carrying and non-carrying BDs).

Panel A: RegTech Investments



Panel B: Probability of Complaints



Panel C: Number of Complaints

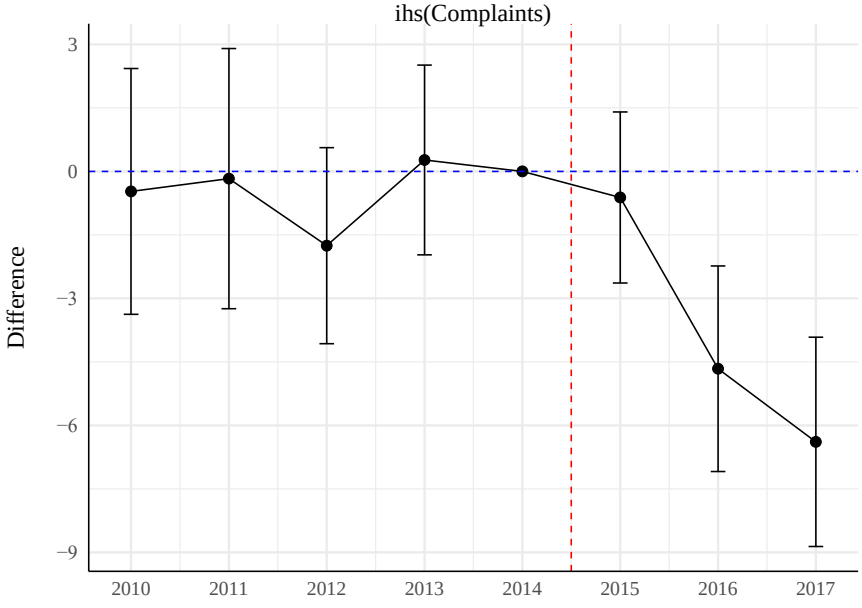


Table 1: Summary Statistics

This table presents summary statistics for our full sample in Panel A and the RegTech variables in Panel B. All observations are at the firm-year level. Values are rounded to three significant digits or three decimals, whichever is shorter, and values in Panel B are count variables as defined in Section 4.1 (except for the IT Budget, which is in $000s). The main sample has 26,530 firm-year observations from 4,547 unique firms. The Aberdeen Software sample has 4,415 firm-year observations from 1,762 unique firms. The Aberdeen Hardware sample has 10,996 firm-year observations from 2,210 unique firms. The BGT Skill Demand sample has 1,799 firm-year observations from 343 unique firms.

Panel A: 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
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

Table 2: RegTech Investments

This table studies RegTech investments using equation (1). In Panel A, the dependent variable is 100 times the inverse hyperbolic sine of the number of each software type, the number of servers or personal computers and laptops, or the IT budget. In Panel B, the dependent variable is 100 times the inverse hyperbolic sine of the number of job postings with a particular skill. *Post* is an indicator variable equal to one after 2014, and *Treated* is an indicator variable equal to one for carrying BDs. Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$. At the bottom of the table, we present the mean and standard deviation of the transformed dependent variable.

Panel A: Software and Hardware					
Dep Var:	Data Management	Enterprise Resource Planning	Servers	PCs & Laptops	IT Budget
	(1)	(2)	(3)	(4)	(5)
Treated × Post	12.10**	9.838*	44.43***	23.89***	63.14***
	(5.790)	(5.776)	(8.742)	(8.094)	(13.58)
N	4,415	4,415	10,996	10,996	10,996
R^2	0.836	0.666	0.925	0.928	0.856
Mean Dep Var	56.8	22.7	278	440	1,373
SD Dep Var	81.9	69.7	217	173	218

Panel B: Labor Demand		
Dep Var:	Compliance	Enterprise Resource Planning
	(1)	(2)
Treated × Post	13.79*	5.902**
	(8.248)	(2.366)
N	1,799	1,799
R^2	0.394	0.315
Mean Dep Var	19.5	2.58
SD Dep Var	75.1	20.1

Table 3: Complementary Investment

This table studies complementary investments. Panel A presents summary statistics. The Aberdeen Software sample has 4,415 firm-year observations from 1,762 unique firms. The BuiltWith Website Technologies sample has 10,114 firm-year observations from 1,830 unique firms. Panel B presents the results of estimating equation (1). The dependent variables are 100 times the inverse hyperbolic sine of the number of each software type (Panel B and C columns 1 and 2) or the number of unique technologies on the BD's website (Panel B column 3 and 4). Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$. At the bottom of the table, we present the mean and standard deviation of the transformed dependent variable.

