The Impact of Regulatory Growth on Operating Costs

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Abstract

We investigate the effect of recent regulatory growth on operating costs per unit of output across a variety of US industries. Using an Augmented Mean Group estimator approach, we find that regulations in the current year and four to five years prior have statistically significant upward effects on operating costs per unit of output. This suggests that the most pronounced effects of regulations occur when a regulation is passed and when compliance dates arrive. Our results imply that the average level of annual regulatory growth (3.55 percent) increases operating costs per unit of output by 3.3 percentage points per year relative to a baseline of no regulatory growth.

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I. Introduction

There is a growing body of research on the negative impacts of regulations on individuals, businesses, and the economy. Most of these studies assume (implicitly or explicitly) that the negative outcomes are driven by increased operating costs—the costs of inputs and processes used in day-to-day operations—that businesses face as a result of new regulations. However, there has been little empirical evaluation of the direct impact of regulations on the average operating costs of businesses. Our study aims to fill this gap by examining the effect of regulatory growth on operating costs per unit of output.

From a microeconomic theory perspective, newly imposed regulations should, ceteris paribus, cause an upward shift in the representative firm's average cost function. Accordingly, we expect the equilibrium operating costs per unit of output to be higher as the imposition of regulations grows. Some international studies corroborate this by examining the magnitude of direct and indirect compliance costs resulting from specific regulations or laws (Masksus, Otsuki, and Wilson 2005; Franks, Schaefer, and Staunton 1997; Cao et al. 2005; Sneller and Langendijk 2007). Increased operating costs from new regulations will also reduce investment geared toward production—and thereby firm growth—through two channels. First, regulations divert a business's resources toward compliance activities, leaving fewer resources available for productive investment. Second, increased costs reduce profitability, making new investments in businesses less attractive. These effects are evident in studies that link regulatory growth to reduced investment (Dawson and Seater 2013),

slower economic growth (Coffey, McLaughlin, and Peretto 2016), and fewer businesses in the market (Chambers, McLaughlin, and Richards 2018).

The impacts of compliance costs also extend beyond individual firms (businesses) and can have harmful distributional effects. As governments introduce new regulations, firms often pass the costs of these regulations on to consumers in the form of higher prices. Furthermore, because of the historical incidence of regulation (i.e., which goods and services tend to be most regulated), the increased prices from regulations tend to disproportionately burden low-income households (Chambers, Collins, and Krause 2019). To the extent that firms are unable to pass the costs on to consumers, these costs also tend to disproportionately burden small businesses relative to their larger competitors (Bailey and Thomas 2017; Gutiérrez and Philippon 2019).

This study undertakes an explicit empirical evaluation of the impact of new current-year regulations on per-unit operating costs. The sampling frame covers 28 industries at the three-digit level of the North American Industry Classification System (NAICS) over the 1998 to 2017 time period. In order to capture the less immediate effects of regulations, we also generate estimates of the impact of regulations imposed in each of the previous five years. Since fixed effects will not appropriately control for common correlated variables that impact regulations and operating costs in different ways across different industries (e.g., general technological growth), we use an Augmented Mean Group (AMG) estimator. This allows us to account for cross-section dependence with heterogeneous effects. Our estimates indicate that new regulations—particularly in the current year and the fourth and fifth previous years—result in a compounding and significant impact on per-unit operating costs.

When we estimate the relationship between current operating costs per unit of output and current-year regulatory growth, the elasticity is positive and statistically significant. A 1 percent increase in regulatory restrictions leads to a 0.2 percent increase in operating costs per unit of output. When we incorporate consecutive years of regulatory growth into the estimation process, the combined effect of those regulations coupled with current-year regulations is much more substantial: a 1 percent increase in regulatory restrictions in each included year leads to an increase of approximately 0.94 percent in operating costs per unit of output.

II. Literature Review

Many researchers have empirically studied the effects of regulations on businesses and the broader economy, mostly finding that increased regulations lead to poorer outcomes using various performance metrics. Though few studies address operating costs directly, the findings of other research provide evidence of the various ways that regulations affect the actions and successes or failures of businesses. Understanding these mechanisms is helpful for understanding how regulations affect operating costs.

