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REGULATION AND PRODUCTIVITY

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ABSTRACT

A NEW METRIC provided by RegData counts the number of "binding words"—"shall," "must," "may not," "prohibited," and "required" —that appear in the *Code of Federal Regulations*, and cross-references those word counts with the industries to which they apply. A comparison of the RegData data to production-efficiency measures provided shows that industries that are subject to less regulation have significantly higher production-efficiency measures than do industries that are subject to more regulation. Over the period 1997 through 2010, the least regulated industries experienced 63 percent growth in output per person, 64 percent growth in output per hour, and a 4 percent decline in unit labor costs. Over the same period, the most regulated industries experienced 33 percent growth in output per person, 34 percent growth in output per hour, and a 20 percent increase in unit labor costs.

JEL codes: H30, L51, K20

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When the government regulates, it reaches into a market and requires the consumers or producers to behave in certain ways. It is the alteration in behavior, not the extraction of money (at least, not directly), that results in reduced productivity. There are arguments that government regulations can be beneficial, particularly where correcting for information asymmetries. The classic case is G. A. Akerlof's description of used-car markets. Because the seller knows the quality of the car and the buyer does not, the seller has a greater incentive to sell lower-quality used cars (because the buyer would be unaware of the low quality) than to sell higher-quality used cars (because the buyer would be unaware of the high quality). Knowing this, buyers will adjust their quality expectations downward, providing sellers with an incentive to bring even-lower-quality cars to market. The result is that the market for used cars would cease to exist. Akerlof's argument is that government regulations that force the seller to reveal information about the quality of the car are beneficial, because the shared information allows the used-car market to exist.[1]

The counterargument is that, if the information truly is valuable, markets will find ways to disseminate it. Examples of market solutions to information asymmetry abound: *Consumer Reports*, Underwriters Laboratories, and seller ratings on eBay are three well-known examples. In the used-car market, CARFAX aggregates information about vehicle histories, and manufacturers offer certified pre-owned programs. This line of argument begs the question, is any regulation desirable? Some clarification is required on this point. Noneconomists often speak as if markets exist in one of two states: regulated or unregulated. In fact, there is no such thing as an unregulated market. All markets are regulated. The question is whether a market is regulated by government or by consumers.

For example, hairdressers in many states are required by law to be licensed by the state government.[2] The stated purpose is to protect consumers by prohibiting

1. George A. Akerlof, "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics* 84, no. 3 (1970): 488–500.

2. Howard Baetjer, *Free Our Markets: A Citizens' Guide to Essential Economics* (New Hampshire: Jane Philip Publications, 2013).

untrained people from cutting or styling hair. However, no state requires teenagers to be licensed in order to babysit—despite the fact that poor babysitting has far more serious ramifications than does poor hairstyling. Yet the market for babysitters is not unregulated. It is regulated by consumers. If parents are pleased with a babysitter, they will use the babysitter again and may recommend the babysitter to others. Parents who are displeased with a babysitter will not. Babysitters who are not asked back, not recommended, or given poor recommendations drop out of the market and look for alternate employment.

Regulation by consumers is voluntary. Consumers choose for themselves whether to punish a firm by not purchasing its product or by encouraging others not to purchase. Regulation by government imposes a cost on producers or consumers because it requires them to act in a way that they would not act voluntarily. We know this because, if the required action resulted in greater profit to the producer or greater benefit to the consumer, the producer or consumer would undertake the action voluntarily. For the government to have to require the action implies that the action is more costly to the consumer or producer than the voluntary alternative.

Voters tend to regard regulation—particularly when it is billed as "protecting the consumer"—as a good thing. Where public health and safety are concerned, polls show a majority of Americans favor maintaining or strengthening current regulations on food production, environmental protection, car safety, workplace safety, and prescription drug safety.[3] Despite this, a plurality (49%) of Americans believe that small businesses are overregulated.[4]

A political feedback mechanism favors the growth of regulation. Regulation can generate profit for specific favored industries that, in turn, will contribute to specific politicians' campaigns.[5] The important part of this feedback mechanism is known as "regulatory capture" or, more generally, "rent-seeking." Rent-seeking occurs when people or businesses use the political arena to gain benefit for themselves.[6] Regulatory capture is the process by which government agencies charged with regulating industries come to be influenced by the regulated industries.[7] The result is that regulated firms have a profit motive to encourage the regulatory agency to adopt rules that benefit those firms. While the problem can manifest

3. Pew Research Center, "Auto Bailout Now Backed, Stimulus Divisive; Mixed Views of Regulation, Support for Keystone Pipeline," February 23, 2012, www.people-press.org/files/legacy-pdf/2-23-12%20Regulation%20release.pdf.

4. Frank Newport, "Americans More Likely to Say Government Doing Too Much," *Gallup Politics*, September 21, 2009, www.gallup.com/poll/123101/americans-likely-say-government-doing-too-much.aspx.

5. Michael E. Levine and Jennifer L. Forrence, "Regulatory Capture, Public Interest, and the Public Agenda: Toward a Synthesis," *Journal of Law, Economics, and Organization* 6 (April 1990): 167–98.

6. David R. Henderson, "Rent Seeking," in *The Concise Encyclopedia of Economics*, 2nd ed., accessed May 5, 2014, http://www.econlib.org/library/Enc/RentSeeking.html.