Panel A: Summary Statistics

Variable	Mean	SD	P25	Median	P75
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

Panel B: Complementary Investment

Dep Var:	Customer Relationship Management	Business Intelligence	Website Technologies	Premium Website Technologies
	(1)	(2)	(3)	(4)
Treated × Post	13.260***	13.820**	11.120***	27.680***
	(4.648)	(6.904)	(4.131)	(5.480)
N	4,415	4,415	10,114	10,114
R^2	0.884	0.819	0.846	0.819
Mean Dep Var	57.3	62.4	360	99.4
SD Dep Var	101.8	95.8	90.9	94.7

Panel C: Placebo

Dep Var:	Anti-Virus	Other Tech
	(1)	(2)
Treated × Post	7.856	-13.300
	(5.328)	(8.350)
N	4,415	4,415
R^2	0.867	0.878
Mean Dep Var	97.9	427
SD Dep Var	95.5	144

Table 4: Complementary Investment and Customer Complaints

This table studies customer complaints using equation (1). The dependent variable in Panel A, column 1 (2) is 100 times an indicator for whether the BD has a customer complaint recorded on BrokerCheck that year (the inverse hyperbolic sine of the number of customer complaints). *High Inv* is an indicator variable for BDs with high technological investment as described in Section 4.2. Observations are at the BD-year level. All regressions include firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies p < 0.1, ** signifies p < 0.05, and *** signifies p<0.01. At the bottom of the table, we present the mean and standard deviation of the transformed dependent variable.

Panel A: OLS		
Dep Var:	Complaint	*f*(Complaints)
	(1)	(2)
Treated × Post	-2.253**	-3.490***
	(0.914)	(1.346)
N	26,530	26,530
R^2	0.566	0.617
Mean Dep Var	2.10	3.50
SD Dep Var	14.2	28.4

Panel B: Instrumental Variables			
Dep Var:	*High Inv*	Complaint	*f*(Complaints)
	(1)	(2)	(3)
Treated × Post	0.225***		
	(0.026)		
$\widehat{High\ Inv}$		-10.482**	-19.345*
		(5.134)	(11.045)
First-Stage Clustered F-Stat	10.742		
N	14,002	14,002	14,002
R^2	0.397	0.584	0.707
Mean Dep Var	0.060	3.50	5.15
SD Dep Var	0.238	18.4	28.7

Table 5: Investigating Customer Complaints- Technological Detection

This table studies customer complaints using equation (1). The dependent variable in column 1 (2) is 100 times an indicator for whether the BD has recorded an easy (hard) to detect complaint on BrokerCheck that year. Complaints that are easy to detect are defined in Section 4.2.1. Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies p < 0.1, ** signifies p < 0.05, and *** signifies p<0.01.

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

Table 6: Investigating Customer Complaints- Location and Affirmer

This table studies customer complaints using equation (1). The dependent variable in column 1 (2) is 100 times an indicator for whether the BD has recorded complaints at non-headquarter (headquarter) locations on BrokerCheck that year. The dependent variable in column 3 and 4 is 100 times an indicator for whether the BD has recorded a complaint on BrokerCheck that year. In column 3 (4), affirmer quality is 100 times an indicator variable for whether the affirmer in 2011 is a Chief Compliance Officer (high-ranking). Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies p < 0.1, ** signifies p < 0.05, and *** signifies p<0.01.

Dep Var:	Complaint Not in HQ	Complaint in HQ	Complaint	
2011 Affirmer Quality =			Affirmer is a Chief Compliance Officer	Affirmer is High Ranking
	(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

Table 7: Robustness

This table assesses the robustness of our Table 4 results using equation (1). The dependent variable in columns 1-3 is 100 times an indicator for whether the BD has recorded a complaint on BrokerCheck that year. In column 4 (5), the dependent variable is the number of complaints per employee times 100 (inverse hyperbolic sine of the total alleged damages, times 100). The dependent variable in column 6 is 100 times an indicator for whether the BD has customer complaints that are not later denied compensation, settlement, or restitution by FINRA, the SEC, or state regulators. Observations are at the BD-year level. All regressions include controls from equation (1) and include firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