The most relevant studies are those measuring the compliance costs of regulations. Although some compliance costs (more required investment in new capital, for example) cannot be labeled operating costs, most compliance costs of regulations do come in the form of increased operating costs—for example, increased labor costs because of more significant paperwork requirements or more costly energy, materials, or services. A few studies separate operating costs from other compliance costs, providing direct measures of changes in operating costs resulting from regulations. For example, Masksus, Otsuki, and Wilson (2005) study the effects of standards and technical regulations imposed by importing countries on the developing countries they trade with. They find that such standards increase both variable costs—which we

can roughly interpret as operating costs—and fixed costs for businesses in developing countries. In another study, Cao et al. (2005) attempt to forecast the effects of a newly passed Risk Management Program in New Zealand that is meant to manage safety risk and facilitate market access in the animal product processing industry. The authors estimate that the new requirements may increase variable costs for the seafood industry anywhere from 2 percent to 22 percent.

Broader studies measuring the effects of regulations on national economies tend to find that the buildup of regulations over time reduces economic growth. Whether this is the result of reduced investment, less productive businesses, or both, the underlying implication is that regulations drive up the costs of production, including operating costs. In one such paper, Coffey, McLaughlin, and Peretto (2016) find not only that regulations decrease investment, but that regulatory growth between 1980 and 2012 reduced US GDP growth by approximately 0.8 percentage points per year. In other words, if regulations had remained at their 1980 level, the US economy would have been about $4 trillion larger in 2012. Dawson and Seater (2013) use data from 1949 to 2005 and find a much stronger downward effect of regulations on growth. These authors estimate that regulations over the sample period reduced US real output growth by about 2 percentage points per year. They also posit that regulatory growth largely explains the productivity slowdown of the 1970s.

A primary reason regulatory costs can be so high is the substantial portion of these costs that are indirect or simply unexpected. “Indirect” refers to secondary costs resulting from the direct costs. These are often behavioral changes stemming from changes in incentives—for example, reduced purchases may result from price increases or changes in the quality or

convenience of goods and services.[1] Although indirect costs are beyond the scope of this study, understanding their role in the cumulative costs of regulations is important for understanding the role of operating costs. Franks, Schaefer, and Staunton highlight the significance of indirect costs in their 1997 study on financial industries in the United Kingdom. They estimate that the indirect costs of regulations in the securities industry are about 4.1 euros per 1 euro of direct costs, and in the investment management industry about 3.2 euros per 1 euro of direct costs. The findings imply that while compliance costs may be high, indirect costs can lead to far greater effects. These indirect costs are also notoriously difficult to predict and may elude even the most expert regulators.

Though direct costs are more predictable than indirect costs, evaluating direct costs ex ante is still a difficult task for regulators. Sneller and Langendijk (2007) provide an example of this difficulty when they examine the costs of the Sarbanes-Oxley Act, which required more rigorous internal assessments of company procedures and actions. The authors find that hours spent on internal assessment exceeded the predictions twelvefold, and that other expenses the regulated businesses incurred were 1.4 times what the regulators had estimated these expenses to be. These examples of indirect or unpredictable compliance costs underscore the need to better understand the full effects of regulations on operating costs.

Some studies have found that regulations also reduce the number of firms in a market as the costs of operation become unaffordable for some. For example, Chambers, McLaughlin, and Richards (2018) find that industry-specific regulations reduce the number of small firms within that industry and that these effects are amplified by consecutive years of high regulatory growth. Similarly, Bailey and Thomas (2017) find that industry-specific regulations reduce the entry rate

[1] These indirect costs are analogous to changes that dynamic scoring is designed to account for in the budget costs of new tax and other legislation. Dynamic scoring takes into account economic behavioral changes that may add to or detract from the budget implications of new tax and other legislative changes (Tax Policy Center 2020).

of new firms within that industry, disproportionately harming small firms. This implies that the reduced number of small firms in a market (Chambers, McLaughlin, and Richards 2018) is driven more by fewer small firms entering than by more small firms exiting, and that there is no real effect on the growth of existing firms (i.e., firm size growth from the small firm cohort to the large firm cohort).

These last two studies have important implications for measuring aggregate operating costs. Since regulations may reduce the number of firms within an industry, this reduction of firms (and the loss of their operating costs) may mask any firm-level increases in operating costs for the remaining firms if operating costs are measured at the industry level—other things being equal, fewer firms means lower total operating costs. By measuring aggregate operating costs, we would *under*estimate the positive (upward) effect of regulations on operating costs for the remaining firms. Measuring operating costs per firm creates a similar problem. Since regulations tend to have more of an effect on the number of small firms than on the number of large firms, the reduction in the number of small firms from regulatory growth may increase operating costs on a per-firm basis simply because the larger firms tend to have higher total operating costs. By measuring operating costs per firm, we would *over*estimate the upward effect of regulations on operating costs for the remaining firms.