7. *Mises Wiki* (Auburn, AL: Ludwig von Mises Institute), s.v. "regulatory capture," last modified December 8, 2012, http://wiki.mises.org/wiki/Regulatory_capture.

itself as blatant corruption, as in firms buying off regulators and politicians, it can also manifest itself as an innocent byproduct of regulators having to turn to the regulated firms for input because the regulators lack the necessary information or expertise to make informed decisions.[8] Examples of regulation benefiting incumbent firms include the California Public Utilities Commission fining competitors to traditional taxis in response to pressure from cab companies that are regulated by the commission,[9] and the Louisiana State Board of Embalmers and Funeral Directors, at the urging of regulated funeral homes, filing suit to prevent monks from selling caskets unless they have a mortuary and licensed mortician on staff—despite the fact that the monks do not handle bodies.[10]

Regardless of the motivation, regulatory capture benefits larger, well-established regulated firms at the expense of smaller regulated firms, consumers, or nonregulated industries. For example, large health-insurance companies benefit from regulations that make it difficult for smaller insurers to operate across state lines.[11] The greater the difficulty, the less competition large insurers will feel from small insurers. Banks benefit from regulations that require and subsidize federally sponsored depositor insurance, because they do not have to bear the full cost of private insurance that their depositors would otherwise demand and because they can be less capitalized.[12] Medical specialists benefit from state regulations that require insurance policies to cover specific procedures.[13] Labor unions often support regulations that reduce labor competition, such as minimum-wage legislation, prevailing-wage legislation, and certification requirements. In exchange for politicians' support for these regulations, these special interests contribute to politicians' campaigns.

Regulations can alter the behavior of at least four sets of market participants. Regulation directly alters the behavior of consumers and producers in the regulated market. It then indirectly alters the behavior of consumers and producers who may be external to the market but who benefit or suffer from the regulation. For example, ethanol regulations directly affect the behaviors of producers and consumers of gasoline. But they also affect corn farmers, who benefit from a higher price for corn.

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8. Nolan McCarty, "Complexity, Capacity, and Capture," in *Preventing Regulatory Capture: Special Interest Influence and How to Limit It*, ed. Daniel Carpenter and David A. Moss (New York: Cambridge University Press, 2013).

9. Benny Evangelista, "PUC Fines 3 App-Hailing Taxi Startups," *San Francisco Chronicle*, November 14, 2012.

10. Jennifer Levitz, "Benedictine Monks Allowed to Run Casket Business," *Wall Street Journal*, July 21, 2011.

11. Sabrina Corlette et al., *Selling Health Insurance across State Lines: An Assessment of State Laws and Implications for Improving Choice and Affordability of Coverage* (Center on Health Insurance Reforms, Georgetown University Health Policy Institute, Washington, DC, October 2012).

12. Baetjer, *Free Our Markets*.

13. Edmund F. Haislmaier, "Obamacare and Insurance Benefit Mandates: Raising Premiums and Reducing Patient Choice" (WebMemo No. 3110, Heritage Foundation, Washington, DC, January 20, 2011), http://www.heritage.org/research/reports/2011/01/obamacare-and-insurance-benefit-mandates-raising-premiums-and-reducing-patient-choice.

In this paper, I examine the effects of regulation on only one of these four groups: producers within the regulated market. In the face of regulation, we should expect some producers—those who cannot benefit from regulatory capture—to alter their production levels and processes in ways that they would not have chosen voluntarily and that make them worse off. We should also expect some producers—those who can benefit from regulatory capture—to alter their production levels and processes in ways that competition would have prevented. Thus, we should expect producers' productivity to decline as the regulatory burden placed on them increases.

Competition pushes firms to find ways to produce the quality and quantity of products that consumers desire at the lowest possible per-unit cost. In pursuit of cost savings, firms will adjust their suppliers, the technology they bring to bear on production, management styles, geographic location, the mix of inputs they use in producing their products, and any other factor they can find that will reduce their costs of production. Because regulations force producers to behave in ways they otherwise would not, by definition, we would expect regulations to increase producers' costs. In short, more regulation should be associated with higher production costs.

A possible counterargument is that antitrust regulations can reduce production costs by preventing natural monopolies from inhibiting competition. This argument, however, overlooks the fact that natural monopolies exist in the first place because of economies of scale. That is, a single natural monopoly can produce at a lower cost than can multiple smaller firms. Of course, left unregulated, the natural monopoly will attempt to maximize its profit by restricting the amount it produces. This will result in the unregulated monopoly incurring greater production costs—possibly, though not certainly, greater than the production costs of multiple smaller firms.

Further, this argument ignores the longer-term economic effects. When an industry evolves into a natural monopoly (or an approximation thereof), there arises a profit incentive for entrepreneurs to create competing industries. The profits earned by railroads provided an incentive for the development of air transport. Profits earned by long-distance carriers provided an incentive for the development of cellular networks. Profits earned by cellular networks provided an incentive for the development of VoIP (Voice over Internet Protocol) services. Regulating a natural monopoly so as to maintain lower production costs reduces the economic incentive for entrepreneurs to develop new and better competing industries.

Government regulation of natural monopolies can force monopolies to charge prices closer to what a competitive market would attain, though at the potential cost of dampening the incentive for entrepreneurs to found competing industries. Whether the trade-off is worth making depends on the benefit gained from the price reduction and the benefit lost from the potential delay in the founding of new competing industries. While the price reduction can either be observed directly or estimated, the lost benefit from delaying the founding of new industries is impossible to know except in hindsight.