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

Table 8: Auditor and Regulator Attention

This table investigates auditor and regulator attention-based explanations for complaint changes using equation (1). The dependent variable in column 1 (2) is 100 times an indicator for whether the BD has recorded an auditor-related (non-auditor related) complaint on BrokerCheck that year. The dependent variable in column 3 is 100 times an indicator for whether the BD has recorded a complaint on BrokerCheck that year. The dependent variable in column 4 is 100 times an indicator for whether the BD has a regulator-reported complaint on BrokerCheck that year. Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Column 3 includes firm x auditor fixed effects, and column 5 excludes BDs affiliated with banks. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

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

Table 9: Employee Switching

This table studies employee switching. The dependent variable is 100 times an indicator for whether the BD has an employee join from another specific BD that year, e.g., BD_i from BD_j. The independent variables are indicators for combinations of types of origin and destination BDs for the employee, times *Post*, an indicator variable equal to one after 2014. $Size_{t-1}$ is an indicator for destination BDs with at least 100 employees the prior year. The sample in Panel A includes all possible pairs of destination and origin BDs. The sample in Panel B is limited to pairs where the origin BD has 100 or fewer employees. Observations are at the BD firm pair-year level. For brevity, cross-terms are suppressed. Standard errors are clustered by destination BD and shown in parentheses. * signifies p < 0.1, ** signifies p < 0.05, and *** signifies p<0.01.

Panel A: Full Sample				
	Has Switcher			
	(1)	(2)	(3)	(4)
Joins Carrying, Left Non-Carrying x Post	0.0595***	0.0637***	0.0641***	0.00587
	(0.0110)	(0.0105)	(0.0105)	(0.00701)
Joins Carrying, Left Carrying x Post		0.254***	-0.0840	-0.137
		(0.0601)	(0.102)	(0.122)
Joins Non-Carrying, Left Carrying x Post		0.0160	-0.324***	-0.213*
		(0.0112)	(0.0700)	(0.110)
Joins Carrying, Left Non-Carrying x Post x $Size_{t-1}$				0.0486**
				(0.0200)
Joins Carrying, Left Carrying x Post x $Size_{t-1}$				0.226**
				(0.1091)
Joins Non-Carrying, Left Carrying x Post x $Size_{t-1}$				0.0933**
				(0.0440)
Post x $Size_{t-1}$				0.0705***
				(0.0082)
Origin x Destination Pair FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		
Origin BD x Year FE			Yes	Yes
N	29,446,680	29,446,680	29,446,680	29,446,680
R^2	0.410	0.410	0.411	0.411

Panel B: Origin BD has <=100 Employees				
	Has Switcher			
	(1)	(2)	(3)	(4)
Joins Carrying, Left Non-Carrying x Post	0.0252***	0.0260***	0.0262***	-0.00633
	(0.00643)	(0.00643)	(0.006434)	(0.00554)
Joins Carrying, Left Carrying x Post		0.0949**	0.0925*	0.156***
		(0.0414)	(0.04777)	(0.0594)
Joins Non-Carrying, Left Carrying x Post		0.00643	0.00391	0.139*
		(0.00613)	(0.05218)	(0.0825)
Joins Carrying, Left Non-Carrying x Post x $Size_{t-1}$				0.0428***
				(0.0124)
Joins Carrying, Left Carrying x Post x $Size_{t-1}$				0.118
				(0.0789)
Joins Non-Carrying, Left Carrying x Post x $Size_{t-1}$				0.0160
				(0.0217)
Post x $Size_{t-1}$				0.0151***
				(0.0044)
Origin x Destination Pair FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		
Origin BD x Year FE			Yes	Yes
N	23,157,251	23,157,251	23,157,251	23,157,251
R^2	0.368	0.368	0.369	0.369

Table 10: Labor Market Concentration

This table studies labor market concentration. The dependent variable in column 1 is the Herfindahl-Hirschman Index for the MSA-year, multiplied by 1,000, where the index is based on headcount. The dependent variable in column 2 (3) is the aggregate market share of headcount in percent at the top four (eight) firms. Observations are at the MSA-year level. All regressions include MSA fixed effects, and standard errors are clustered by MSA and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

Dep Var:	HHI	C4	C8
	(1)	(2)	(3)
Post	8.172***	2.467***	3.027***
	(1.084)	(0.240)	(0.216)
Observation Level	MSA-Year	MSA-Year	MSA-Year
N	2,984	2,984	2,984
R^2	0.947	0.903	0.910

Online Appendix

A.1. Data Merging

We merge our main sample of BDs with Aberdeen CiTDB and Burning Glass Technologies using a variety of methods, as the databases have no common identifiers. For both data merges, we include the observations in either databases with values of zero.