This leaves operating costs per unit of output as a measurement tool. The reduction in the number of small firms may drive down operating costs on a per-unit basis if smaller firms tend to be less efficient—that is, if larger firms tend to have lower operating costs per unit of output. However, the bias when using per-unit operating costs is likely to be more muted than the biases when using industry or per-firm operating costs. Furthermore, the per-unit bias pushes in the opposite direction (downward) of our predicted effect of regulations (upward) so that any effect

of regulations that we do find will actually be underestimated (smaller than the true effect). This econometric motivation for choosing operating costs per unit of output complements the theoretical motivation for doing so: that measuring operating costs on a per-unit basis is consistent with microeconomic theory (the theory of the firm) because the imposition of regulation on a firm would cause an upward shift in the firm's average cost function.

III. Regulations and Operating Costs

Regulations on private firms either create new restrictions on behavior or create new obligations. If we start from the standard microeconomic assumption that firms maximize profit (revenue minus costs), then we can also assume that firms produce goods or provide services as cheaply as possible—that is, they minimize costs for a given product or service at their simultaneously chosen quality and quantity. Any mandated changes to the firms' operations then increases the costs at which they produce goods or provide services. The increase in costs will raise the firms' average cost curves, but the channel through which this occurs will differ depending on the type of regulation and the nature of the industry being regulated.

Regulations can increase both fixed and variable costs. Regulations that increase fixed costs are often those that require firms to purchase new capital or take on other expenses that do not substantially change day-to-day operations. One example of such an expense is newly mandated safety training for all employees. This will likely require a large up-front expense to train all current employees, plus smaller expenses each time a firm hires new employees. Yet

the impact on variable costs will likely be low.[2] Another example of a regulation that drives up fixed costs is a mandate that firm capital meet some minimum safety or environmental threshold (e.g., emissions standards). This will force many firms to invest in new (and likely more expensive or less efficient) capital.

Regulations that increase variable costs (which we refer to as operating costs) are often those that alter the day-to-day operations of a firm in some way. This could be through changes in the allowed or mandated behavior of employees or through changes in the technology that firms can or must use during operations. An example of regulations that change employee behavior are health and safety requirements, such as requirements that personnel perform safety checks or adhere to proper handling procedures when working with food. Probably the most visible example of regulations that change employee behavior is reporting requirements. On the basis of McLaughlin and Mulligan's (2020) work, a reasonable estimate of the paperwork burden associated with reporting requirements is approximately 15 percent of all regulatory costs.

Regulations that alter the technology that firms must use may have large effects on fixed costs, operating costs, or both. These regulations may require new technology in the form of new capital, which, as discussed above, is an example of increased fixed costs. Regulations may also require firms to introduce new technology that makes operations take longer or cost more. For example, if a regulation mandates that firms use a different type of machinery in manufacturing plants, that new machinery may require more labor hours to produce the same amount of output. Almost any regulation that requires the use of new technology or equipment in the operations of a firm is likely to increase operating costs since, as already mentioned, firms would likely have already adopted any changes that would decrease costs.

[2] Based on our prior assumption that firms minimize costs, if the safety training (or any other fixed expense) led to a substantial decrease in variable costs, most firms would have already incorporated the training into their onboarding processes.

Regulations may also increase the operating costs of firms that are not even in the industry targeted by the regulations. If the targeted industry does not sell goods and services directly to the consumer, then any downstream firms that purchase goods or services from the regulated firms will also experience an increase in operating costs because their input costs will rise. Consider again the manufacturing plant example. Any good, whether intermediate or final, that the manufacturing plant sells to another producer, wholesaler, or retailer will carry with it a higher price, which will then increase the operating costs of those downstream firms. These downstream effects are beyond the scope of this study but present an important avenue for future research.

The effects of regulations on operating costs will also differ depending on the nature of the targeted industry. Various factors will contribute to these differences, such as industry and firm structure, the statutory mandate and staffing of the agencies responsible for regulating the industry, and the nature and significance of concerns about the industry's workers and customers, as well as the industry's effect on the broader public. For example, regulations in the meat-packing industry are likely to focus on processes that ensure consumer safety, whereas in the steel industry, regulations are likely to focus on processes that ensure worker safety. Though the effects may differ, the regulations in both cases increase operating costs. Compare that to regulations in the energy-production sector. These regulations are likely to focus on pollution abatement, resulting in higher fixed costs.

