Measuring Regulation

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Abstract

This paper uses occupational employment and wage data for over 270 industries from 1990 to 2017 to estimate the percentage of an industry's annual labor costs paid to perform regulation-related tasks. We hypothesize that this measure reflects the intensity of regulations that incentivize firm spending on compliance to avoid legal liability or regulatory sanctions. We study the sensitivity of this measure to shocks that change regulatory intensity in the finance and energy sectors. Compared to text-based measures that count words in regulations, our *Regulation Index* reflects broader sources of regulation, can better detect the impact of regulations, and can better distinguish deregulation from regulation. Using microdata, our methodology can also detect increases in regulatory intensity for publicly traded firms relative privately held firms *within an industry*, as we demonstrate using the Sarbanes-Oxley Act of 2002.

JEL codes: D22, G28, G38, K2, L5.

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1. Introduction

Regulation is challenging to quantify uniformly due to its tremendous variation across industries with respect to form, content, and enforcement. Recent efforts to measure regulation at the industry level focus on counting words in selected regulatory texts. Yet, more words do not always translate into more stringent regulation, and there are many sources of regulation that are not reflected in the selected texts. In this paper, we develop a different approach by examining the intensity of regulations reflected in the regulated industry's direct compliance spending.

In particular, we develop a novel index of regulation, *Regulation Index*, based on the *percentage* of an industry's labor costs dedicated to performing regulation-related tasks.[1] This Regulation Index can indicate regulation intensity assuming that firms spend resources on regulation-related tasks to reduce the risks of legal liability or penalties from regulatory infractions. Under this assumption, a profit-maximizing firm responds to regulation by spending resources until the marginal benefit of such spending (in reduced penalties and liability) equals the marginal cost of compliance (Becker (1968)). Thus, *ceteris paribus*, more stringent regulations with more severe penalties and stricter enforcement will induce firms to spend more on regulation-related tasks.

Our Regulation Index has several potential advantages compared to the text-based measures of regulation that count restrictive words in regulations. First, the Regulation Index is not confined to specific sources of regulations, such as the Code of Federal Regulations that many text-based measures focus

[1]We define regulation-related tasks formally in Section 3. Examples of regulation-related tasks include "verify that transportation and handling procedures meet regulatory requirements" for agricultural inspectors, and "Interpret safety regulations for others interested in industrial safety [...]" for health and safety engineers. A survey of 577 U.S. manufacturers in 2014 suggests that over two thirds of direct compliance costs are in-house labor costs devoted to compliance. Other important categories include capital investment and maintenance and expenditures on outside advisors (see Crain and Crain (2014)).

on. Rather, it can pick up any source of regulation including state, local, judicial, and even privately-enforced regulations. Second, the Regulation Index can better detect impactful regulations that require industry compliance because such regulations are likely to induce firms to spend more on regulation-related tasks. Third, our Regulation Index can more clearly identify deregulation as profit-maximizing firms can reduce spending on compliance tasks after deregulation. In contrast, text-based measures struggle to distinguish deregulation from increased regulation because both can increase the length of regulation texts.

To construct the Regulation Index, we first obtain an occupation's tasks as well as an importance scaler of each task for the occupation from the O*Net database. We classify a task as *regulation-related* if the task's statement includes keywords related to regulations. We next compute the aggregate importance of regulation-related tasks for each occupation. Finally, we create an industry's Regulation Index by aggregating the importance of regulation-related tasks for all occupations in the industry, weighted by each occupation's labor costs in the industry.[2] By using occupations' labor costs as weights, our Regulation Index can naturally be interpreted as the proportion of an industry's labor costs paid to perform regulation-related tasks. This procedure results in the Regulation Index for over 270 industries for each year from 1990 to 2017.

We conduct extensive validity tests of our Regulation Index measure. First, we observe that the Regulation Index, which captures mainly an industry's in-house spending on regulation-related tasks, is also positively correlated with the industry's outsourced legal spending. This correlation is significant both across industries and across time within industries. Such complementarity between in-house and outsourced spending reinforce our confidence that our

[2]We obtain employment and wage rate of each occupation within each industry from the publicly-available Occupational Employment Statistics (OES) data from the Bureau of Labor Statistics. An occupation's labor costs is the production of employment and wage rate.

Regulation Index indicates an industry's total compliance costs.

Second, we explore the response of our Regulation Index to three industry-specific regulatory shocks through case studies. First, we consider deregulation of the oil and gas extraction industry under the Energy Policy Act (EPAct) of 2005. Next, we track re-regulation of the industry after the BP Deepwater Horizon oil spill in 2010. Finally, we consider regulation of financial industries under the Dodd-Frank Act of 2010. For comparison, we also show responses to these shocks for the text-based measure of regulation—the RegData measure by Al-Ubaydli and McLaughlin (2017).

Our Regulation Index produces robust results to all three shocks—declining after deregulation and increasing during regulation for the regulated industries. In contrast, the RegData measure generates mixed results. In particular, the RegData measure struggles to identify deregulation and to distinguish which sub-sectors in the financial industry are most heavily regulated by the Dodd-Frank Act.

Our Regulation Index should be best interpreted as an indicator of regulatory intensity for an industry as a whole over time. At the micro level, a firm's response to regulation may include both a common component and an idiosyncratic component. By aggregating to the industry level, our regulation index reflects the common component of firm responses within an industry. In addition, because firms within the industry are weighted by total labor spending, our measure is likely to reflect the responses to regulation of large firms more than small ones.

Given that our goal is to propose not only a new industry-level measure, but also a new methodology to detect the intensity of regulation, we further validate our methodology at the firm level *within each industry*. We explore the enactment of Sarbanes-Oxley Act (SOX) in 2002 which increased the regulations on financial reporting and internal controls primarily for publicly traded firms but not for privately held firms. We use establishment-occupation level

OES microdata to compare the Regulation Index of establishments owned by publicly traded firms to establishments in the same industry and state, and with similar employment size that are owned by privately held firms. We find strong evidence that after the enactment of SOX, the Regulation Index increased dramatically for publicly traded firms compared to privately held industry peers.

It is important to note that our measure and methodology may not be sensitive to several kinds of regulations. First, regulations that clearly mandate capital expenditures, such as purchasing pollution abatement equipment, may entail minimal changes in labor costs. Second, regulations that clearly prohibit a specific line of business, such as a ban on advertising tobacco products on broadcast television, may cause industries to terminate lines of business rather than spend resources on compliance. Third, regulations that directly create barriers to entry, such as licensing requirements, may affect potential entrants more than incumbents and thus can be underestimated by our measure.

The rest of this paper is organized as follows. Section 2 discusses previous attempts to measure regulatory complexity and burdens and the limitations of those attempts. Section 3 explains our data and methods of constructing the Regulation Index. Section 4 validates the Regulation Index using regulatory and deregulatory shocks that affect different industries or different types of firms within industry differently. Section 5 concludes.

2. A Review of Existing Measures of Industry Regulation

At least four approaches to measuring regulation have historically been used.

The first approach is text-based. It involves a quantitative measure of cod-

ified text such as statutes or regulations. Goff (1996), Dawson and Seater (2013), and Mahoney (2019) count words in the U.S. Code or in the Code of Federal Regulations (CFR). Al-Ubaydli and McLaughlin (2017) developed "RegData" to further improve identification of regulations by counting restrictive words in the CFR such as "shall", "must", "may not", "prohibited", and "required".

These text-based measures provide the first set of measures of regulation for a panel of industries over a long time-series. The use of these measures is apparent. Yet, one may be concerned about this text-based approach in that more words or more restrictive words in regulation do not necessarily reflect the burdensomeness of regulation or the enforcement of regulation. First, one restrictive word may mean more or less burdensomeness depending on the sentence.[3] Second, regulatory texts may still grow in length for *deregulation* or regulations that benefit the industry. Third, a regulation that is later overturned by case law may still remain in the regulatory texts but have little impact.

The remaining three approaches focus on specific industries or specific time periods and therefore can hardly be generalized across all industry-years. Specifically, the second approach involves an examination of regulatory resources such as head counts or budgets of particular federal regulatory agencies (Goff (1996) and Jackson (2007)). The third approach involves quantifying regulatory enforcement actions, inspections, or other activities (Gray and Shadbegian (1993)). The fourth approach tracks barriers to entry such as licensing requirements and anti-competitive pricing floors within particular markets.[4]

[3]For an obvious example, a regulation which says "You may not do A through Z" seems both shorter and more burdensome than a regulation that says "You may not do A, unless any of the following exceptions apply".

[4]Studies that measure barriers to entry typically focus on cross-country or cross-state comparisons without industry-specific detail (Nicoletti and Scarpetta (2003), Bassanini and Ernst (2002), Djankov et al. (2002), Aghion et al. (2010), among many others). Nicoletti and Scar-

Another concern with all these measures is that they are tied to specific sources of regulation. Hence, they do not reflect regulations from other sources, such as from private rights of action enforced by plaintiffs' lawyers, from self-regulatory organizations such as the Financial Industry Regulatory Authority or securities exchanges, from common law created by the judiciary, from state or local laws and regulations, and from rules in other leading jurisdictions that affect U.S. firms (See e.g., Agrawal (2013) and Macey and Miller (1991)).

In summary, we believe a new measure of regulation is needed that (i) can better assess the impact of regulations and identify deregulation, (ii) can reflect industries' regulation from multiple sources, and (iii) is available at the detailed industry level on an annual-basis for over a decade. Our Regulation Index aims to fill this gap.