Some regulations act not on existing firms but on potential entrants. These regulations affect existing firms' behavior in two ways. First, by making it harder for new firms to enter an industry, these regulations inhibit competitive forces that would otherwise put pressure on existing firms to reduce their production costs. Second, once such regulations are in place, existing firms have an incentive to lobby the government to maintain and strengthen the regulations so as to prevent future competition. This incentive draws the firms' financial and creative resources away from production and toward lobbying.

REGULATION AND PRODUCTIVITY: EVIDENCE

Testing the hypothesis that increased regulation is associated with increased production costs presents a significant problem: how to measure "regulation." Does a requirement to install nonslip mats in restaurant kitchens constitute a greater or lesser regulation than a requirement that cooks wear hairnets? Does requiring airbags in cars constitute a greater or lesser regulation than requiring ethanol in gasoline? Further, we must take care to distinguish between the quantity of regulation and the *effect* of regulation. For example, a regulation requiring that all new cars be covered by extended warranties is, legislatively, not much different in size than a regulation requiring that all new cars attain at least 40 mpg. That is, both regulations could be stated in about the same number of words and at the same level of detail. But the difference in the *effects* of the two regulations is tremendous. The first is easily attained and boils down to incorporating the price of an existing optional product (the extended warranty) into the car's sale price. The second is very difficult to attain as it requires redesigning the cars and possibly developing new technologies.

One possible approach to measuring the quantity of regulation is simply to count regulations. The more regulations there are, the more regulated an industry must be. This is not unreasonable, and several studies have taken this approach by counting, not the number of regulations, but the number of pages in the *Federal Register*—the printed collection of all federal regulations.[14] Of course, the number of pages the regulations comprise is not an exact measure of the scope of regulation. Since an exact measure is impossible, what we seek is an unbiased measure. That is, what we require of our measure is not that it be exact in every instance, but rather that it neither systematically overestimate nor systematically underestimate the scope of regulation. For example, if the number of pages a regulation comprises is *on average* proportional to the scope of the regulation, then the measure is adequate for analytic purposes.

A better measure, developed by Omar Al-Ubaydli and Patrick McLaughlin, counts the number of binding words—"shall," "must," "may not," "prohibited," and

14. Veronique de Rugy and Antony Davies, "Midnight Regulations and the Cinderella Effect," *Journal of Socioeconomics* 38 (2009): 886–90.

"required"—that appear in the *Code of Federal Regulations* (CFR).[15] The authors categorize their counts by industry (as determined by the North American Industry Classification System, NAICS). The binding-word count is better than a mere page count because it is correlated with the constraints imposed by the regulations rather than merely the wordiness of the regulations.

An additional problem with using *Federal Register* page counts as a measure of regulations is that, to remove previously enacted regulations, pages must be added to the *Federal Register* that describe the regulations that are to be removed. That is, the *Federal Register* not only contains every regulation ever enacted, regardless of whether the regulations were ultimately rescinded, but it also contains all orders rescinding and amending previous regulations. Consequently, the number of pages in the *Federal Register* grows when the number of regulations changes, regardless of whether the change represents an increase or a decrease in regulations. In contrast, the *Code of Federal Regulations* contains the net stock of federal regulations after rescinded regulations have been removed. However, while the CFR contains the net stock of regulations, as with the *Federal Register* a page count of the CFR would provide only a measure of the length of the printed regulation, not the number of binding words within the regulations.

To estimate the effects of regulations, one can construct a regulations index and compare it to subsequent productivity measures for various industries over time. RegData provides a regulatory index for each of 96 industries (as categorized by three-digit NAICS codes) in each year from 1997 through 2010. NAICS codes are arranged such that a larger number of digits indicates a greater degree of subcategorization. For example, 311 is food manufacturing, 3114 is fruit and vegetable preserving (a subset of food manufacturing), and 31142 is fruit and vegetable canning, pickling, and drying (a subset of fruit and vegetable preserving).

The Bureau of Labor Statistics (BLS) provides production-efficiency measures for 48 industries at a three-digit level of categorization plus information for 6 additional industries at a four-digit level of categorization. For each of these 6 additional industries, I take the average of the information provided for each four-digit categorization within a three-digit superset as an estimate for the information for the three-digit category. For example, while BLS does not provide information for industry 221 (utilities), it does provide information for sub-industries 2211 (electrical-power generation) and 2212 (natural-gas distribution). I take the average of the data for subindustries 2211 and 2212 as an estimate of the data for industry 221.

The RegData dataset includes 96 such three-digit industry categories, of which 51 overlap with the BLS data. While the BLS dataset contains information for the years 1987–2010, the RegData dataset includes only the years 1997 through 2010.

15. Omar Al-Ubaydli and Patrick A. McLaughlin, "RegData: A Numerical Database on Industry-Specific Regulations for All U.S. Industries and Federal Regulations, 1997–2010" (Working Paper No. 12-20, Mercatus Center at George Mason University, Arlington, VA, January 2013).