These final examples represent just a couple of the many ways in which regulations can affect different industries' operating costs in different ways. The differences in effect highlight the importance of the case studies referenced in the previous section for evaluating and improving regulations. Yet, even if the channels differ, the result of ever-increasing regulatory burdens can be lost if we focus on only one regulation at a time. We must also abstract from the

individual regulation or industry and consider how overall regulatory growth is increasing operating costs across the economy. In this study, we aim to measure this effect.

IV. Data

We use operating cost data and output data from the Integrated Industry-Level Production Account dataset, produced by the Bureau of Economic Analysis and the Bureau of Labor Statistics, to calculate our unit operating costs. To measure operating costs, we sum variable costs, including compensation for energy, materials, services, and labor (college and noncollege). These data are available from 1998 to 2017 for many three-digit NAICS industries. For output, we use the production account quantity index of gross output, which indexes gross output to 2012. To get our unit operating costs metric, we divide each industry's total operating costs by its gross output quantity index in each year. Because we divide by an index of output, only percent changes in this metric—not its actual levels—will be comparable across industries. We get our measure of regulations from RegData.

RegData counts the number of regulatory restrictions—words such as "shall," "must," and "may not"—in the *Code of Federal Regulations* (CFR), which contains the stock of all current regulations (Al-Ubaydli and McLaughlin 2017). By using the CFR (as opposed to the *Federal Register*), RegData captures only restrictions that are currently in effect and avoids restrictions that do not limit economic activity, such as those in deregulatory actions. RegData then uses a machine-learning algorithm to determine which restrictions are relevant to each NAICS industry, providing a total restriction count for each NAICS industry each year from 1970 to 2017 (McLaughlin et al. 2017). Combining the data from the Integrated Industry-Level Production Account dataset and RegData, we have a dataset covering 28 industries at the three-digit NAICS level from 1998 to 2017. Table 1 presents the summary statistics of this dataset.

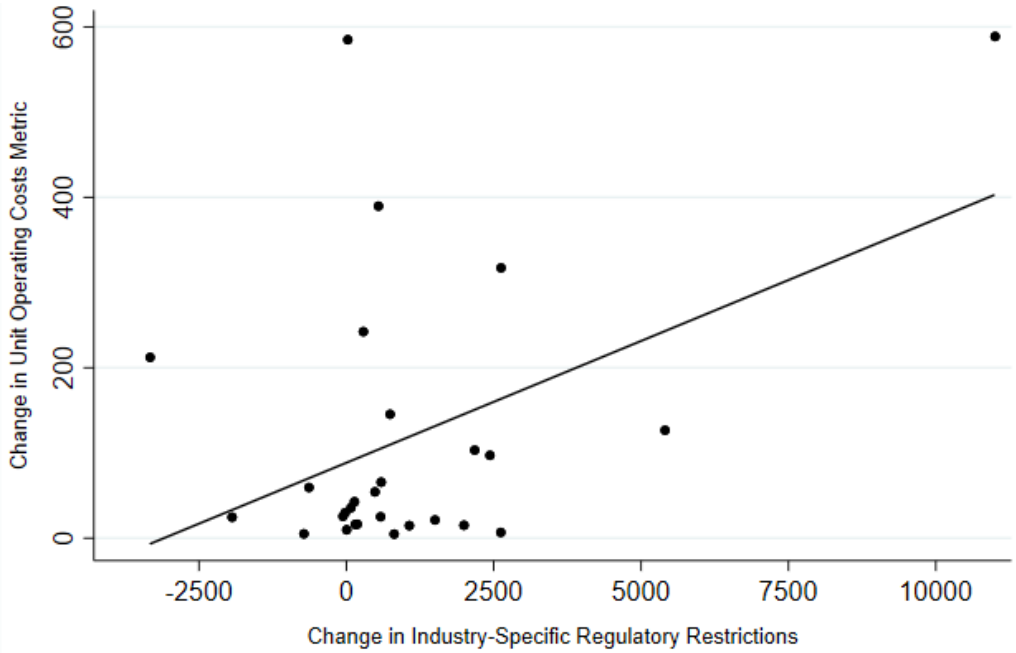
Table 1. Summary Statistics

	Mean	Std. dev.	Min.	Max.
Operating costs (billions of dollars)	216.60	219.55	11.51	1,194.28
Gross output (2012 = 100)	95.38	18.59	18.61	142.83
Unit operating costs metric	2,294.76	2,264.57	118.48	10,348.51
Industry regulatory restrictions	18,467.55	20,714.60	379.01	102,732.60

Note: These data span 28 industries over 20 years (1998–2017) for a total of 560 observations. All values are rounded to the nearest hundredth.