3. Constructing the Regulation Index

We construct an industry Regulation Index based on the proportion of an industry's labor costs paid to perform regulation-related tasks—principally performed by legal and compliance occupations. The following example illustrates our methodology. After the example, we discuss our methodology and data in greater detail. Imagine an industry that hires only two workers working in two different occupations. The first occupation pays \$20 per hour for performing two different tasks, neither of which is regulation-related, while the second occupation pays \$40 per hour for performing two different tasks, one of which is regulation-related. The regulation-related task is one third as important (or is performed one third as frequently) as the other task for the second occupation. We then compute the industry's labor costs for performing regulation-related tasks as \$10 (\$40 $\times$ 1/4) and the industry's total labor costs as \$60 (\$20 + \$40). The industry's Regulation Index is the ratio of the

petta (2003) use this approach to measure industry regulation in a single year, 1998.

two costs 0.17 ($10/$60).

More formally, we construct our industry Regulation Index following three steps. In the first step, we identify "regulation-related" tasks through textual analysis of the O*Net 23.1 database—a dictionary of occupations maintained by the U.S. Department of Labor. We obtain task statements for 964 occupations classified under the 8-digit Standard Occupational Classification (SOC) codes. Each occupation is associated with between 4 (shampooers) and 40 (special education teachers for elementary schools) tasks, with an average of 22 tasks per occupation. Importantly, each task is assigned several values by occupational experts or incumbents to indicate how important the task is or how frequently the task is performed for the occupation.

We identify a task to be regulation-related if its statement (usually a one-sentence description) includes one or more of the following keywords: *Compliance, Complied, Complies, Comply, Complying, Safety, Codes, Law, Laws, Lawsuit, Lawsuits, Legal, Legalities, Legality, Legislate, Legislated, Legislates, Legislating, Legislation, Legislature, Ordinance, Ordinances, Regulatory, Regulation, Regulations, Statute, Statutes, Statutory.* We then manually examine the statements to rule out false positives such as statements that mention computer programming codes. This procedure identifies 833 regulation-related tasks out of a total 19,612 tasks in the O*Net database.

Table 1 lists several examples of the regulation-related tasks. Such examples include "verify that transportation and handling procedures meet regulatory requirements" for agricultural inspectors, or "Interpret safety regulations for others interested in industrial safety [...]" for health and safety engineers.

[TABLE 1 ABOUT HERE]

In the second step of constructing our Regulation Index, we compute the importance of regulation-related tasks for each occupation, which we label as

"regulatory-task intensity" (RTI) for the occupation, by averaging all tasks for each occupation weighted by their importance value discussed above. Weighting by frequency of tasks performed by each occupation instead of importance gives very similar results. We further aggregate RTIs to occupations at the 6-digit SOC level for future use. To be conservative and ensure that we are capturing spending on intensive performance of regulation-related tasks, we further classify occupations as "regulation-related occupations" if their RTIs are above 0.2; that is, occupations with over 20% of their tasks (weighted by importance) are regulation-related occupations. We set RTI for all the other occupations at zero so that spending on occupations that perform minimal regulation-related tasks are not included in our calculation of the Regulation Index.[5]

Table 2 lists the RTI for all the 20 regulation-related occupations.[6] We see regulation-related occupations can largely be divided into legal-related occupations, such as lawyers and law clerks, and compliance-related occupations, such as compliance officers and financial examiners.

[TABLE 2 ABOUT HERE]

In the third step, we compute the proportion of each industry's labor costs paid to perform regulation-related tasks. We use the Occupational Employment Statistics (OES) data from the Bureau of Labor Statistics (BLS), which provides information on head counts and mean hourly wages for each occu-

[5]In untabulated analyses, we perform robustness checks by varying the RTI cutoff. The results are very similar to our main results.

[6]Because we are interested in private sector response to regulation, we then excluded occupations that have RTI above 0.2 but are employed only by the government from our list of regulation-related occupations, including Administrative Law Judges, Adjudicators, and Hearing Officers (SOC code 23-1021) and Judges, Magistrate Judges and Magistrates (SOC code 23-1023), Fish and Game Wardens (SOC code 33-3031). We also exclude Managers, All Other (SOC code 11-9199) since it is unclear what exact type of managers are included in this occupation.

pation within each industry.[7] The OES data use the 5-digit OES occupational classification, with 828 detailed occupation definitions before 1999, and use the 6-digit Standard Occupational Classification (SOC), with 896 detailed occupation definitions in 1999 and subsequent years. We match the RTI for each 6-digit SOC occupation in the later sample, and we construct the RTI for the 5-digit OES occupation using a crosswalk from the SOC and OES, provided by the BLS. Lastly, we compute an industry's Regulation Index as the percentage of labor costs paid to perform regulation-related task as follows:

$$\text{Regulation Index}_i = \frac{\sum_j RTI_j \times emp_{i,j} \times wage_{i,j}}{\sum_j emp_{i,j} \times wage_{i,j}} \times 100, \tag{1}$$

where RTI_j is the RTI for occupation j, $emp_{i,j}$ and $wage_{i,j}$ are the number of employees and hourly wages for occupation j in industry i.[8]

The OES data use the 3-digit Standard Industry Code (SIC), with 378 industry classifications before 2002, and use the 4-digit North American Industry Classification System (NAICS), with 290 industry classifications starting from 2002. Because we are focusing on regulation on private industries, we exclude industry categories which provide legal or compliance work as their primary source of revenue or function: legal services (i.e., law firms), accounting firms, government administration, courts, and central banking. Consistent with the literature (Song et al. (2018)), we also exclude educational institutions.

[7] This data is constructed based on surveys of 1.2 million establishments in the U.S. over 3-year cycles, covering 62% of total national employment from 1990 to 2016. Every six months, the OES program selects a panel of 200,000 establishments that are nationally representative. Most establishments are surveyed once every three years to reduce respondent burden. Then, the OES program aggregates information from the last three years (six panels) to produce statistics of the occupational composition within each industry.

[8] OES treats annual wages as hourly wages multiplied by 2,080. Hence, using either hourly wages or annual wages does not affect our Regulation Index measure. The OES data do not have wage information before 1998. Therefore, for years before 1998, we estimate the hourly wages from the Census Current Population Survey Merged Outgoing Rotation Groups (CPS-MORG) following Zhang (2018).

Industries differ substantially in their Regulation Index in the cross-section. While 81 NAICS 4-digit industries have Regulation Indexes equal to zero in 2016, highly regulated industries, e.g., financial and energy industries, as shown in Table 3 can have a Regulation Index ranging from 0.86 to 3.21 in 2016. Figure 1 plots the time-series of our Regulation Index aggregated across all private industries, weighted by industries' total labor costs. We observe that the Regulation Index increased dramatically from 0.19 in 2002 to 0.30 in 2016.[9] Table 4 provides the pooled summary statistics of the Regulation Index at the NAICS 4-digit industry level during 2002-2016. The average industry has a Regulation Index of 0.17 with a standard deviation of 0.33.

[TABLE 3 ABOUT HERE]
[TABLE 4 ABOUT HERE]
[FIGURE 1 ABOUT HERE]

4. Validation of Regulation Index

4.1 Relation with Other Regulation-related Measures

We examine the relations between our Regulation Index and three other measures that are related to regulation as a first-pass to validate our measure. We discuss these relations below.

4.1.1 Relation with Outsourced Legal Services

Our Regulation Index by construction captures an industry's in-house spending on regulation-related tasks. Firms may also outsource legal work to law

[9] OES data starts to use the NAICS industry classification after 2002. Hence, our Regulation Index can be linked to other variables mostly after 2002. Given that many other variables are available until 2016, our empirical analyses focus on the period of 2002 to 2016.

firms and such spending on outsourced legal services can also be part of the firms' response to regulation. Chayes and Chayes (1985) show that firms with more outside legal work typically also have larger in-house legal and compliance groups. If in-house and outsourced spending are correlated, we can be more confident that our measure based on in-house spending is likely to function as an indicator of the total regulatory intensity on industries.

To examine the relation between the Regulation Index and outsourced legal spending, we construct a measure of outsourced legal spending for 64 industries using the Input-Output table from the Bureau of Economic Analysis. For each year, we compute an industry's reliance on outsourced legal services as the percentage of its costs on legal services input out of its total input costs. Because our regulation Index is based on OES surveys which aggregate data through a 3-year moving average, we measure an industry's outsourced legal spending using a similar fashion by averaging the percentages across $t-2$ to t. Lastly, we aggregate our Regulation Index from the NAICS 4-digit level to the BEA industry level, weighted by the detailed industries' total labor costs.

We find a positive correlation of 0.42 between outsourced legal services and our Regulation Index during 2002-2016. Panel A of Table 5 shows that this relation is statistically significant. The additional finding in the cross-section that industries with high Regulation Indexes also have high outsourced legal spending reinforces Chayes and Chayes (1985)'s findings using earlier data. Moreover, we also find a positive relation between in-house and outsourced spending in the time-series within industry whiling controlling for time trend, suggesting that the two variables tend to move together over time. In light the strong positive relation between in-house and outsourced spending on regulation-related tasks, we are confident that our Regulation Index can be a valid proxy for industries' regulatory intensity.

Figure 2 shows the time-series of aggregated outsourced legal spending for private industries in the U.S. from 1992 to 2017. Note that in addition to

an upward trend, outsourced legal spending exhibits pronounced counter-cyclicality—it increased dramatically during the 2008-2009 great recession. This difference in cyclicality between outsourced legal spending and our Regulation Index could be because legal services such as bankruptcy, restructuring and litigation, which are counter-cyclical, tend to be outsourced to law firms whereas regulatory compliance tends to be handled in house.

[FIGURE 2 ABOUT HERE]

4.1.2 Relation with Text-based RegData Measure of Regulation

The RegData measure of regulation, first introduced in Al-Ubaydli and McLaughlin (2017), has become a popular proxy for regulation in recent years. Despite the wide-use of this measure, as we discussed in Section 2, we believe RegData is likely to include regulations that are favorable to industry (or captured by industry) as well as those that burden industry, whereas our Regulation Index more selectively measures regulations that are burdensome to industry. In addition, we believe our Regulation Index can better assess the burdensomeness of regulations and better capture deregulation than the text-based RegData measure. We analyze these differences in greater detail in Section 4.2.