To match BDs to Aberdeen, we use two methods. First, we use CIK codes and EINs provided by Form BD to form a link to EIN, which allows us to link to firmographic databases such as Orbis containing DUNS numbers and websites. The websites and DUNS numbers serve as common identifiers with Aberdeen. Second, we conduct fuzzy-name matching on name and phone number and name and address directly between Form BD and Aberdeen. Our final software (hardware) dataset sample with non-missing control variables includes 1,762 (2,210) unique firms and 4,415 (9,034) firm-year observations.

To match to BGT, we rely entirely on fuzzy matching of names and locations, as BGT does not provide any mappings to standard identifiers. Using conservative criteria, we obtain 675 firm matches between Form BD and BGT. Our final sample with non-missing control variables includes 343 unique firms and 1,799 firm-year observations.

A.2. RegTech and Complementary Investments

Table A.2: Complementary Investments

This table studies complementary investments. The dependent variable in column 1 is an indicator for whether the BD has any CRM or business intelligence software. The dependent variable in columns 2 and 3 is the number of unique technologies on the BD's website. *RegTech Software* is an indicator for whether the BD has any data management or ERP software. *High PC / IT Budget or Software* is an indicator for whether the BD has an above median number of PCs, an above median IT budget, or invests in data management, ERP, CRM, or business intelligence software. *CRM* is an indicator variable for whether the BD has any CRM software. Column 1 uses only the Aberdeen software sample, column 2 uses the combined Aberdeen software and hardware sample, and column 3 uses the combined Aberdeen software and hardware sample with non-missing website technology data. Observations are at the BD-year level. The regression includes controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

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

A.3. Sample Details

Figure A.1. Covariate Balance

This figure illustrates the covariate balance for both the matched ("adjusted") and raw variables, based on the mean absolute difference.