For this study, we are interested in the relationship between the change in regulatory restrictions over time and the change in operating costs per unit of output over time. Figure 1 provides a scatterplot of the change in both variables for each industry over the entire period examined (1998–2017), along with a fitted line. Section V examines this relationship in more detail.

Figure 1. Relationship between Changes in Regulatory Restrictions and Changes in Unit Operating Cost Metric from 1998 to 2017



Source: Author's calculations; US Bureau of Economic Analysis and US Bureau of Labor Statistics 2019; McLaughlin and Sherouse 2017.

V. Methodology

The nature of the interaction between regulations and unit operating costs creates endogeneity issues for examining this relationship because of the influence of technology. Not only does technology influence both regulations (as regulatory agencies address concerns related to new technologies) and operating costs (as new technologies drive production costs down),[3] but the nature of each industry's technology means that different industries will consistently have different rates of change in their per-unit operating costs. Some industries may experience perpetual declines in per-unit operating costs because of innovation while others may experience roughly steady per-unit operating costs. In addition to the different trends in unit operating costs, differences in technology will also mean that general technological shocks will affect each industry differently (i.e., technological shocks will often have a larger downward effect on operating costs in some industries than in others).

This is where a standard fixed-effects model would fall short. Fixed effects can account for trends and differences in levels of operating costs in each industry. Yet fixed effects cannot account for differences in the *effect* of common trends (e.g., how technological growth affects each industry's operating costs differently). Any evaluation of the relationship between industry-level regulations and per-unit operating costs requires an account of general technological growth, the effect of that growth on each industry's per-unit operating costs, the level of per-unit operating costs within each industry, and the trend of per-unit operating cost growth (positive or negative) within each industry.

The AMG estimator described in Eberhardt and Bond (2009) allows us to better account for each of these components of the relationship. The AMG estimator was first used in Eberhardt

[3] We refer here to market-driven technological innovations that decrease production costs or increase product quality. This should not be confused with technologies that are created or adopted in response to new regulations, which, as mentioned before, are likely to increase costs.

and Teal (2010) to examine cross-country productivity differences, and it was later adopted to examine various other economic relationships in studies such as Ma (2015), Atasoy (2017), Shahbaz et al. (2018), and Paramati and Roca (2019). AMG estimators help account for endogeneity driven by stationary and nonstationary unobservables (here, technology and any other unobservables) in two stages. In stage 1, this approach estimates cross-section dependence (i.e., general technological growth and other unobserved factor trends across all industries, such as inflation) with year dummies in a pooled regression in first differences. The equation is written as

$$\Delta \log\left(unit_{op_{costs}\,it}\right) = \beta' \Delta \log(regs_{it}) + \sum_{t=2}^{T} \eta'_t \Delta D_t + \varepsilon'_{it}, \quad (1)$$

where $unit\_op\_costs_{it}$ is the unit operating costs metric in industry i at time t, $\log(regs_{it})$ is the number of regulatory restrictions on industry i at time t, D_t is a set of $T-1$ year dummies, and ε_{it} is an idiosyncratic error term. Note that $\eta'_2, \eta'_3, \ldots, \eta'_T$ are all separate coefficients to be estimated for each year from $t = 2$ to $t = T$. These coefficients provide the estimates of cross-section dependence described above. We will use these coefficient estimates to account for differences in the effects of common trends in the next stage. Though equation (1) only includes current-year regulations, we will later introduce lags since many of the costs of regulations are incurred over time (not instantaneously).