With that said, for regulations that are not captured by industry and are highly burdensome, we believe both RegData and our Regulation Index, by measuring the enactment and reactions to regulations, respectively, should reflect regulatory intensity on industries. To compare the Regulation Index and RegData, we obtain the NAICS 4-digit RegData version 3.1 from QuantGov.org and merge the measure with our Regulation Index.[10] We see in Panel

[10]RegData provides a balanced panel for 134 industries out of over 300 NAICS 4-digit industries. We focus on these identified industries in our main text when analyzing the effects of RegData. The results are similar if we include the rest of the industries in our analyses

B of Table 5 that the two measures are significantly positively correlated both across industries and within industries. In addition, Figure 3 shows that the aggregated RegData for all private industries also exhibits an upward trend which is similar to the trend of our Regulation Index.

[FIGURE 3 ABOUT HERE]

4.1.3 Relation with Lobbying Spending

Lobbying is a way industries can influence regulators to encourage regulation that is more favorable (or less harmful) to lobbying firms. *A Priori*, the relation between lobbying spending and our Regulatory Index could go either way. If consumer demand for regulation is fixed, more industry lobbying spending can reduce the passage of burdensome regulations, which would reduce observed regulatory intensity on lobbying industries (Peltzman (1976)). However, if regulatory intensity would change over time holding industry lobbying constant, for example if consumers demand more regulations on banks after the financial crisis in 2008 and 2009, then firms might spend more on lobbying activities to limit the increase in regulatory intensity, yet still face increased regulation and therefore have incentives to also spend more on regulation-related tasks.

We obtain industries' annual lobbying spending from the Center for Responsive Politics (CRP) and create a matching Regulation Index for 207 broader industries available in the lobbying data.[11] Panel C of Table 5 shows that lobbying spending and Regulation Index are positively correlated in the cross-section, i.e., industries that spend more on lobbying activities also spend more

and regard them as unregulated, i.e., we impute the RegData measure for those industries as zero.

[11]The CRP lobbying data categorizes industries based on the SIC codes. We crosswalk our NAICS industry codes to the SIC codes using a crosswalk from Fort and Klimek (2018).

on regulation-related tasks. When examining the time-series by including industry fixed effects, we see an insignificant relation between the two. Hence, for a given industry, increased lobbying spending some times corresponds to more realized regulatory intensity, other times corresponds less as we discussed earlier.

[TABLE 5 ABOUT HERE]

4.2 Validation based on Industry-Specific Regulatory Shocks

After validating our Regulation Index by comparing it with other regulation-related measures, we next examine whether our Regulation Index can pick up large regulatory shocks to industries. Our test of sensitivity to regulatory shocks has two prongs. As an initial test, we expect to see our Regulation Index go up for an industry after a large industry-specific regulatory shock, and to fall after industry-specific deregulation. If major regulatory shocks are burdensome and less susceptible to regulatory capture, then failure of the Regulation Index to respond, or responses in the wrong direction would falsify our measure.

As an additional test, we demonstrate advantages of our measure over text-based measures in earlier literature. As we discussed in Section 3, our Regulation Index has potential advantages in distinguishing high-impact regulations from low-impact ones and distinguishing legal changes that are deregulatory from those that increase regulatory burdens. Specifically, we compare our measure to the most recent version of RegData, a text-based measure of regulation.

We identify regulatory shocks in the oil and gas extraction industry and in the financial industry to use as case studies. For the oil and gas extraction industry, we consider deregulation under the Energy Policy Act of 2005 and

re-regulation following the Deepwater Horizon oil spill of 2010, and for the financial industry, we examine the Dodd-Frank Act of 2010. We examine how our industry Regulation Index responds to the shocks.

To distinguish regulatory shocks from trends, we identify a control industry or group of industries that exhibit parallel trends to the treated industry with respect to the Regulation Index prior to the regulatory shocks. We construct the control group based on input-output relations. Specifically, we select the top downstream industries as control industries if they use a significant amount of the treated industry's output as their inputs. Downstream industries share close economic ties with the upstream treated industry. Thus, both industries may be affected by similar economic and regulatory forces prior to the shocks.[12] One challenge with this approach is that the control group may also be affected by the new regulatory shocks. If so, we will be less likely to detect significant differences between the treated and control groups post-treatment. In this sense, our selection of control industries is conservative.

4.2.1 Energy Policy Act and Deregulation of Oil & Gas Industries

The Energy Policy Act of 2005 (EPAct) deregulated domestic oil and gas production with the intention of increasing production by reducing environmental regulations. EPAct exempted oil and gas extraction from some requirements under the Safe Drinking Water Act and Clean Water Act, preempted state and local regulations relating to oil and gas extraction, refining, storage and transportation, exempted hydraulic fracturing from regulation by the Environmental Protection Agency (except when diesel fuel is injected into the ground), streamlined environmental review of oil, gas, and coal extraction

[12]While intuitive, choosing control industries based on input-output relations offers no guarantee that the treated and control industries will exhibit parallel trends in the Regulation Index during the pre-treatment periods. We examine this necessary condition empirically when analyzing each regulatory shock.

leases on federal lands, and deregulated oil, gas and coal leases on Indian lands by removing the requirement of approval from the Secretary of the Interior (Holt and Glover (2006)).

Our treated industry is oil and gas extraction (NAICS 2111). Using Input-Output data from BEA, we observe the top 10 detailed industries that use significant among of oil and gas products as inputs in 2007 are from the following 3 broader industries: petroleum and coal products manufacturing (NAICS 3241), natural gas distribution (NAICS 2212), and basic chemical manufacturing (NAICS 3251).[13] We thus select the above three industries as the control group.

As shown in Figure 4, there were parallel trends of Regulation Index for the oil and gas extraction industries and its control industries before the enactment of EPAct. After 2005, there is a dramatic decline in the Regulation Index for oil and gas extraction relative to the control industries. This decline in the Regulation Index for oil and gas extraction is consistent with contemporary interpretation of of EPAct as deregulatory for those industries. From 2005 to 2008, the Oil & Gas Industry reduced regulation-related labor costs by $ 56 million; while the control industries *increased* regulation-related labor costs by $40 million.

To the contrary, the RegData regulation measure based on counting restrictive words of the CFR does not detect the decline in regulation for oil and gas extraction either in absolute terms or relative to control industries. Perhaps not surprisingly, RegData measure shows an increase in regulation of oil and gas extraction after the EPAct is signed into law. We interpret this as evidence that the Regulation Index is better able to distinguish regulation from deregulation than other measures of based on counting words in legal documents.

[13]The Input-Output Account Data from BEA provides information at the detailed industry level for only 2007 and 2012. See https://www.bea.gov/industry/input-output-accounts-data.

[FIGURE 4 ABOUT HERE]

4.2.2 BP Oil Spill and Re-regulation of Oil & Gas Industries

On April 20, 2010, the BP Deepwater Horizon, an offshore oil rig near the Mississippi River Delta, exploded and subsequently sank, killing 11 workers and injuring 17. As a result of the explosion, the uncapped Macondo oil well discharged millions of gallons of oil into the Gulf of Mexico before the well was sealed nearly 3 months later, making it the largest marine oil spill to date. The spill caused extensive damage to marine and wildlife habitats, as well as to the fishing and tourism industries.

In response, President Obama issued Executive Order 13543 on May 21st, 2010, which formed a National Commission to investigate the spill and provide recommendations for improving the safety of offshore oil drilling. The National Commission report (Graham and Reilly (2011)), published in January 2011, blamed the disaster on lax regulatory oversight, political interference with regulators' autonomy and a lack of resources for inspections, insufficient policy emphasis on environmental protection, and expedited permitting and plan approvals. The report specifically faulted exemptions from environmental review of offshore drilling in certain parts of the Gulf of Mexico, which were enacted to stimulate production.

As a result, on January 1st, 2011, the White House issued Executive Order 13547, which called for environmental conservation and science-driven decision-making with respect to management of coastal and ocean resources. According to the Bureau of Ocean Energy Management, the new rules were "the most aggressive and comprehensive reforms to offshore oil and gas regulation and oversight in U.S. history."[14]

We examine the treatment effect of reregulation following the oil spill on

[14]See https://www.boem.gov/regulatory-reform/.

oil and gas extraction industry (NAICS 2111). We choose the three industries identified in Section 4.2.1 to maintain consistency.

In Panel A of Figure 5, we observe strong parallel trends for our treatment and control industries prior to the oil spill and a dramatic increase in the Regulation Index for the oil and gas extraction industry afterwards. From 2010 to 2014, the Oil & Gas Industry increased regulation-related labor costs by $ 212 million, while the control industries *reduced* regulation-related labor costs by $11.5 million. Yet, in Panel B, we observe that while the RegData measure for oil and gas extraction industry increased after 2010, the increase cannot be differentiated from the increase in the control industries.

[FIGURE 5 ABOUT HERE]

4.2.3 Dodd-Frank Act and Regulation of Financial Industries

The Dodd-Frank Act was enacted in 2010 following the 2007-2008 financial crisis. The financial crisis started after spikes in defaults on subprime and non-prime mortgages eroded the solvency of many systemically important financial institutions. Many financial institutions were unable to absorb large, sudden losses without either restructuring their debts or obtaining rescue financing and liquidity support because the financial institutions were highly leveraged (see Beltratti and Stulz (2012), Simkovic (2009), Yellen (2011), among many others). In addition, the crisis also raised concerns about possible misconduct by financial institutions (Egan et al. (2019)) such as misreporting the quality of mortgage loans that were securitized (Piskorski et al. (2015) and Griffin and Maturana (2016)) and possible misconduct when selling complex financial products to retail investors (Chang et al. (2015)). Both policy makers and consumers demanded stricter regulation of financial institutions, resulting in the Dodd-Frank Act.