Combining the two datasets yields a panel of 51 industries and 14 years, for a total of 714 observations.[16]

To capture differences in regulations across industries and across time, one can construct a relative index equal to the RegData index for a given industry in a given year divided by the average RegData index over all industries and all years. For example, the average RegData index over all industries and all years is 6,139. The RegData index for the oil and gas extraction industry in 2010 is 35,580. The ratio, 5.8, indicates that there were 5.8 times as many binding words in oil and gas regulations in 2010 as for all industries and years on average. I will call this ratio the *relative regulatory index*. (Al-Ubaydli and McLaughlin construct an industry-specific relative measure that reflects changes in regulations within an industry over time, but does not reflect differences across industries.)

As with regulations, there is no clear definition of productivity. Most measures of productivity relate output to inputs or to costs. The measures used in this paper are output per hour, output per person, and unit labor costs.[17] Each of these measures captures effects of productivity from a slightly different perspective. Because productivity will vary across industries and because regulatory changes require time to take effect, I compare the change in productivity for each industry in each year to the relative regulatory index for that industry in the previous year.

To begin, for each year, I split the industries into three groups (industries subject to the least regulation, industries subject to the most regulation, and industries subject to moderate regulation) by separating the relative regulatory index into terciles. For each year, the least regulated industries are those among the bottom third when ranked by relative regulatory index, while the most regulated are those among the top third. Table 1 shows the number of years (over the period 1997 through 2010) that each industry appeared among the least regulated and the most regulated industries. Industries that appear in neither category are in the middle (unshown) category of "moderately regulated."[18]

16. Lagging regressors reduces the effective dataset to 663 observations.

17. The measures all come from the Bureau of Labor Statistics, Industry Productivity and Costs Data Tables (www.bls.gov/lpc/iprprodydata.htm).

18. Dividing the data into three parts highlights differences among the set of "more regulated" and "less regulated" by eliminating from consideration the middle industries that might be classified as either. In econometrics, this technique is the basis for the Chow test that is used to determine differences in subgroups of a population. See Gregory C. Chow, "Tests of Equality between Sets of Coefficients in Two Linear Regressions," *Econometrica* 28, no. 3 (1960): 591–605.

TABLE 1. LEAST REGULATED AND MOST REGULATED INDUSTRIES INCLUDED IN THE ANALYSIS, 1997–2010

NAICS code	Industry	Years least regulated	Years most regulated
211	Oil and Gas Extraction	0	14
212	Mining (except Oil and Gas)	0	14
213	Support Activities for Mining	14	0
221	Utilities	0	14
311	Food Manufacturing	0	14
312	Beverage and Tobacco Product Manufacturing	0	0
313	Textile Mills	0	0
314	Textile Product Mills	0	0
315	Apparel Manufacturing	1	0
316	Leather and Allied Product Manufacturing	14	0
321	Wood Product Manufacturing	14	0
322	Paper Manufacturing	0	14
323	Printing and Related Support Activities	0	0
324	Petroleum and Coal Products Manufacturing	14	0
325	Chemical Manufacturing	0	14
326	Plastics and Rubber Products Manufacturing	14	0
327	Nonmetallic Mineral Product Manufacturing	14	0
331	Primary Metal Manufacturing	14	0
332	Fabricated Metal Product Manufacturing	14	0
333	Machinery Manufacturing	0	0
334	Computer and Electronic Product Manufacturing	0	8
335	Electrical Equipment, Appliance, and Component Manufacturing	0	0
336	Transportation Equipment Manufacturing	14	0
337	Furniture and Related Product Manufacturing	0	0
339	Miscellaneous Manufacturing	14	0
425	Wholesale Electronic Markets and Agents and Brokers	0	14
441	Motor Vehicle and Parts Dealers	0	14
442	Furniture and Home Furnishings Stores	0	0
443	Electronics and Appliance Stores	14	0
444	Building Material and Garden Equipment and Supplies Dealers	14	0
446	Health and Personal Care Stores	14	0
447	Gasoline Stations	0	10
448	Clothing and Clothing Accessories Stores	0	0
451	Sporting Goods, Hobby, Book, and Music Stores	0	0
452	General Merchandise Stores	14	0
453	Miscellaneous Store Retailers	14	0

TABLE 1, continued

NAICS code	Industry	Years least regulated	Years most regulated
454	Nonstore Retailers	13	0
481	Air Transportation	0	14
484	Truck Transportation	0	14
491	Postal Service	0	14
492	Couriers and Messengers	0	0
493	Warehousing and Storage	0	14
511	Publishing Industries (except Internet)	0	0
515	Broadcasting (except Internet)	0	0
517	Telecommunications	0	10
561	Administrative and Support Services	0	14
621	Ambulatory Health Care Services	14	0
721	Accommodation	0	0
722	Food Services and Drinking Places	0	14
811	Repair and Maintenance	0	14
812	Personal and Laundry Services	0	0

Figure 1 shows the average growth rates in output per hour for the most and least regulated industries in each year. In 10 out of the 14 years in the dataset, the least regulated industries showed greater annual growth than did the most regulated industries. Over the period 1997 through 2010, the 221 least-regulated industries in each year averaged 3.5 percent annual growth in output per hour in the subsequent year while the 221 most regulated industries averaged a significantly lower 1.9 percent annual growth.[19] Accumulating the growth rates over all the years, the least regulated industries experienced a total of 64 percent growth in output per hour from 1997 through 2010 versus 34 percent for the most-regulated industries.