Stage 2 consists of individual standard regressions for each of the 28 industries with the estimated dummy coefficients from stage 1, which we denote $\hat{\eta}_t$, included in the regression, along with an intercept and a separate linear trend term to capture industry-specific trends over time. Equation (2) shows the stage 2 regression for a single industry (call it j). It is written as

$$\log(unit\_op\_costs_{it}) = \alpha + \lambda t + \beta \log(regs_t) + \zeta \hat{\eta}_t + \varepsilon_t, \quad (2)$$

where α is the intercept and accounts for the initial level of the unit operating costs metric in industry *j*; λ accounts for the trend of unit operating costs in industry *j*; ζ accounts for the effect of general technological growth and other common factors across all industries (measured by $\hat{\eta}_t$) on industry *j*; and β measures the effect of regulatory restrictions on unit operating costs in industry *j*. The average of the coefficients on regulations is the estimated effect of current-year regulations on unit operating costs across all 28 industries. Robust standard errors are calculated by testing the statistical difference of the average coefficient from zero, following Pesaran and Smith (1995).[4]

We also perform two other versions of these tests with additional controls to ensure that the 2008 recession is not biasing the results in any substantial way. One version includes an indicator for the post-recession years, and the other interacts that indicator with the year variable to control for a difference in the trend of the unit operating costs metric after the recession.

VI. Results

The results are presented in table 2.[5] Column (1) shows the results of equation (2). The coefficient on current-year regulatory restrictions is positive and statistically significant at the 5 percent level. The magnitude of this coefficient indicates that a 1 percent increase in industry-specific regulatory restrictions is associated with approximately a 0.2 percent increase in operating costs per unit of output. Since regulatory restrictions in our dataset grew at an average annual rate of 3.55 percent, this implies that current-year regulatory growth in these industries between 1998 and 2017 increased operating costs per unit of output by an average of about 0.8 percentage points per year. Hypothetically, if factors other than regulations such as

[4] As described in Eberhardt (2012), this is done by regressing the group-specific coefficients on an intercept.
[5] Tables 3 and 4 in the appendix present the results of the tests using controls for the Great Recession. The results closely resemble the results in table 2.

innovation, inflation, and so on had not driven any changes in operating costs, the current-year effects of regulatory growth alone over the past 20 years would have increased operating costs per unit of output in these industries by roughly 17 percent.

However, as mentioned earlier, the effects of regulations extend beyond the current year. Columns (2) through (6) in table 2 examine the effects of previous-year regulations on current-year operating costs per unit of output. It appears that regulations from the previous two years have no measurable effect (and, in fact, their inclusion reduces or removes the statistical significance of current-year regulations). Yet regulations created four to five years earlier have an even larger effect than those in the current year, as measured in column (1). The positive effect of regulations from four years earlier is not only statistically significant at the 1 percent level in both estimations where this variable is included, but it is over 50 percent larger than the effect of current-year regulations in column (1) (i.e., with no lagged variables). Furthermore, when all five previous years are included, the coefficient on current-year regulations becomes statistically significant at the 5 percent level again, but it is now about 50 percent larger than it was in column (1).

The industries with the smallest and largest coefficients for regulations in the years with significant coefficients also provide some interesting information regarding the differences in effects. The industries with the largest coefficients on regulation were water transportation at 1.94 (current-year regulations), air transportation at 1.39 (four-year lag), and the motion picture and sound recording industries at 2.19 (five-year lag). The industries with the smallest (most negative) coefficients were petroleum and coal products manufacturing at –2.16 (current year) and oil and gas extraction at –0.76 and –0.65 (four-year lag and five-year lag). These findings imply that regulations may be increasing operating costs for the transportation sector while

actually decreasing operating costs for the energy sector, but further examination is necessary to understand the true relationship and its causes.

Table 2. The Effects of Industry Regulatory Restrictions on Industry Unit Operating Costs, 1998–2017

	Log (unit operating costs metric)					
	(1)	(2)	(3)	(4)	(5)	(6)
Log (regulatory restrictions):						
Current year	0.216** (0.107)	0.190** (0.091)	0.172 (0.146)	0.237 (0.150)	0.255 (0.159)	0.330** (0.147)
1-year lag		0.052 (0.113)	0.106 (0.779)	0.022 (0.100)	0.109 (0.121)	0.021 (0.202)
2-year lag			–0.027 (0.090)	–0.060 (0.092)	–0.035 (0.106)	0.173 (0.132)
3-year lag				0.213** (0.086)	0.105 (0.073)	0.060 (0.150)
4-year lag					0.357*** (0.113)	0.341*** (0.107)
5-year lag						0.267** (0.123)
Industry-specific trend	–0.006 (0.006)	–0.008 (0.007)	–0.008 (0.008)	–0.014 (0.009)	–0.018* (0.011)	–0.023 (0.154)
χ^2 *p* value		0.080*	0.275	0.022**	0.011**	0.001***

Note: These results were produced using an AMG estimator. The coefficients were averaged across 28 industry estimations. Coefficients for the constant were omitted from this table. Standard errors are in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$. $N = 560$.