Dodd-Frank burdened financial institutions by pressuring them to reduce risk-taking. Such pressures included stricter underwriting standards for residential mortgages, limits on highly leveraged business loans, increased capital requirements for Systemically Important Financial Institutions (SIFIs) and central clearing parties and exchanges, and increased compliance, reporting, and risk management obligations for bank holding companies and central clearing parties and exchanges. Derivatives dealers were required to move many traditionally bilateral derivatives contracts to exchanges or central clearing parties. Many broker-dealers were compelled to justify their trading activity as falling within one of several exemptions to a new ban on proprietary trading. Dodd-Frank also created a new Consumer Financial Protection Bureau (CFPB) within the Federal Reserve, which was relatively independent from Congressional control. The CFPB was authorized to focus on consumer lending and other retail financial products.

We define the financial industry as industries with NAICS codes starting with 52 (Finance and Insurance) or 5511 (Offices of Bank Holding Companies), excluding central banking such as the Federal Reserve System (NAICS code 5211), which effectively functions as a quasi-governmental provider of regulation. We then aggregate our NAICS 4-digit Regulation Index for the financial industry weighted by each detailed industry's labor costs (employment multiplied by hourly wages).

We identify control industries based on the Use Table of the Input-Output Accounts Data provided by the U.S. Bureau of Economic Analysis (BEA). The BEA Use Table provides the dollar value of financial services that are used as inputs in industries at 6-digit NAICS level in 2007. Among the top 10 industries that use financial services the most, 8 industries are financial and 2 are real estate. Since financial industries are treated industries, we select real estate industries as our control group. Real estate includes industries with NAICS codes starting with digits 531 (real estate leasing and sales) and 236

(real estate construction). An additional advantage of using real estate as the control group is that both financial and real estate industries experienced significant contraction during the Great Recession.

Figure 6 shows that the Regulation Indexes for financial and real estate industries were parallel before the enactment of Dodd-Frank in 2010. However, after the enactment of Dodd-Frank, the Regulation Index increased substantially faster for financial than for real estate. This divergence is economically significant: from 2011 to 2016, the financial industry spent an additional 0.19 percent of its total labor spending on performing regulation-related tasks, which is equivalent to 2.2 billion dollars annually. In contrast, the real estate industry spent an additional 0.03 percent of labor spending on regulation-related tasks, which is equivalent to 0.16 billion dollars.[15] RegData also shows a larger increase in regulation in financial industries than in real estate industries after Dodd-Frank.[16]

[FIGURE 6 ABOUT HERE]

Although Dodd-Frank broadly affected the financial industry, the literature suggests that some sub-sectors of the financial industry are likely more affected than others.

Credit Intermediaries Credit intermediaries were required to verify prospective residential mortgage borrowers' ability to repay their loans (Bubb and Krishnamurthy (2014)). The CFPB also discouraged aggressive lending and

[15]The total labor costs for performing regulation-related tasks in financial industry are $4.42 billion and $6.64 billion in 2011 and 2016, respectively. The total labor costs for performing regulation-related tasks in real estate industry are $0.39 billion and $0.54 billion in 2011 and 2016, respectively. OES computes annual wage as hourly wage multiplied by 2,080 hours per year. In unreported tests, we find that OES's estimates of industry annual labor costs is highly comparable with the industry annual payroll data from the Census Bureau.

[16]In untabulated tests, we confirm that the increases in both the Regulation Index and RegData are statistically significant after Dodd-Frank.

collection practices in consumer mortgages, student loans, credit cards, etc. In addition, Federal Reserve used its authority under Dodd-Frank to limit banks from extending leveraged loans to corporate borrowers (Federal Reserve System et al. (2013) and Adrian (2014)).

Exchanges and Clearinghouses Under the derivatives push-out rule, the clearing of many swaps and derivatives was to be moved from an over-the-counter market operated by banks to exchanges or central clearing parties. In turn, these clearinghouses were subject to regulations mandating heightened risk management, transparency, and capitalization requirements (Bernanke (2011) and Kress (2011)).

Bank Holding Companies Dodd-Frank imposed new reporting, risk management, and compliance requirements for bank holding companies. These include higher capital requirements for Systemically Important Financial Institutions (SIFIs) and obligations to draft plans for restructuring these institutions if they become insolvent (Gordon and Muller (2011)). Bank holding companies were also restricted from engaging proprietary trading under the Volcker rule (Whitehead (2011)) and restricted from investing in private equity or hedge funds.

Broker-Dealers The Volcker rule only applies to broker-dealers that are affiliated with bank holding companies. Such affiliated broker-dealers are limited from engaging proprietary trading. However, the Volcker rule exempted many types of assets such as treasuries and sovereign debt from restrictions on proprietary trading, and included relatively broad exemptions for trading that can be characterized as "market-making". Many have argued that it is difficult to distinguish "market-making" from proprietary trading (Duffie (2012)), casting doubts on the impact of the Volcker rule on broker-dealers

(Kroszner and Strahan (2011)). Thus, Dodd-Frank may not be as burdensome for broker-dealers as for above-mentioned financial institutions.

Insurance Companies In practice, Dodd-Frank did very little to increase regulation of the insurance industry (Zaring (2018)). Specifically, the three largest insurance companies were briefly designated as SIFIs, which were subject to macro-prudential regulations and heightened capital requirements. However, such designations were to be tenuous and short-lived.[17] Dodd-Frank also created a Federal Insurance Office to coordinate with European insurance regulators, but the FIO has relatively little authority over domestic insurers (Zaring (2018)).

Overall, the literature suggests that the impact of Dodd-Frank was likely to be significantly higher on credit intermediaries and exchanges than on broker-dealers and insurance companies. Consistent with these qualitative assessments, Figure 7 shows that before and after Dodd-Frank, our Regulation Index went up most dramatically for non-depository and depository credit intermediation, followed by security and commodity exchanges, and went up less for insurance carriers and securities brokers. However, RegData shows a dramatic increase in regulation for insurance carriers, which can be due to RegData's inclusion of regulations that are ineffective due to court rulings and concessions made by regulators. In addition, RegData does not have information for securities and commodities brokers.

[FIGURE 7 ABOUT HERE]

[17]The Financial Stability Oversight Council's (FSOC) attempt to designate large insurers as SIFIs in 2013 and 2014 was swiftly defeated in court by insurance industry victories in the MetLife case in 2016 (Brewin (2014)). In 2014, Congress relieved insurance companies of Dodd-Frank regulations which would have held insurance companies to more stringent capital adequacy and accounting standards that applied to banks (Webel (2014)). In 2017, FSOC removed remaining large insurers such as Prudential and AIG from its list of non-Bank SIFIs.

4.3 Within-Industry Validation using Sarbanes-Oxley Act

Our previous analyses demonstrated the performance of the Regulation Index using regulatory shocks that affected some industries more than others. In this section, we validate our measure through comparisons *within industry*, using regulations that affected publicly traded firms more than those that were privately held.

The Sarbanes-Oxley Act of 2002 (SOX) was enacted following accounting scandals at large publicly traded firms including Enron and WorldCom. SOX sought to improve the accuracy of financial reporting and the reliability of internal controls at publicly traded companies by requiring senior executives at such firms to personally certify the accuracy of corporate financial reports and adequacy of internal controls, mandating stricter internal controls and enhanced reporting of off-balance sheet transactions, and increasing criminal penalties for financial fraud (Coates IV (2007)). SOX also sought to increase outside scrutiny and oversight by enhancing independence of auditors and securities analysts and protecting whistle blowers from retaliation.

Many of the key provisions of SOX apply exclusively to publicly traded companies listed in the United States. Studies suggest that the cost of SOX compliance were substantial (Zhang (2007), Linck et al. (2009), and Iliev (2010)) and may have discouraged companies from remaining public (Engel et al. (2007)) or listing in the U.S. (Piotroski and Srinivasan (2008)). In addition, small public firms, those with public float less than $75 million, were repeatedly granted exemptions from and delays in compliance (Gao et al. (2009) and Iliev (2010)).

The greater impact of SOX on publicly traded firms provides an additional test of our methodology of measuring the intensity of regulation *across industries*: specifically we test whether the same method can detect the differential impact of regulations on categories of firms *within the same industry*. We com-

pare changes in the Regulation Index at publicly traded firms to changes in the Regulation Index for a matched sample of private firms after SOX was enacted. Specifically, we use the establishment-level microdata from the Bureau of Labor Statistics.[18] In addition to including the number of employees and average wages for each occupation in the establishment, the micro-data also provides the state in which the establishment is located, the establishment's industry affiliation, and establishment's parent's Employer ID number (EIN) and legal and trade names . The microdata covers each establishment once every three years. We therefore construct a sample that includes three cohorts of establishments that were surveyed before and after SOX passage: in 1999 and 2002 (cohort 1), in 2000 and 2003 (cohort 2), and in 2001 and 2004 (cohort 3). Given our focus on publicly traded firms, we exclude establishments owned by government or with less than 20 employees.

We determine whether each establishment is owned by a publicly traded firm or a privately held firm by matching the establishment's legal and trade names and employer identification number (EIN) to firms in the Compustat database following Zhang (2018).[19] These procedures result in a final sample of 221,628 establishment-year observations from 1999 to 2004. About 20% of establishment are owned by publicly traded firms and the remaining 80% are owned by privately held firms.

We then run regressions at the establishment level using the following

[18]The BLS aggregates establishment-level microdata to produce the publicly industry-level data used elsewhere in this paper.