Figure 2 shows the average growth rates in output per person for the most and least regulated industries in each year. In 12 out of the 14 years in the dataset, the least regulated industries showed greater annual growth than did the most regulated industries. Over the period 1997 through 2010, the least regulated industries in each year averaged 3.4 percent annual growth in output per person in the subsequent year while the most regulated industries averaged 1.8 percent annual growth.[20] Accumulating the growth rates over all the years, the least regulated industries experienced 63 percent growth in output per person versus 33 percent growth for the most regulated industries.

19. The difference in means is statistically significant, where $p = 0.017$.
20. The difference in means is statistically significant, where $p = 0.014$.

FIGURE 1. ANNUAL GROWTH IN OUTPUT PER HOUR ONE YEAR FOLLOWING THE NUMBER OF REGULATIONS AS MEASURED BY THE RELATIVE REGULATORY INDEX

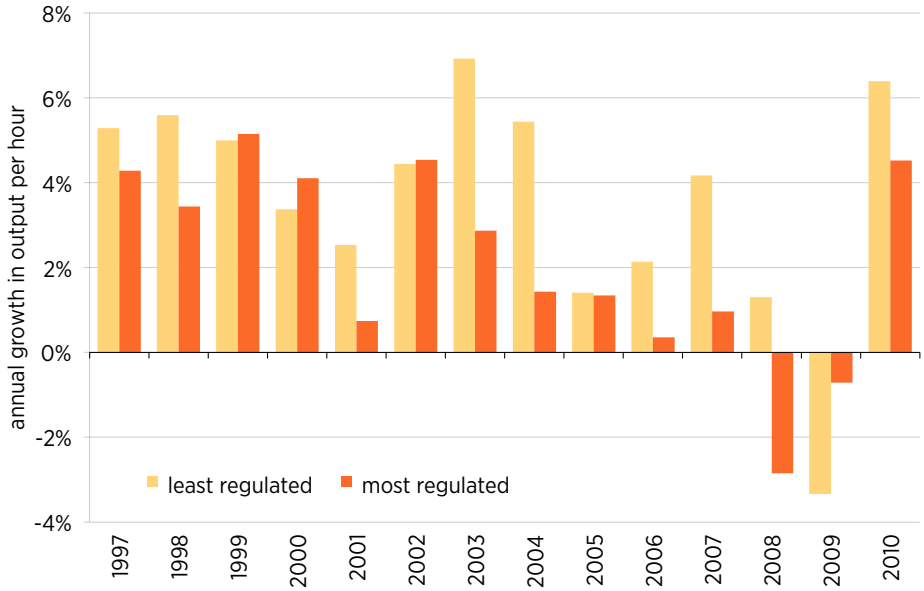

FIGURE 2. ANNUAL GROWTH IN OUTPUT PER PERSON ONE YEAR FOLLOWING THE NUMBER OF REGULATIONS AS MEASURED BY THE RELATIVE REGULATORY INDEX

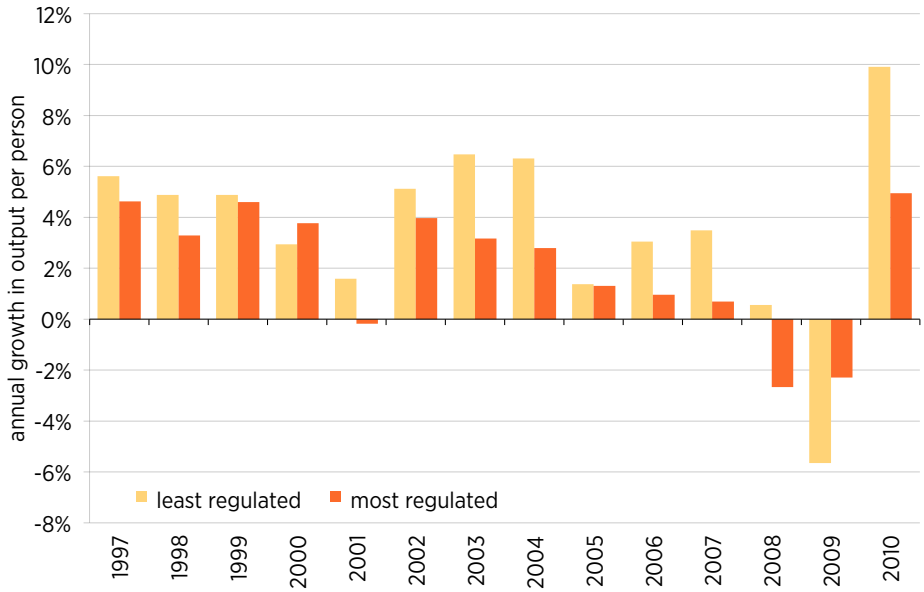

FIGURE 3. ANNUAL GROWTH IN UNIT LABOR COSTS ONE YEAR FOLLOWING THE NUMBER OF REGULATIONS AS MEASURED BY THE RELATIVE REGULATORY INDEX