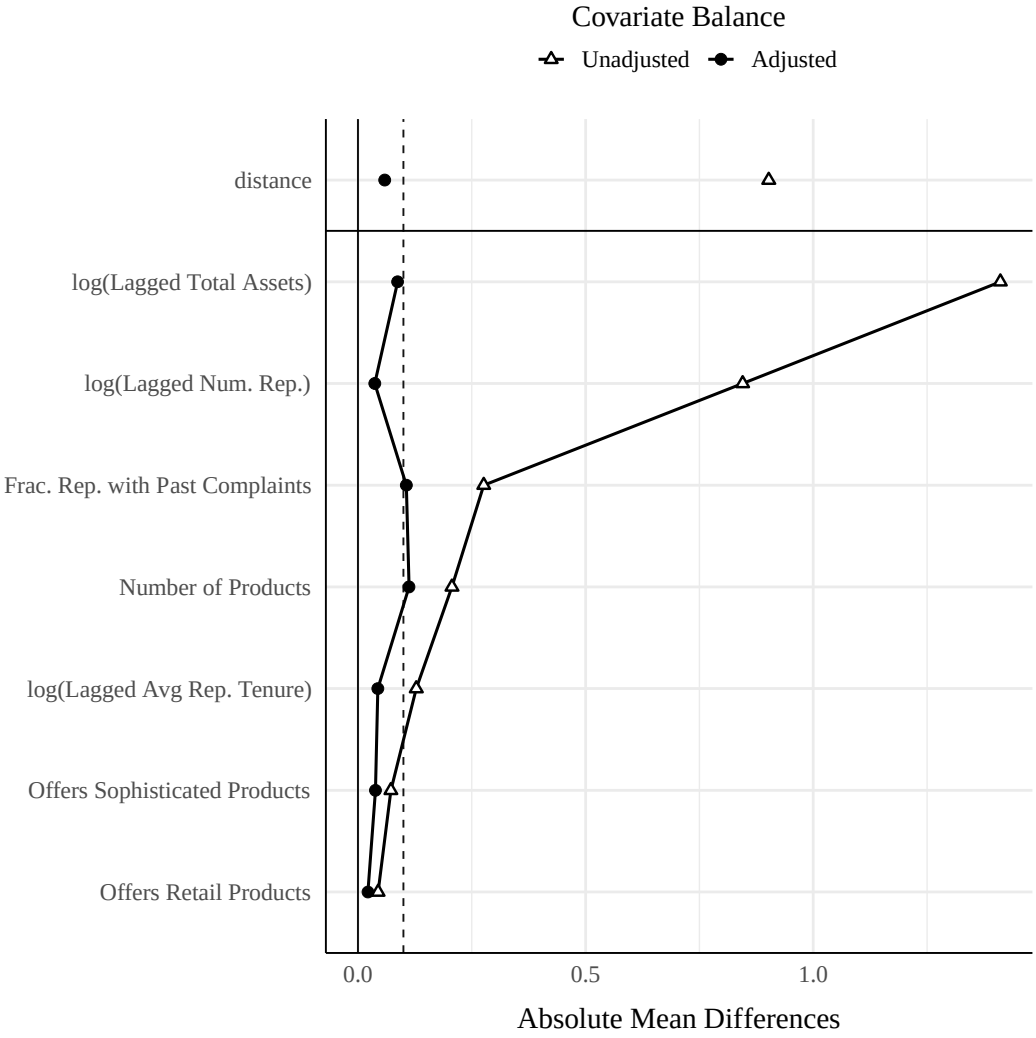


Table A.3: Additional Robustness Tests Controlling for Size and Product Offerings

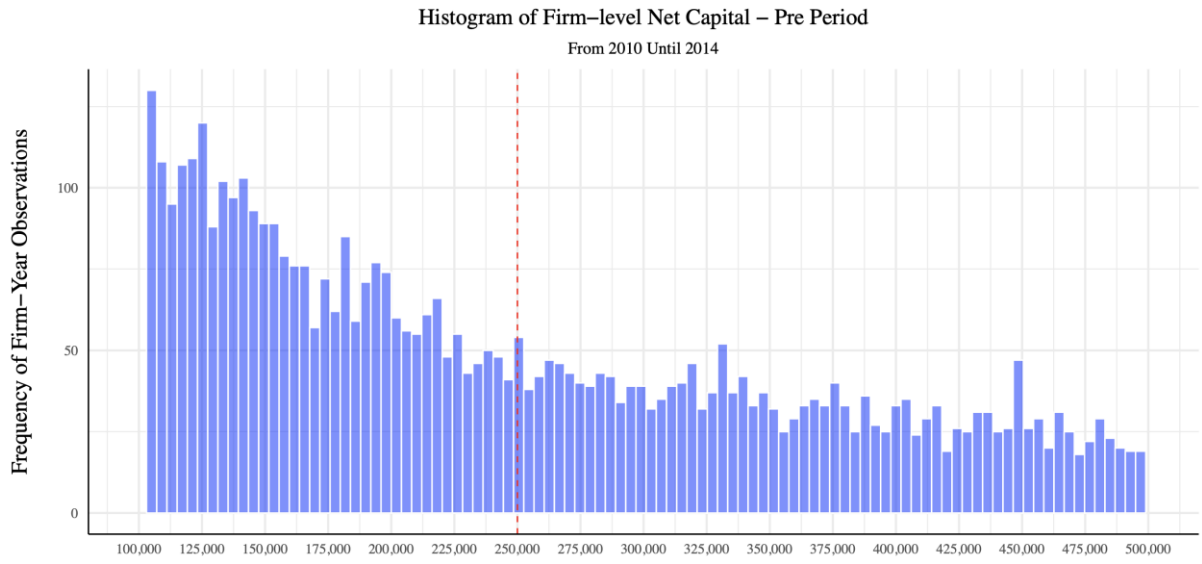
This table assesses the robustness of our Table 4 results using equation (1). The dependent variable in odd (even) columns is 100 times an indicator for whether the BD has a customer complaint recorded on BrokerCheck that year (the inverse hyperbolic sine of the number of customer complaints). Panel A evaluates alternate size controls or samples as labelled at the bottom of the table. Panel B includes interactions between *Post* and various product offering measures. *Product Type* in Columns 1 and 2 counts the number of unique product offerings at the BD. *Product Type* in Columns 3 and 4 (5 and 6) is an indicator for whether the BD offers retail-facing (sophisticated) products. Retail-facing products include investment advice, mutual funds, variable life insurance, or debt products, while sophisticated products include mortgage backed securities, private placements, and derivatives. Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