[19]The Compustat database only provides the headquarters EIN for each firm. However, some firms may have multiple EINs. Failure to identify all EINs with common ownership would incorrectly identify some establishments owned by publicly traded firms as private, and hence would bias us towards finding non-results. To mitigate this concern, we supplement our matching of establishments to firms using legal and trade names as well as EINs. For more details, see Zhang (2018).

difference-in-differences specification:

$$\begin{aligned} Reg.Index_{e,t} &= \beta Public_{e,t} \times Post\ SOX_t + \gamma Public_{e,t} \\ &\quad + FE_e + FE_{EmpBin \times Ind \times Year} + FE_{State \times Year} + \epsilon_{e,t} \end{aligned} \tag{2}$$

where $RegIndex_{e,t}$ is the Regulation Index of the establishment e in year t. The Establishment Regulation Index is constructed using the same methodology that created industry Regulation Index in Section 3. $Public_{e,t}$ is a dummy variable that equals one if the establishment is owned by a publicly traded firm, and zero if the establishment is owned by a privately held firm. $Post\ SOX_t$ is a dummy variable that equals zero if the year is in 1999-2001 and one if the year is 2002-2004.[20] FE_e represents establishment fixed effects which enables us to examine changes in each establishment's Regulation Index before and after SOX.

We also control for fixed effects that include a full interaction of year, SIC 3-digit industry codes, and four employment-size bins. Employment-size bins are defined as (20, 49), (50, 99), (100, 199), and above 200. These fixed effects improve matching of our SOX-treated publicly traded firms and our control group of private firms by ensuring that we compare only establishments within the same industry, with similar employment size, and in the same year. To further control for political and economic heterogeneities across states, we also include state and year fixed effects.

Table 6 shows the results. In Column (1), we find that after SOX was enacted, publicly traded firms shifted an additional 0.022% of their labor spending toward regulation related tasks compared to privately held control firms within the same industry and size bins. The magnitude of this increase in the Regulation Index is substantial, equal to about an 8 percent increase in

[20]SOX was enacted in July 2002. The 2002 OES survey was collected in mainly early 2003 when the survey asks establishments to provide data on their occupational employment as of November 2002. Thus, we regard 2002 as post-SOX.

regulation-related labor spending.[21]

As noted above, SOX affects large public firms more than small public firms because of exemptions for small public firms. We follow the literature (Gao et al. (2009) and Iliev (2010)) and define small public firms as those with public float less than $75 million and the rest as large public firms. In Columns (2) and (3) we observe that most of the effects of SOX on publicly traded firms' Regulation Index are driven by large firms, and the effects on small firms are indistinguishable from zero.

Because SOX focused on auditing and financial reporting, SOX may have the largest impact on the headquarters of a firm rather than its satellite and branch offices. OES does not label whether establishments are headquarters or branches, but we hypothesize that the effect of SOX would be strongest on establishments located in the same state as the public firms' headquarters. Column (4) confirms this hypothesis: the point estimate increases to 0.061%.

To better understand the timing of publicly traded firms' response to SOX, in Figure 8, we shows the differences in Regulation Index between establishments of publicly traded firms and matched private firms in each year from 1999 to 2004 using the sample in Column (4) of Table 6. We find that the difference is indistinguishable from zero before 2001, suggesting that the Regulation Index for public and private firms move in parallel before SOX. After SOX, the difference immediately increased to about 0.14% in 2002 (a 50 percent increase compared to sample mean) and afterwards.

[TABLE 6 ABOUT HERE]

[FIGURE 8 ABOUT HERE]

[21] Prior to the enactment of SOX, the average establishment in our sample spent 0.28% of its labor costs on regulation-related tasks.

5. Conclusion

Regulation is challenging to quantify uniformly due to its tremendous variation across industries with respect to form, content, and enforcement. In this study, we propose a new methodology to detect the intensity of regulations based on the percentage of an industry's labor costs paid to perform regulation-related tasks. We hypothesize that this measure reflects the intensity of regulations that incentivize firms to spend on compliance to avoid legal liability or regulatory sanctions. More stringent regulations with more severe penalties and stricter enforcement will induce firms to spend disproportionately more on regulation-related tasks and thus to have a higher *Regulation Index*.

We validate our methodology by studying the enactments of several well-known laws that change regulation intensity for firms across industry and within industry. We show that our industry-level Regulation Index increases for the finance industry after the Dodd-Frank Act, increases for the oil & gas industry after the BP Deepwater Horizon oil spill, and decreases for the oil & gas industry after the deregulation following the Energy Policy Act. We also show that the Regulation Index increases dramatically for publicly traded firms compared to privately held firms following enactment of the Sarbanes-Oxley Act. In summary, compared to text-based measures that count words in regulations, our Regulation Index reflects broader sources of regulation, can better detect the impact of regulations, and can better distinguish deregulation from regulation.

It is important to note that our measure may not be sensitive to several kinds of regulations. First, regulations that clearly mandate capital expenditures, such as purchasing pollution abatement equipment, may entail minimal changes in labor costs. Second, regulations that clearly prohibit a specific line of business, such as a ban on advertising tobacco products on broadcast tele-

vision, may cause industries to terminate lines of business rather than spend resources on compliance. Third, regulations that directly create barriers to entry, such as licensing requirements, may affect potential entrants more than incumbents and thus can be underestimated by our measure.

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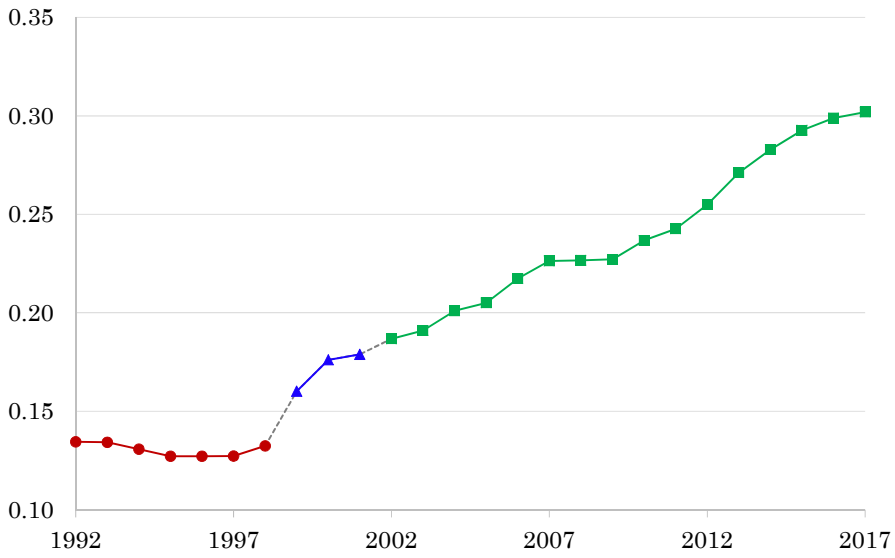

Figure 1: Regulation Index for Private Industries. Regulation Index is defined in Section 3. Different colored lines and different shaped line markers indicates shifting occupational and industry classifications by the underlying OES data. Prior to 1999, OES used its own internal occupation codes. In 1999, OES began classifying occupations using the Standard Occupation Classification. At the aggregate level there are no large jumps during the transition. We exclude detailed industries with year-to-year jumps in reporting or non-reporting of regulation-related occupations, which account for roughly 16 percent of observations. In 2002, OES changed from classifying industries using the Standard Industrial Classification to using the North American Industry Classification System. We exclude educational institutions and industry categories which provide legal or compliance work as their primary source of revenue or function: legal services, accounting firms, government administration, courts, and central banking.

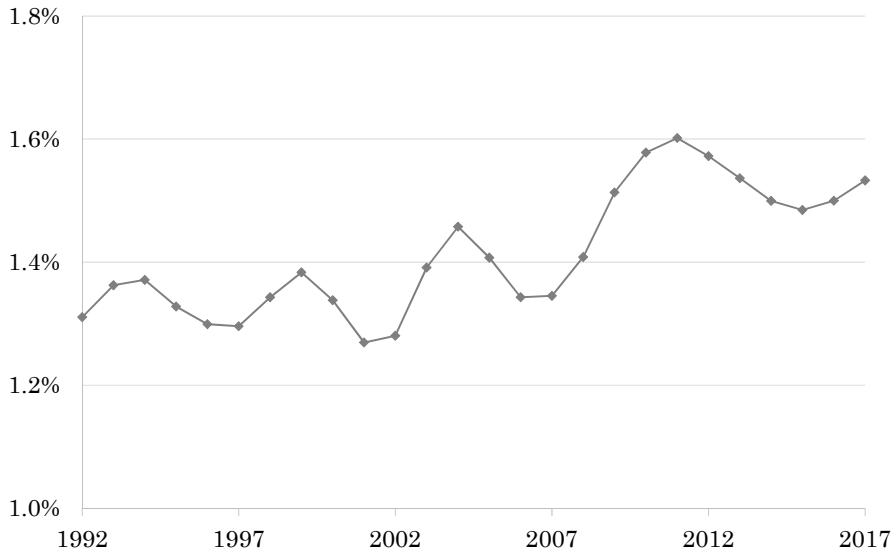

Figure 2: Outsourced Legal Spending for Private Industries. An industry's outsourced legal spending is "legal services" expenditures presented as a percentage of total input costs based on the Input-Output table from the Bureau of Economic Analysis. We smooth the graph by computing the an industry's outsourced legal spending in year t as the moving-average of the percentages from $t-2$ to t. We aggregate the outsourced legal spending for all private industries using each industry's total input costs as weight.