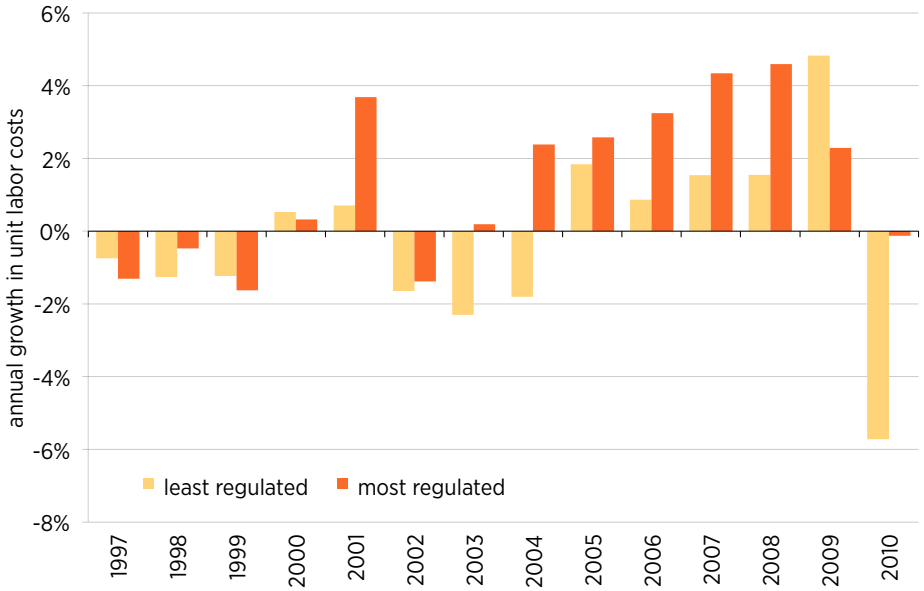

Figure 3 shows the growth in unit labor costs for the most and least regulated industries in each year. In 10 out of the 14 years in the dataset, the least regulated industries showed less annual growth in unit labor costs than did the most regulated industries. Over the period 1997 through 2010, the least regulated industries in each year averaged a 0.2 percent annual *decline* in unit labor costs in the subsequent year while the most regulated industries averaged 1.5 percent annual growth in labor costs.[21] Accumulating the growth rates over all the years, the least regulated industries experienced a 4 percent decline in unit labor costs versus 20 percent growth for the most regulated industries.

The difference-in-means tests show that all three productivity gain measures for the least regulated industries are significantly better than for the most regulated industries. The difference-in-means tests are limited in that, in an attempt to isolate the "most" and "least" regulated industries, the tests ignore the middle tercile of "moderately regulated" industries. Further, the test results can be influenced if, whether by coincidence or some underlying causality, the least regulated industries experience higher productivity gains for reasons that are specific to the industries but not to the degree of regulation of the industries. For example, if emerging industries showed greater productivity gains than mature industries

21. The difference in means is statistically significant, where $p = 0.009$.

(which is reasonable), and if emerging industries were less regulated than mature industries (which is also reasonable), one would expect to find higher productivity gains associated with reduced regulation even though there is no causation.

One way to control for this is to estimate a fixed-effects regression model that filters out nonregulatory industry-specific factors. Specifically, we can estimate the model

$$M_{it} = \alpha + \theta_i + \beta R_{i,t-1} + u_{it}$$

where M_{it} is the productivity measure for industry i in year t, $R_{i,t-1}$ is the relative regulatory index for industry i in the previous year, and θ_i is the average productivity measure for industry i over all years, separate from the effect of the relative regulatory indices for industry i.

The results in table 2 show that, after filtering out industry-specific productivity, an increase in the relative regulatory index is still associated with a significant contraction in growth in output per hour one year later. I employ generalized least squares to correct for heteroscedasticity.

TABLE 2. RELATIONSHIP BETWEEN ANNUAL GROWTH IN OUTPUT PER HOUR AND THE RELATIVE REGULATORY INDEX

Regressor	Estimate (standard error)	*p*-value
Constant	0.051 (0.006)	0.000
$R_{i,t-1}$	–0.024 (0.006)	0.000

Note: Fixed effects feasible GLS with robust errors, 51 cross sections, 13 years, 663 observations.

Table 3 shows similar results for the growth in output per person. After filtering out industry-specific productivity, an increase in the relative regulatory index is associated with a significant contraction in productivity growth one year later. The results in table 4 show a positive relationship between the relative regulatory index and the growth in unit labor costs. The relationship, however, is not statistically significant. If it were the case that more heavily regulated industries also tended to be more unionized, at least some of the higher labor costs could be attributed to the fact of unionization. However, since unions are government-protected monopolies, one could still trace the higher labor costs to regulation, albeit in the form of labor protectionism.

TABLE 3. RELATIONSHIP BETWEEN ANNUAL GROWTH IN OUTPUT PER PERSON AND THE RELATIVE REGULATORY INDEX

Regressor	Estimate (standard error)	*p*-value
Constant	0.044 (0.006)	0.000
$R_{i,t-1}$	–0.019 (0.006)	0.003

Note: Fixed effects feasible GLS with robust errors, 51 cross sections, 13 years, 663 observations.

TABLE 4. RELATIONSHIP BETWEEN ANNUAL GROWTH IN UNIT LABOR COSTS AND THE RELATIVE REGULATORY INDEX

Regressor	Estimate (standard error)	*p*-value
Constant	0.001 (0.008)	0.914
$R_{i,t-1}$	0.005 (0.008)	0.528

Note: Fixed effects feasible GLS with robust errors, 51 cross sections, 13 years, 663 observations.