Though AMG estimators do not establish causality, our results present a strong case for a causal relationship in which new regulations drive up operating costs per unit of output. The AMG estimator accounts for the important common omitted variable across all industries: technological growth. The one important variable that AMG omits is industry-

specific technological growth. To an extent, this is accounted for by the industry trend lines. However, technological growth is often not perfectly linear, and therefore a trend line will not measure this growth accurately. On the other hand, industry-specific technological growth—like measuring operating costs per unit of output—biases the coefficient on regulatory restrictions downward, because technological growth often increases regulations and decreases operating costs. This implies that we underestimate the effect of regulations on operating costs, providing stronger evidence of a causal relationship (since the omission of industry-specific technological growth would push the regulations coefficients in the opposite direction of the causal relationship). The strong relationship between current-year operating costs and regulations from four and five years prior also provides evidence of a causal relationship for two reasons. First, it implies regulatory changes come first. Second, there is no missing variable we can think of that would increase regulations in the immediate term and increase operating costs years down the road.

Given this argument for a causal relationship, our results imply that, when measured in isolation, regulations in the current year increase operating costs per unit of output by an economically significant amount. When considered in the context of past regulatory growth, the effect of current-year regulations becomes even larger. This effect is made worse by the regulations from four or five years earlier, which are driving up operating costs at a rate similar to that of current-year regulations. Considering that regulations often do not require that firms comply immediately, and that firms take time to adjust to the new legal environment,[6] this is not a surprising result. We speculate that when new regulations are introduced, firms take some immediate action (e.g., procedural) to begin moving toward compliance, which drives up

[6] For example, a 2012 Positive Train Control Systems rule for railroads originally required that railroads be in compliance by the end of 2015, but later extended this date to 2018 because many railroads were unable to meet the three-year deadline (Federal Railroad Administration 2012; "Positive Train Control Postponed" 2015).

operating costs. Then, as the years go on, firms make still more adjustments in order to fully comply, which drives up operating costs even more.[7] Furthermore, when firms are still dealing with the lagged effects of many recent regulations, it becomes more difficult to comply with new regulations, making current-year regulations more costly.

Though this study does consider the effect of past regulations on current operating costs, there is another, stronger element of this relationship that we cannot test with the current analysis. Because regulations are accelerating the growth rate of operating costs (or slowing the negative growth rate of operating costs), these effects will compound. The hypothetical described above in which regulations over the past 20 years would have increased operating costs per unit of output by 17 percent highlights this element, but it underestimates it, potentially to a large degree. If we again consider that hypothetical but combine the three statistically significant coefficients from column (6) in table 2, a starkly different picture emerges. We estimate that, had other factors not affected operating costs, regulations alone would have driven operating costs per unit of output up over the 20-year period by 92 percent, not 17 percent.[8] Furthermore, as described earlier, the bias created by reductions in the number of firms means that we still likely underestimate the effect of regulations on operating costs, so the true effect of regulations is likely even greater.

VII. Conclusion

The results of our research clearly point to a significant relationship between the percentage change in regulations affecting three-digit NAICS industries and the percentage change in per-

[7] The lack of a statistically significant effect in the one-, two-, and three-year lags provides a second potential component of the story. This could represent firms setting aside recent regulations to deal with the immediate requirements of new regulations, which forces them to then play "catch up" when they approach the full compliance dates (represented by the four- and five-year lags).

[8] To arrive at this estimate, we assume the same annual growth rate of regulations (3.55 percent) for the five years prior to the sample.

unit operating costs for the firms in these industries. Additional research would be beneficial on two fronts. First, our study examines the effects only of regulations beginning in 1998 because of the data we use from the Integrated Industry-Level Production Account dataset, but RegData dates back to 1970. A study that employed appropriate methods to determine operating costs by industry *before* 1998 would provide valuable information from outside our narrow 20-year window.