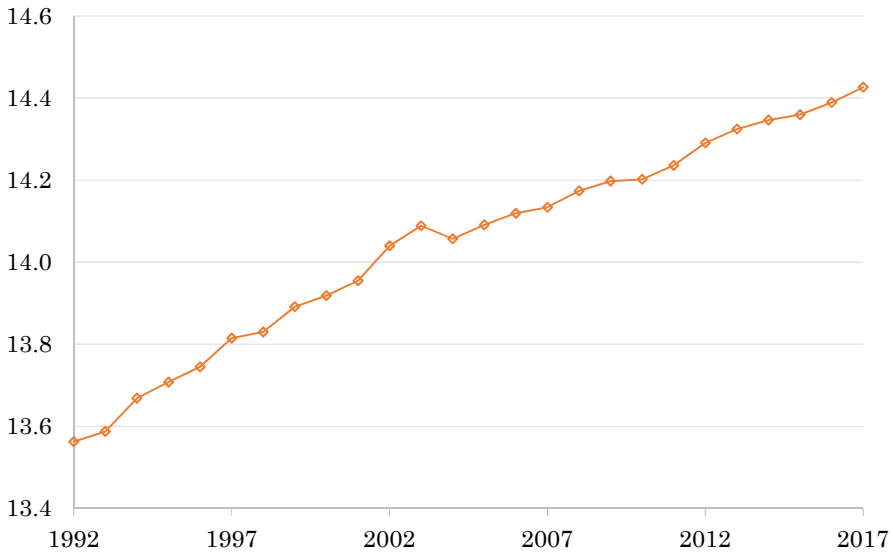

Figure 3: Text-based RegData Regulation Measure for Private Industries. RegData is the natural logarithm of the number of restrictive words in the Code of Federal Regulations applicable to the industry based on Al-Ubaydli and McLaughlin (2017). We exclude educational institutions and industry categories which provide legal or compliance work as their primary source of revenue or function: legal services, accounting firms, government administration, courts, and central banking.

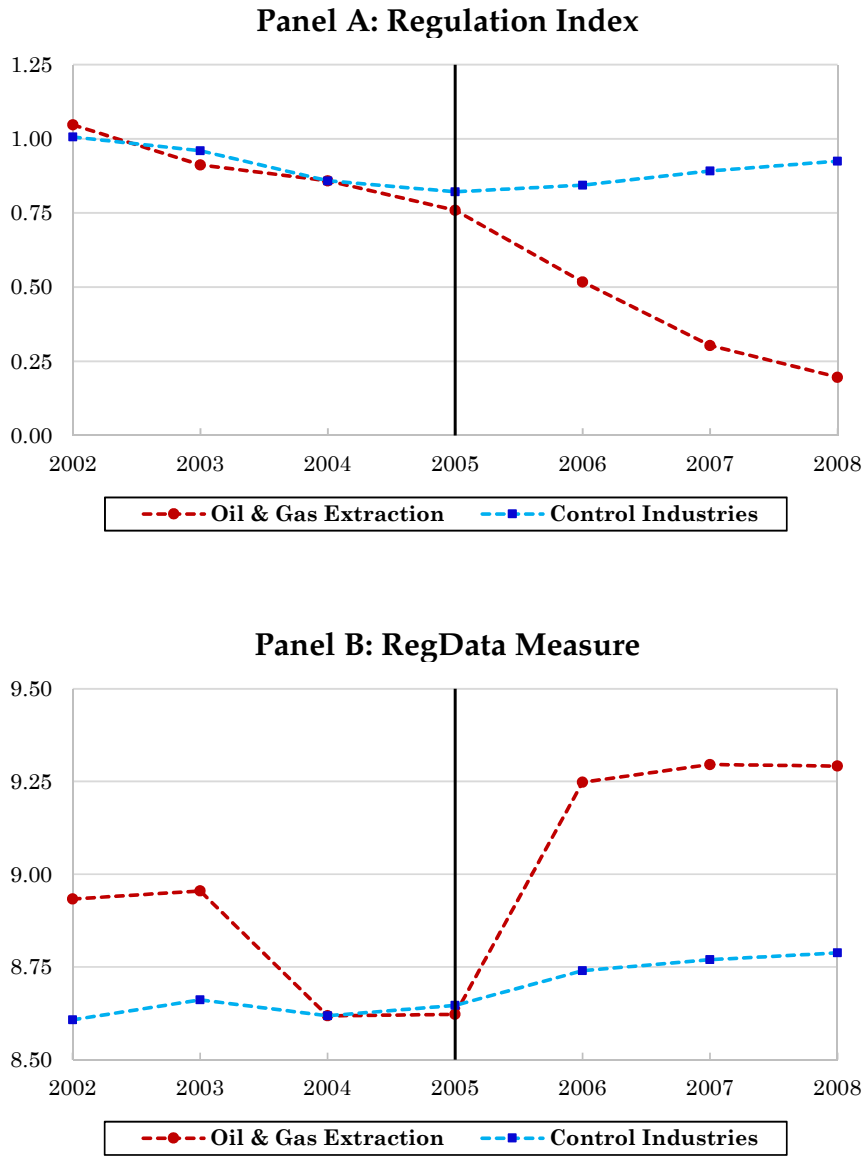

Figure 4: Energy Policy Act and Deregulation of Oil & Gas Extraction Industries. Panel A plots the Regulation Index of oil and gas extraction industries and control industries before and after the Energy Policy Act of 2005 (EPAct). Panel B plots the counter party graph using the RegData regulation measure. Classification of oil and gas extraction industries and control industries are discussed in Section 4.2.1. Regulation Index is defined in Section 3. RegData is the natural logarithm of the number of restrictive words in the Code of Federal Regulations applicable to the industry based on Al-Ubaydli and McLaughlin (2017). To ease comparisons around the time of treatment, the lines have been shifted vertically so that they have the same value in the year before the treatment. This value in the year before the treatment is the average of the regulation measures across the treated and control industries in that year. The difference between the two lines after the treatment, minus the difference between the two lines before the treatment reflects the difference-in-difference estimation.

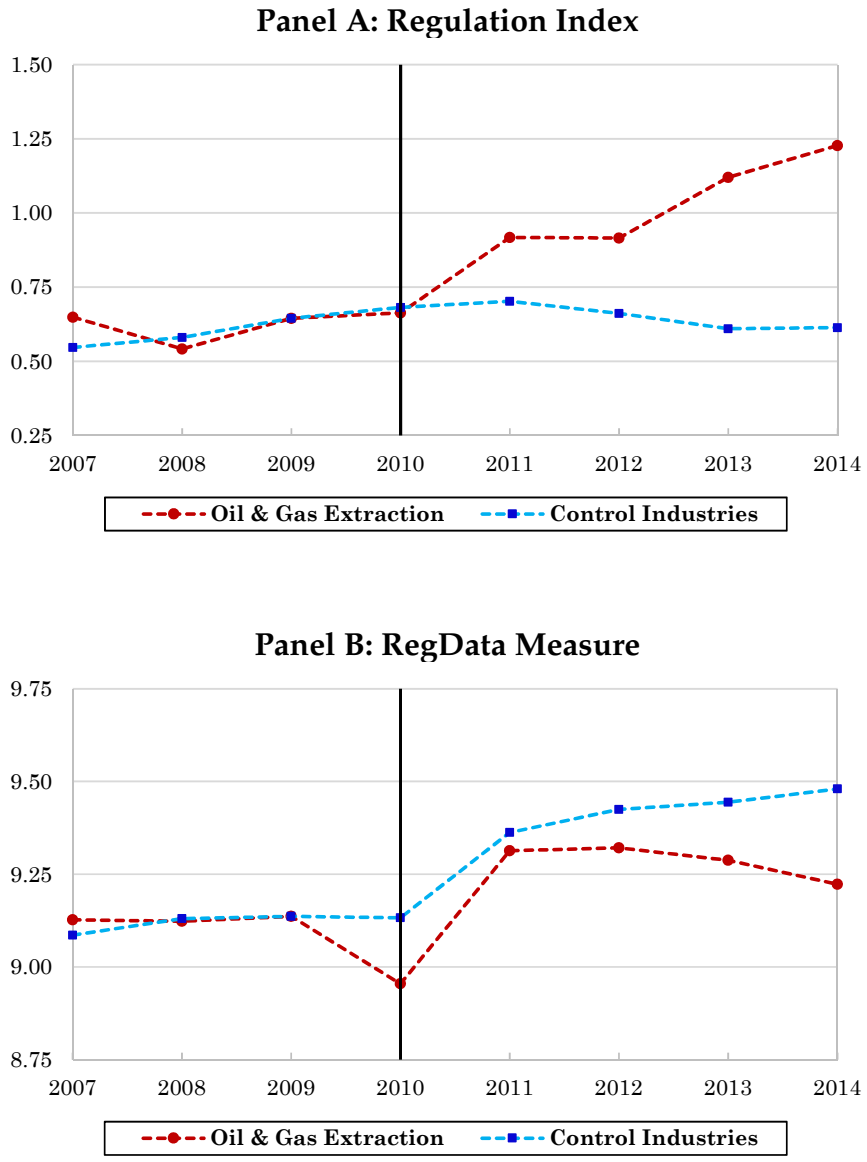

Figure 5: BP Oil Spill and Reregulation of Oil & Gas Extraction Industries. Panel A plots the Regulation Index of oil and gas extraction industries and control industries before and after two President Executive Orders following the BP Deepwater Horizon oil spill in 2010. Panel B plots the counter party graph using the RegData regulation measure. Classification of oil and gas extraction industries and control industries are discussed in Section 4.2.1. Regulation Index is defined in Section 3. RegData is the natural logarithm of the number of restrictive words in the Code of Federal Regulations applicable to the industry based on Al-Ubaydli and McLaughlin (2017). To ease comparisons around the time of treatment, the lines have been shifted vertically so that they have the same value in the year before the treatment. This value in the year before the treatment is the average of the regulation measures across the treated and control industries in that year. The difference between the two lines after the treatment, minus the difference between the two lines before the treatment reflects the difference-in-difference estimation.