It is reasonable to assume that productivity measures would be influenced by factors other than regulation—most notably capital and technology. As industries acquire capital and technology, labor productivity naturally grows. I use the combination of the growth in GDP and interest rates (as measured by the Aaa corporate bond yield) as a proxy for the growth in economic capital and technology. Other things equal, growth in capital and technology will result in GDP growth. But GDP growth can also be caused by increases in government spending, the labor force, and autonomous consumption. Since capital and technology expenditures are heavily influenced by the interest rate, including the cost of borrowing (as estimated by the Aaa bond yield) allows us to control GDP growth for changes in noncapital and nontechnology factors.[22]

Including these factors gives us the relationship between changes in regulations and changes in productivity after filtering out industry-specific factors, the growth in economic output, and the cost of investment. The following tables show estimates of the model

$$M_{it} = \alpha + \theta_i + \beta_1 R_{i,t-1} + \beta_2 G_{t-1} + \beta_3 A_{t-1} + u_{it}$$

where G_t is the growth rate in GDP from year t–1 to year t, and A_{t-1} is the Moody's seasoned Aaa bond yield in year t.[23]

TABLE 5. RELATIONSHIP BETWEEN ANNUAL GROWTH IN OUTPUT PER HOUR AND THE RELATIVE REGULATORY INDEX

Regressor	Estimate (standard error)	*p*-value
Constant	–0.008 (0.018)	0.645
$R_{i,t-1}$	–0.016 (0.006)	0.014
G_{t-1}	–0.313 (0.081)	0.000
A_{t-1}	1.050 (0.256)	0.000

Note: Fixed effects feasible GLS with robust standard errors, 51 cross sections, 13 years, 663 observations.

22. Marika Karanassou, Hector Sala, and Pablo F. Salvador, "Capital Accumulation and Unemployment: New Insights on the Nordic Experience," *Cambridge Journal of Economics* 32, no. 6 (2008): 977–1001; J. Aron and J. Muellbauer, "Interest Rate Effects on Output: Evidence from a GDP Forecasting Model for South Africa," *IMF Staff Papers* 49 (2002): 185–213.

23. This model follows Bronwyn H. Hall, "Innovation and Productivity" (NBER Working Paper No. 17178, 2011).

TABLE 6. RELATIONSHIP BETWEEN ANNUAL GROWTH IN OUTPUT PER PERSON AND THE RELATIVE REGULATORY INDEX

Regressor	Estimate (standard error)	*p*-value
Constant	0.019 (0.019)	0.318
$R_{i,t-1}$	–0.021 (0.006)	0.002
G_{t-1}	–0.439 (0.083)	0.000
A_{t-1}	0.737 (0.247)	0.004

Note: Fixed effects feasible GLS with robust standard errors, 51 cross sections, 13 years, 663 observations.

TABLE 7. RELATIONSHIP BETWEEN ANNUAL GROWTH IN UNIT LABOR COSTS AND THE RELATIVE REGULATORY INDEX

Regressor	Estimate (standard error)	*p*-value
Constant	0.027 (0.017)	0.114
$R_{i,t-1}$	0.007 (0.008)	0.383
G_{t-1}	0.477 (0.092)	0.000
A_{t-1}	–0.798 (0.237)	0.001

Note: Fixed effects feasible GLS with robust standard errors, 51 cross sections, 13 years, 663 observations.

Tables 5 and 6 show that, after accounting for economic growth, the cost of investment, and industry-specific factors that influence productivity, increases in regulation are associated with significant contractions in productivity growth one year later. Table 7 shows a positive, though statistically insignificant, relationship between regulations and the growth in unit labor costs one year later.

For example, consider a one-unit increase in the relative regulatory index (see table 8 for a list of industries by relative regulatory index). Each of the following industries are separated on the relative regulatory index by approximately one unit: general merchandise industry (NAICS Code 452); justice, public order, and safety industry (922); fishing, hunting, and trapping industry (114); food service industry (722); truck transportation industry (484); securities, commodities, and financial investments industry (523). The relative regulatory index for the oil and gas extraction industry (211) has increased by approximately one unit since 1997. According to tables 5 and 6, an increase in regulations equivalent to a one-unit increase in the relative regulatory index is followed one year later by a 1.6 percent decline in output per hour and a 2.1 percent decline in output per worker.

Interestingly, in both the difference-of-means tests and the regressions, unit labor costs appeared to be unrelated to the relative regulatory index. One possibility is that regulations largely don't affect labor costs (e.g., automobile emissions standards). Another is that, when regulations do affect labor costs (e.g., worker safety regulations), firms are able to substitute capital for labor and so, while production costs may rise, unit labor costs may not.