Second, and more importantly, our study only examines year-to-year changes in regulations. A growing literature shows that it is not only the annual changes in regulations that matter but also the total accumulation of regulations over time. The growing complexity and sheer mass of an ever-growing regulatory code can make the total costs of all regulations greater than the sum of the costs of individual regulations when each is considered in isolation. Thus, a study that accounted for year-to-year changes in regulations *and* the accumulation of regulations over time would uncover vital information regarding the hidden effects of regulatory accumulation on operating costs. Since increases in costs are the theoretical underpinning for much of the research on the effects of regulations, such a study would also shed light on the other downstream effects of regulations on individuals, businesses, and the overall economy.

Even with these limitations, the policy implications of our findings cannot be overstated. The ability of businesses to absorb new regulations—despite their benefits—may be limited without incurring substantial overall negative effects. The findings here could provide the foundation for a "regulatory budget framework" within which constraints are placed on the number of additional regulations imposed by the federal government on the private sector. The parameters estimated above provide insight regarding not just the costs of new regulations but the potential savings from regulatory cutbacks. Returning again to our hypothetical economy in

which only regulations affect operating costs, a regulatory reform initiative that reduced the total volume of regulations to 1998 levels would nearly cut operating costs per unit of output in half (a reduction of approximately 48 percent). In other words, our findings indicate that deregulation resembles technological innovation that increases economic growth, even when we assume technology to be constant.

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Appendix: Statistical Tables with Great Recession Indicator

Table 3. The Effects of Industry Regulatory Restrictions on Industry Unit Operating Costs, 1998–2017 (with Great Recession Indicator)

	Log (unit operating costs metric)					
	(1)	(2)	(3)	(4)	(5)	(6)
Log (regulatory restrictions):						
Current year	0.251** (0.105)	0.212** (0.094)	0.185 (0.132)	0.248* (0.130)	0.320** (0.140)	0.287* (0.147)
1-year lag		–0.011 (0.141)	0.070 (0.107)	0.016 (0.107)	0.074 (0.126)	–0.030 (0.159)
2-year lag			–0.105 (0.098)	–0.106 (0.090)	–0.059 (0.091)	0.030 (0.120)
3-year lag				0.155 (0.105)	0.070 (0.071)	–0.052 (0.110)
4-year lag					0.317** (0.130)	0.379*** (0.130)
5-year lag						–0.006 (0.153)
Industry-specific trend	–0.007 (0.006)	–0.007 (0.007)	–0.007 (0.007)	–0.013* (0.007)	–0.015* (0.008)	–0.006 (0.012)
Post-recession indicator	–0.012 (0.022)	0.007 (0.035)	0.008 (0.037)	0.009 (0.038)	0.319*** (0.043)	–0.005 (0.042)
χ^2 *p* value		0.080*	0.418	0.015**	0.026**	0.012**

Note: These results were produced using an AMG estimator. The coefficients were averaged across 28 industry estimations. Coefficients for the constant were omitted from this table. Standard errors are in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$. $N = 560$.

Table 4. The Effects of Industry Regulatory Restrictions on Industry Unit Operating Costs, 1998–2017 (with Great Recession Trend)

	Log (unit operating costs metric)					
	(1)	(2)	(3)	(4)	(5)	(6)
Log (regulatory restrictions):						
Current year	0.251** (0.105)	0.212** (0.094)	0.185 (0.132)	0.248* (0.130)	0.321** (0.140)	0.287* (0.147)
1-year lag		–0.010 (0.141)	0.071 (0.106)	0.016 (0.107)	0.074 (0.127)	–0.030 (0.159)
2-year lag			–0.104 (0.098)	–0.106 (0.090)	–0.058 (0.091)	0.030 (0.120)
3-year lag				0.156 (0.105)	0.070 (0.071)	–0.052 (0.110)
4-year lag					0.317** (0.130)	0.380*** (0.130)
5-year lag						–0.006 (0.153)
Industry-specific trend	–0.007 (0.006)	–0.007 (0.007)	–0.007 (0.007)	–0.013* (0.007)	–0.015* (0.008)	–0.006 (0.012)
Post-recession trend	0.00016*** (0.00001)	0.00017*** (0.00002)	0.00018*** (0.00002)	0.00017*** (0.00002)	0.00016*** (0.00002)	0.00014*** (0.00002)
χ^2 *p* value		0.079*	0.413	0.015**	0.025**	0.012**

Note: These results were produced using an AMG estimator. The coefficients were averaged across 28 industry estimations. Coefficients for the constant were omitted from this table. All coefficients rounded to the thousandth except for the post-recession trend coefficients. Standard errors are in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$. $N = 560$.