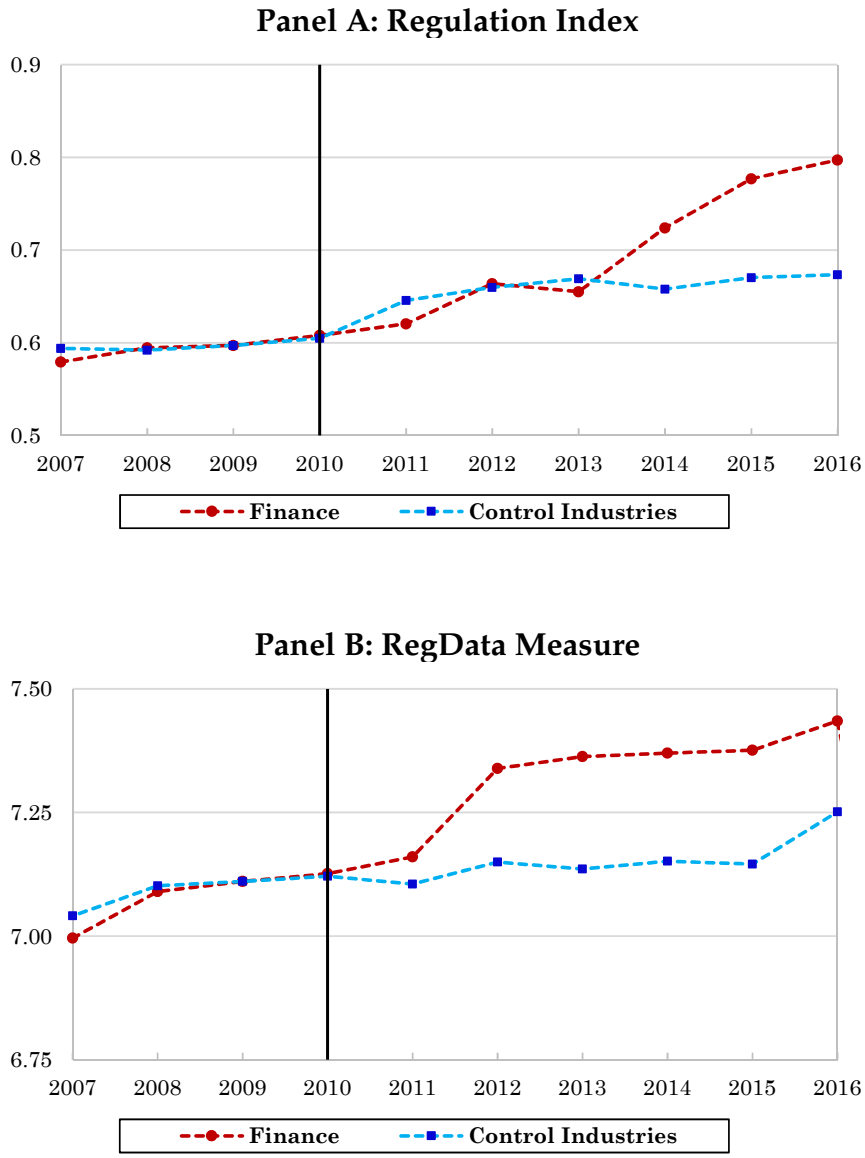

Figure 6: Dodd-Frank Act and Regulation of Financial Industries. Panel A plots the Regulation Index of financial industries and control industries before and after the enactment of Dodd-Frank Act in 2010. Panel B plots the counter party graph using the RegData regulation measure. Classification of finance industries and control industries are discussed in Section 4.2.3. Regulation Index is defined in Section 3. RegData is the natural logarithm of the number of restrictive words in the Code of Federal Regulations applicable to the industry based on Al-Ubaydli and McLaughlin (2017). To ease comparisons around the time of treatment, the lines have been shifted vertically so that they have the same value in the year before the treatment. This value in the year before the treatment is the average of the regulation measures across the treated and control industries in that year. The difference between the two lines after the treatment, minus the difference between the two lines before the treatment reflects the difference-in-difference estimation.

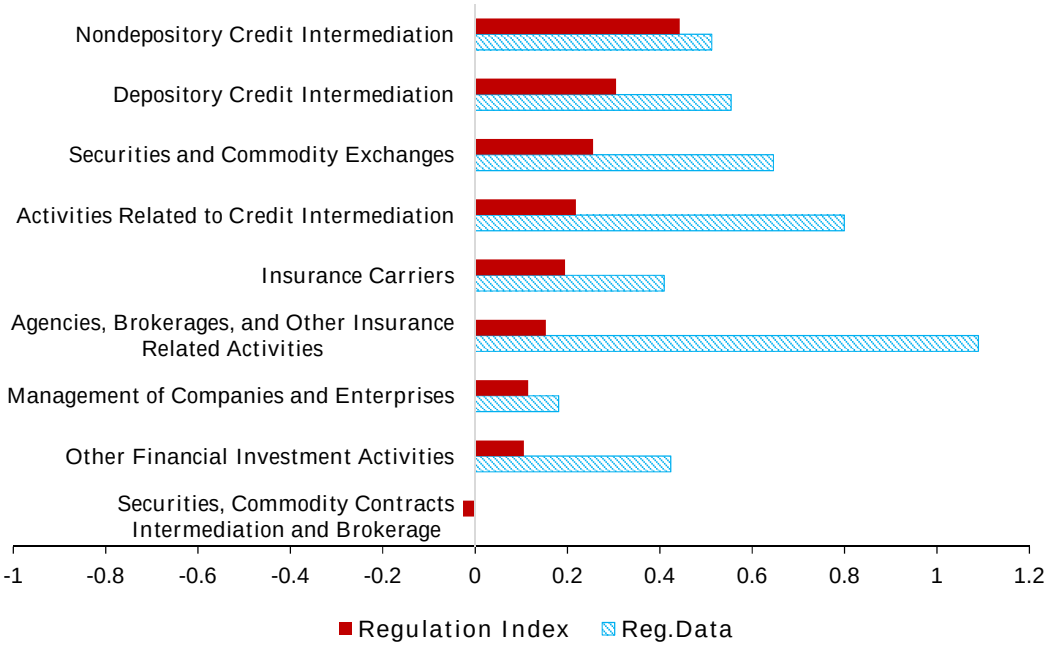

Figure 7: Changes in Regulation Index for Financial Sub-sectors before and after Dodd-Frank (2007-2009 vs. 2014-2016). This figure reports the changes in average Regulation Index and RegData regulation measure before and after Dodd-Frank. We regard 2007-2009 as the pre-treatment period and 2014-2016 as the post-treatment period. Industry titles in the figure correspond to the financial sub-sectors defined based on the NAICS 4-digit industry classification. Regulation Index is defined in Section 3. RegData is the natural logarithm of the number of restrictive words in the Code of Federal Regulations applicable to the industry based on Al-Ubaydli and McLaughlin (2017).

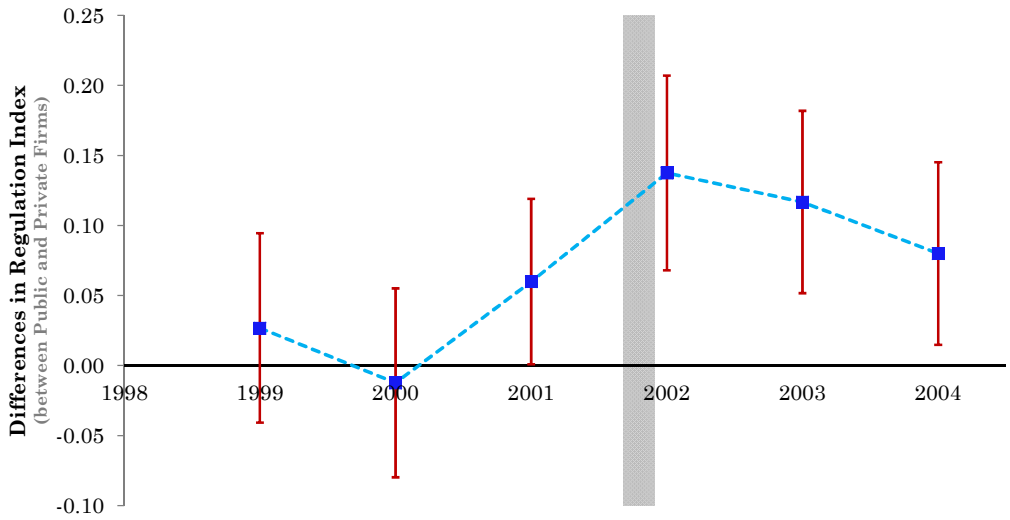

Figure 8: Differences in Regulation Index for publicly traded and privately held firms before and after the Sarbanes-Oxley Act of 2002. This figure reports the estimated differences between the Regulation Index for publicly traded firms and matched privately held firms during 1999- 2004 using microdata of the Occupational Employment Statistics Survey from the Bureau of Labor Statistics. See more details on sample selection in Section 4.3. In each year, establishments of publicly traded firms are matched with establishments of privately held firms in the same group based on SIC 3-digit industry classification and four employment bins. Employment bins are defined as (20, 49), (50, 99), (100, 199), and above 200. We require publicly traded firms' establishments to be located in the same state as the firms' headquarters state. The blue squares represent the estimated differences in the Regulation Index between establishments of publicly traded firms and establishments of matched privately held firms. Regulation Index is defined in Section 3. The red vertical bars indicate 95% confidence intervals. The intersection of the 95% confidence intervals and the x-axis in 1999 and 2000 suggests that the Regulation Index for public and private firms move in parallel before the Sarbanes-Oxley Act.