TABLE 8. INDUSTRIES BY RELATIVE REGULATORY INDEX

Industry	Relative regulatory index
Motor Vehicle and Parts Dealers	10.3458
Administrative and Support Services	4.9692
Oil and Gas Extraction	4.9238
Securities, Commodity Contracts, and Other Financial Investments and Related Activities	4.4961
Rail Transportation	3.8729
Transit and Ground Passenger Transportation	3.8373
Truck Transportation	3.7423
Construction of Buildings	3.5519
Scenic and Sightseeing Transportation	3.5003
Water Transportation	3.4339
Support Activities for Transportation	3.4337
Air Transportation	3.4336
Insurance Carriers and Related Activities	3.3533
Wholesale Electronic Markets and Agents and Brokers	3.0043
Repair and Maintenance	2.9866
Food Services and Drinking Places	2.7427
Food Manufacturing	2.5455
Mining (except Oil and Gas)	2.1829
Warehousing and Storage	2.0748
Fishing, Hunting and Trapping	1.9173
Executive, Legislative, and Other General Government Support	1.8906
Funds, Trusts, and Other Financial Vehicles	1.8436
Chemical Manufacturing	1.3558
Utilities	1.1926
Animal Production	1.0916
Rental and Leasing Services	1.0897
Educational Services	0.9613
Crop Production	0.9454
Justice, Public Order, and Safety Activities	0.8705
Hospitals	0.8633
Postal Service	0.6266
Paper Manufacturing	0.5913
Gasoline Stations	0.5689
Computer and Electronic Product Manufacturing	0.5504
Telecommunications	0.5440
Broadcasting (except Internet)	0.5048
Printing and Related Support Activities	0.4239
Pipeline Transportation	0.4121
National Security and International Affairs	0.3995

TABLE 8, continued

Industry	Relative regulatory index
Sporting Goods, Hobby, Book, and Music Stores	0.3904
Real Estate	0.3824
Machinery Manufacturing	0.3651
Amusement, Gambling, and Recreation Industries	0.3102
Monetary Authorities—Central Bank	0.2851
Religious, Grantmaking, Civic, Professional, and Similar Organizations	0.2776
Electrical Equipment, Appliance, and Component Manufacturing	0.2408
Clothing and Clothing Accessories Stores	0.2354
Accommodation	0.2278
Administration of Housing Programs, Urban Planning, and Community Development	0.2124
Publishing Industries (except Internet)	0.1893
Waste Management and Remediation Services	0.1891
Textile Mills	0.1885
Personal and Laundry Services	0.1695
Forestry and Logging	0.1324
Professional, Scientific, and Technical Services	0.1177
Textile Product Mills	0.1045
Furniture and Home Furnishings Stores	0.0967
Furniture and Related Product Manufacturing	0.0960
Museums, Historical Sites, and Similar Institutions	0.0854
Beverage and Tobacco Product Manufacturing	0.0841
Couriers and Messengers	0.0704
Data Processing, Hosting and Related Services	0.0652
Apparel Manufacturing	0.0594
Nonstore Retailers	0.0469
Miscellaneous Store Retailers	0.0469
Leather and Allied Product Manufacturing	0.0452
Motion Picture and Sound Recording Industries	0.0401
Performing Arts, Spectator Sports, and Related Industries	0.0401
Nursing and Residential Care Facilities	0.0333
Electronics and Appliance Stores	0.0210
Transportation Equipment Manufacturing	0.0157
Space Research and Technology	0.0153
Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	0.0124
Health and Personal Care Stores	0.0105
Petroleum and Coal Products Manufacturing	0.0044
Building Material and Garden Equipment and Supplies Dealers	0.0033
Wood Product Manufacturing	0.0029
Heavy and Civil Engineering Construction	0.0022

TABLE 8, continued

Industry	Relative regulatory index
Private Households	0.0019
Primary Metal Manufacturing	0.0016
Plastics and Rubber Products Manufacturing	0.0011
General Merchandise Stores	0.0011
Other Information Services	0.0009
Credit Intermediation and Related Activities	0.0007
Ambulatory Health Care Services	0.0006
Miscellaneous Manufacturing	0.0006
Specialty Trade Contractors	0.0005
Administration of Human Resource Programs	0.0004
Support Activities for Agriculture and Forestry	0.0003
Management of Companies and Enterprises	0.0002
Fabricated Metal Product Manufacturing	0.0002
Nonmetallic Mineral Product Manufacturing	0.0001
Social Assistance	0.0001
Administration of Economic Programs	0.0001
Support Activities for Mining	0.0001
Administration of Environmental Quality Programs	0.0000

CONCLUSION

The purpose of this paper is to examine the effects of regulations on productivity. Qualitative analysis of regulations is already possible, and the regulatory literature is full of anecdotes about the specific effects of specific regulations.[24] However, because the quantity of regulations cannot be precisely measured, it is difficult to construct empirical models of the effects of regulations.

This paper uses a new measure from the RegData database that provides a quantitative measure of regulations by counting the number of binding words in the *Code of Federal Regulations*. RegData provides the count broken down by industry group and time. Cross-referencing this data with industry-specific data from the BLS provides a comparison, over time and across industries, of the quantity of regulations with productivity measures.

Analysis of the data suggests that industries that are more regulated are also less productive. The one-third of industries that are least regulated show growth rates in output per hour and growth rates in output per worker that are 1.8 and 1.9 times, respectively, the growth rates for the one-third of industries that are most regulated.

24. Robert W. Hahn, Randall W. Lutter, and W. Kip Viscuisi, *Do Federal Regulations Reduce Mortality?* (Washington, DC: AEI Press, 2000).

A reasonable question is why productivity should matter at all. Productivity is important to individual consumers because improved productivity means lower product costs that, in turn, translate into lower consumer prices and improved product availability. Productivity is important to society as a whole because improved productivity means that we use fewer scarce resources to produce the same quantity of goods and services. To the extent that government regulation decreases productivity, consumers suffer from paying higher prices than they otherwise would have had to pay, and society suffers from expending more scarce resources than would otherwise be required to produce what we need.