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

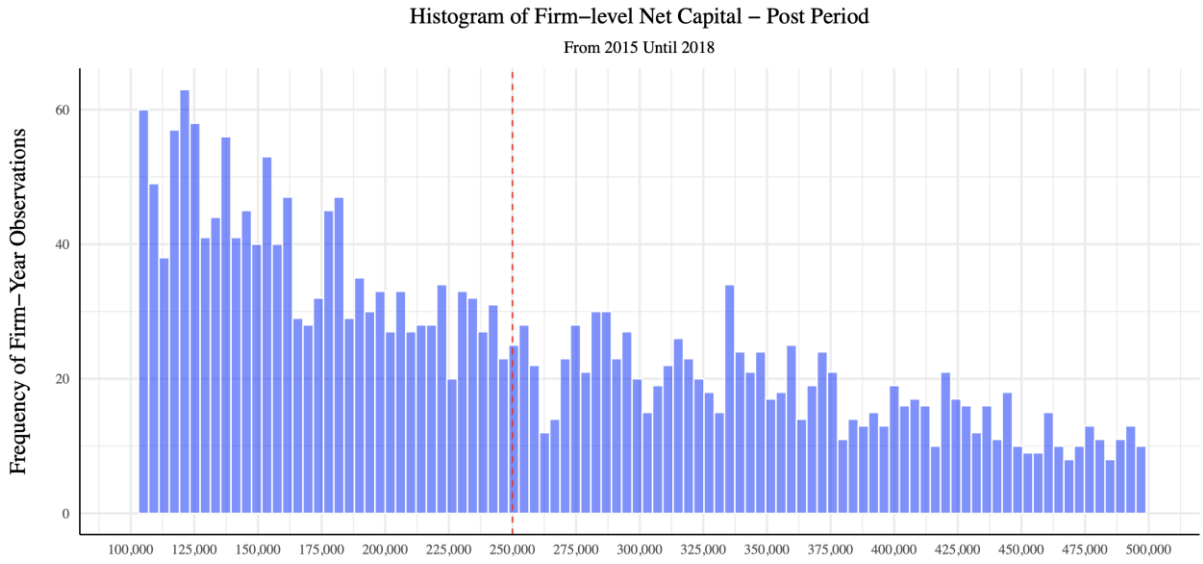
Figure A.2: Net Capital around Rule 17a-5 Amendment

The figures below present the histogram of Net Capital for BDs, zoomed in to focus between $100,000 and $500,000 of capital, separated into pre- and post-amendment periods.

Panel A: Pre-Amendment Period



Panel B: Post-Amendment Period



A.4. Regulatory Enforcement

Table A.4: Distance to Nearest FINRA Office

This table studies whether customer complaints depend on the BD's distance to the nearest FINRA office. The dependent variable in column 1 (2) is 100 times an indicator for whether the BD has a customer complaint recorded on BrokerCheck that year (the inverse hyperbolic sine of the number of customer complaints). *Distance from FINRA Office* is the log distance from the BD to the nearest FINRA office, relative to the unconditional median log distance. Therefore, the interaction coefficient can be interpreted as the difference in the treatment effect for a BD that is one percent farther from its nearest FINRA office than the median BD. Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

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

A.5. Dodd-Frank

The Dodd-Frank Act was enacted in July 2011. As documented in Charoenwong, Kwan, and Umar (2019), the Dodd-Frank Act changed the enforcement intensity of existing investment advisory rules for firms with less than $100 million in assets under management. Many BDs are also registered investment advisers. The regulation went into effect two years before our sample period. Therefore, we conduct three analyses to ensure that our empirical results are not driven by these changes.

First, we begin our sample in 2012, the year immediately following the enactment of the Dodd-Frank Act. Consistent with the evidence from Figure 3, columns 1 and 2 in Table A.5 show results similar to our original findings.

Second, we exclude BDs whose majority of employees are dual-registered as investment advisers. Those dual-registered employees must adhere to both BD rules and investment advisor rules, and are therefore affected by changes in investment adviser enforcement. Columns 3 and 4 show that our results strengthen when we exclude these employees.

Third, we exclude BDs reporting that they are conflicted on Form ADV due to having multiple lines of business. Columns 5 and 6 show that our results remain.

Table A.5: Dodd-Frank

This table assesses the robustness of our Table 4 results using equation (1). The dependent variable in odd (even) columns is 100 times an indicator for whether the BD has a customer complaint recorded on BrokerCheck that year (the inverse hyperbolic sine of the number of customer complaints). Each column limits the sample as labelled at the bottom of the table. Observations are at the BD-year level. All regressions include controls from equation (1) and firm and FINRA district-by-year fixed effects. Standard errors are clustered by firm and shown in parentheses. * signifies $p < 0.1$, ** signifies $p < 0.05$, and *** signifies $p<0.01$.

	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