Table 1: Examples of Regulation-related Tasks

This table provides a selected list of tasks that are related to regulation. We identify tasks as regulation-related using textual analyses of statements of all tasks for occupations in the O*Net database. See Section 3 for more details of our methodology. *Task* is the statement of a task. *Occupation* is the occupation that the performs the task. *Import.* is the importance of the task to the occupation, which is a measure between 1 and 5. The tasks are sorted by the labor costs of the associated occupations in 2016.

Task	Occupation	Import.
Interpret laws, rulings and **regulations** for individuals and businesses.	Lawyers	4.26
Research and **keep informed** of pertinent information and developments in areas such as EPA **laws** and **regulations**.	Compliance Officers	4.05
Monitor construction activities to ensure that environmental **regulations** are not violated.	Construction and Building Inspectors	3.91
Review and **analyze** new, proposed, or revised **laws**, **regulations**, policies, and procedures to interpret their meaning and determine their impact.	Financial Examiners	3.83
Determine whether land-related documents can be registered under the relevant **legislation** such as the Land Titles Act.	Title Examiners, Abstractors, and Searchers	3.56
Determine the effects of **regulatory** limitations on land use projects.	Urban & Regional Planners	4.00
Interpret safety **regulations** for others interested in industrial safety, such as safety engineers, labor representatives, and safety inspectors.	Health and Safety Engineers	3.82
Inspect food processing areas to ensure compliance with government **regulations** and standards for sanitation, safety, quality, and waste management standards.	Food Scientists and Technologists	4.27
Inspect and test fire protection or fire detection systems to verify that such systems are installed in accordance with appropriate **laws**, codes, **ordinances**, **regulations**, and standards.	Fire Inspectors	4.28
Verify that transportation and handling procedures meet **regulatory** requirements.	Agricultural Inspectors	4.36
Monitor establishment activities to ensure adherence to all state gaming **regulations** and company policies and procedures.	Gaming Surveillance Officers & Gaming Investigators	4.75

Table 2: Regulatory-Task Intensity for Regulation-Related Occupations

This table reports the regulatory-task intensity score (RTI) for regulation-related occupations. We compute RTI score for each occupation as the proportion of an occupation's regulation-related tasks weighted by the task's importance for that occupation. See Table 1 and Section 3 for more details on regulation-related tasks. An occupation has 25 tasks on average. Occupations with RTI above 0.2 are regarded as regulation-related occupations. We exclude occupations that are only employed by governmental entities since our research focuses on private industries. OES data uses 5-digit occupation codes (*OES Codes*) before 1998, and 6-digit Standard Occupational Classification codes (*SOC Codes*) in 1998 and later years.

Occupation	OES Codes	SOC Codes	RTI
Legal-Related Occupations			
Lawyers	28108	23-1011	0.45
Paralegals and Legal Assistants	28305, 28399	23-2011	0.51
Law Clerks	28302	23-2092	0.36
Title Examiners, Abstractors, and Searchers	28311, 28308	23-2093	0.24
Legal Secretaries	55102	43-6012	0.32
Compliance-Related Occupations			
Compliance Officers	21911	13-1041	0.36
Financial Examiners	21911	13-2061	0.41
Agricultural Inspectors	21911	45-2011	0.23
Construction and Building Inspectors	21908	47-4011	0.49
Food Scientists and Technologists	24305	19-1012	0.33
Health and Safety Engineers, Except Mining	21911, 22132	17-2111	0.43
Urban and Regional Planner	27105	19-3051	0.22
First-Line Supervisors of Police and Detectives	61005	33-1012	0.30
Fire Inspectors and Investigators	63002	33-2021	0.29
First-Line Supervisors of Fire Fighting	61002	33-1021	0.21
Police and Sheriff's Patrol Officers	63014	33-3051	0.29
Transit and Railroad Police	63038	33-3052	0.28
Nuclear Engineers	22117	17-2161	0.22
Parking Enforcement Workers	63021	33-3041	0.23
Gaming Surveillance Officers & Gaming Investigators	63035	33-9031	0.21

Table 3: Top 15 Industries with Highest Regulation Index in 2016

This table reports the top 15 NAICS 4-digit industries sorted by their Regulation Indexes in 2016. The Regulation Index (*Reg.Index*) is the percent of labor costs that the industry pays for regulation-related tasks. See Section 3 for more details of our methodology.

Rank	Industry	Reg.Index
1	Securities and Commodity Exchanges	3.21
2	Oil and Gas Extraction	1.89
3	Lessors of Nonfinancial Intangible Assets	1.70
4	Insurance Carriers	1.67
5	Management of Companies and Enterprises	1.33
6	Other Financial Investment Activities	1.26
7	Architectural, Engineering, and Related Services	1.16
8	Electric Power Generation, Transmission and Distribution	1.16
9	Natural Gas Distribution	1.15
10	Business, Professional, Labor, Political, and Similar Organizations	1.13
11	Social Advocacy Organizations	1.10
12	Nondepository Credit Intermediation	1.03
13	Scientific Research and Development Services	0.96
14	Pharmaceutical and Medicine Manufacturing	0.89
15	Depository Credit Intermediation	0.86

Table 4: Summary Statistics

This table reports summary statistics of the industry-year panel for industries with the Regulation Index available during 2002-2016. Section 4.1 provides the data source for each variable. *Regulation Index* is the percent of labor costs that the industry pays for regulation-related tasks following equation (1). *Outsourced Legal Service* is the three-year moving average of the percentage of the industry's intermediary input costs that are paid for legal services. *Text-based RegData* is the natural logarithm of the number of restrictive words in the Code of Federal Regulations (CFR) applicable to the industry based on Al-Ubaydli and McLaughlin (2017). *Lobbying Spending* is the natural logarithm of the industry spending on lobbying.

Variable	n	Mean	S.D.	Min	P50	Max
Regulation-related variables						
Regulation Index	4371	0.17	0.33	0	0.04	3.42
Outsourced Legal Spending	943	1.5	1.26	0.04	1.04	5.18
Text-based RegData	2093	8.41	1.44	5.03	8.34	11.43
Lobbying Spending	2196	14.36	2.6	0	14.69	19.04

Table 5: Relation between Regulation Index and other Measures

This table reports results of regressing three different regulation-related measures on the Regulation Index at the industry-year level. *Reg.Index* is the percent of labor costs that the industry pays for regulation-related tasks. *Outsourced Legal Service* is the three-year moving average (from $t-2$ to t) of the percentage of the industry's input costs that are paid for legal services from Bureau of Economic Analysis data. *Text-based RegData* is the natural logarithm of the number of restrictive words in the CFR applicable to the industry based on Al-Ubaydli and McLaughlin (2017). *Lobbying Spending* is the natural logarithm of the industry spending on lobbying from the Center for Responsive Politics data. NAICS 4-digit Regulation Indexes are aggregated to the corresponding industry classifications of the dependent variables for regressions. Columns (1) to (3) report results of OLS, cross-sectional, and time-series regressions. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Sample period is from 2002 to 2016.

Regression Spec.:	Pooled: OLS	Cross-Section: Year FE	Time-Series: Ind. FE + Year Trend
	(1)	(2)	(3)
Panel A. Outsourced Legal Service			
Reg.Index	1.54^{***}	1.54^{***}	0.19^{**}
	(0.10)	(0.10)	(0.09)
Observations	1,005	1,005	1,005
Adjusted R^2	0.18	0.17	0.94
Panel B. Text-based RegData			
Reg.Index	0.65^{***}	0.62^{***}	0.05^{*}
	(0.09)	(0.09)	(0.03)
Observations	1,792	1,792	1,792
Adjusted R^2	0.03	0.03	0.99
Panel C. Lobbying Spending			
Reg.Index	1.63^{***}	1.59^{***}	-0.54
	(0.14)	(0.14)	(0.35)
Observations	2,267	2,267	2,267
Adjusted R^2	0.06	0.07	0.71

Table 6: Response of Public Firms to Sarbanes-Oxley Act of 2002

This table reports establishments' response to the Sarbanes-Oxley Act (SOX) of 2002 for publicly traded firms and matched private firms. The analysis uses microdata of the Occupational Employment Statistics Survey from the Bureau of Labor Statistics, which surveys each establishment every 3 years. Our sample includes three cohorts of establishments that were surveyed in 1999 and 2002 (cohort 1), in 2000 and 2003 (cohort 2), and in 2001 and 2004 (cohort 3). *Public* is a dummy variable that equals one if the establishment is owned by a publicly traded firm, and zero if the establishment is owned by a privately held firm. *Post SOX* is a dummy variable that equals zero if the year is 1999-2001 and one if the year is 2002-2004. We exclude establishments with less than 20 employees. All regressions have establishment fixed effects, state-year fixed effects, and fixed effects that include a full interaction of SIC 3-digit industry codes, year, and four employment bins. Employment bins are defined as (20, 49), (50, 99), (100, 199), and above 200. Column (1) uses the full sample of establishments. Columns (2) and (3) use subsamples of establishments form large and small publicly traded firms based on whether the firms' public float is above or below $75 million (Iliev (2010)). Column (4) uses public firms' establishments only if the establishments are located in the same state as the firm's headquarters state. Heteroscedasticity-consistent standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Full Sample			Only HQ-State
	All Firms	Large Firms	Small Firms	All Firms
	(1)	(2)	(3)	(4)
Public	-0.019	-0.100^{**}	0.042	-0.069
	(0.031)	(0.050)	(0.037)	(0.065)
Public×Post SOX	0.022^{**}	0.034^{***}	0.005	0.061^{***}
	(0.010)	(0.012)	(0.014)	(0.023)
Establishment FE	Yes	Yes	Yes	Yes
State×Year FE	Yes	Yes	Yes	Yes
EmpBin×Ind×Year FE	Yes	Yes	Yes	Yes
Observations	201,478	180,638	174,046	165,554
Adjusted R^2	0.886	0.892	0.892	0.893