Regulation and Economic Growth: Evidence from British Columbia's Experiment in Regulatory Budgeting

Bentley Coffey and Patrick A. McLaughlin

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Abstract

We exploit a quasi-natural experiment to identify the effect of regulatory accumulation on economic growth. Following a decade of poor economic growth, the Canadian province of British Columbia implemented a regulatory budget in 2001. We use a difference-in-differences strategy to estimate the effect of this policy intervention, finding that British Columbia's growth rate increased by about 25 percent relative to other provinces. We also present a set of regressions that, using data from the RegData project, directly account for changes to the stock of regulations as a possible determinant of economic growth. We find that regulatory budgeting, as implemented in British Columbia, is associated with much-improved economic performance. A 1 percent increase in the stock of regulations is associated with a 0.028 percent decrease in year-to-year economic growth. This finding implies that British Columbia's regulatory budget experiment, through reducing the quantity of regulations by about 36 percent, positively affected year-to-year growth by approximately 1 percentage point.

JEL codes: E20; H72; H73; H83; L50; O43

Keywords: Regulatory budget; British Columbia; regulatory reform; red tape reduction; RegData; economic growth; synthetic control; difference-in-differences; growth accounting

Author Affiliation and Contact Information

Bentley Coffey
Clinical Assistant Professor
University of South Carolina
bentley.coffey@moore.sc.edu

Patrick A. McLaughlin
Director of Policy Analytics and Senior Research Fellow
Mercatus Center at George Mason University
pmclaughlin@mercatus.gmu.edu

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Evidence from British Columbia's Experiment in Regulatory Budgeting

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1. Introduction

In 2001, the newly elected government of the Canadian province of British Columbia commenced a novel regulatory reform initiative. The intent of the initiative was to deliver on a campaign promise to reduce regulatory burden in the province by one-third within three years—one of many campaign promises that signaled the new government's intent to improve the province's economy. And with good reason: economic growth in British Columbia had trailed the rest of Canada for years. Between 1994 and 2001, British Columbia's real GDP grew at a rate of about 2.6 percent per year, while that of the country overall grew at a rate of about 3.9 percent per year.

To meet the target of a one-third reduction within three years, the British Columbia government imposed a form of a regulatory budget upon itself, requiring that two regulatory requirements be eliminated for every new one introduced. The results were remarkable: at the end of three years, regulatory requirements—the metric of burden that was ultimately selected for use in the regulatory budget—had been reduced 37 percent, more than meeting the government's one-third reduction target. Simultaneously, British Columbia's economy transformed, notching a growth rate that surpassed the national rate by 1.1 percentage points on average in the five-year period following the inception of the regulatory reform program.

How much of British Columbia's economic turnaround is attributable to its regulatory budget? Although the timing and direction of the change in its growth rate appears consistent with the notion that the province's regulatory reform efforts were salutary to the economy, other potential explanations abound. For example, when the new government took office in 2001, its leaders quickly acted to reform tax policy by reducing personal income tax rates by 25 percent, eliminating the provincial sales tax on production machinery and equipment, and scrapping the corporate capital tax on nonfinancial institutions (Jones 2015).

Empirical analysis of regulations' actual effects has been historically hampered by a paucity of data (Al-Ubaydli and McLaughlin 2017). This lack was also the case for British Columbia's regulatory budgeting experiment. Although policymakers within British Columbia strongly suspected that their regulatory budget had been partly responsible for the province's improved economic performance, data scarcity prevented formal analysis of its effect. The advent of the RegData project filled that data gap by offering a comprehensive, objective, and replicable method of quantifying regulation.

In this study, we empirically test the hypothesis that British Columbia's implementation of a regulatory budget was a significant, causal determinant of the province's economic turnaround. We first perform a simple difference-in-differences estimation that compares British Columbia to other provinces before and after the reforms of 2001. However, because this approach cannot perfectly control for other policy reforms unrelated to regulation that were implemented in British Columbia in 2001, we also perform a series of regressions that investigate industry-specific regulatory reforms via a metric of the quantity of regulations applicable to each industry.

Our results are consistent with the hypothesis that British Columbia's regulatory budget caused the province's economic growth rate to significantly increase. Our difference-in-differences approach shows that, following the 2001 implementation of the regulatory budget, British Columbia's growth rate increased dramatically—by about 25 percent relative to other provinces. Our second set of regressions, which directly accounts for changes to the stock of regulations as a possible determinant of economic growth, shows that regulatory budgeting—at least as implemented in British Columbia—is associated with improved economic performance. A 1 percent increase in the stock of regulations is associated with a 0.028 percent decrease in year-to-year economic growth. If British Columbia's regulatory budget experiment led to a decrease of 36 percent in the stock of regulations, then the implied effect on growth is an increase of about 1 percentage point.

In the next section, we describe the phenomenon of regulatory accumulation and a policy solution known as *regulatory budgeting*. Section 3 describes our data. Section 4 details our regression results, section 5 discusses the policy implications, and section 6 concludes.

2. Background

Regulation is an unsurprising feature of all modern democracies. After all, regulation is merely delegated lawmaking, and delegation tends to happen in organizations of all shapes and sizes. In the United States, for example, regulatory agencies promulgate and enforce regulations, but both the regulations and the agencies themselves are delegated their authority by acts of Congress. Such patterns of delegation of lawmaking authority are ubiquitous in national jurisdictions and recurrent in subnational jurisdictions as well.

2.1. The Economic Effects of Regulatory Accumulation

A more subtle feature of modern governance is the tendency toward regulatory accumulation or the buildup of the stock of regulations over time.[1] Regulatory accumulation is readily apparent at the federal level in the United States, where the number of pages of regulation in effect in a given year has grown from 9,745 pages in 1950 to 185,434 pages in 2018.[2] Regulatory restrictions contained in US federal regulations have increased from 405,647 in 1970 to 1,076,892 as of October 2019.[3] As shown in figure 1, other countries included to this point in the RegData project appear to follow this accumulative pattern as well (McLaughlin, Atherley, and Strosko 2019; McLaughlin, Potts, and Sherouse 2019).

Whatever the causes of regulatory accumulation, its potential impact on the economy has caught the interest of economists and policymakers alike.[4] The challenge in any analysis of regulatory accumulation, however, is the likelihood that its effects might amount to more than the sum of the costs of individual regulations. One study of US federal regulatory accumulation eloquently articulated the difficulty for analysts and policymakers: "[N]ew rules are [placed] on top of existing reporting, accounting, and underwriting requirements. . . . For each new regulation added to the existing pile, there is a greater possibility for interaction, for inefficient

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[1] Regulatory accumulation should not be confused with *agencification*, or proliferation in the number of regulatory agencies. Although the two phenomena often occur together, having more agencies will not always mean having more regulations.

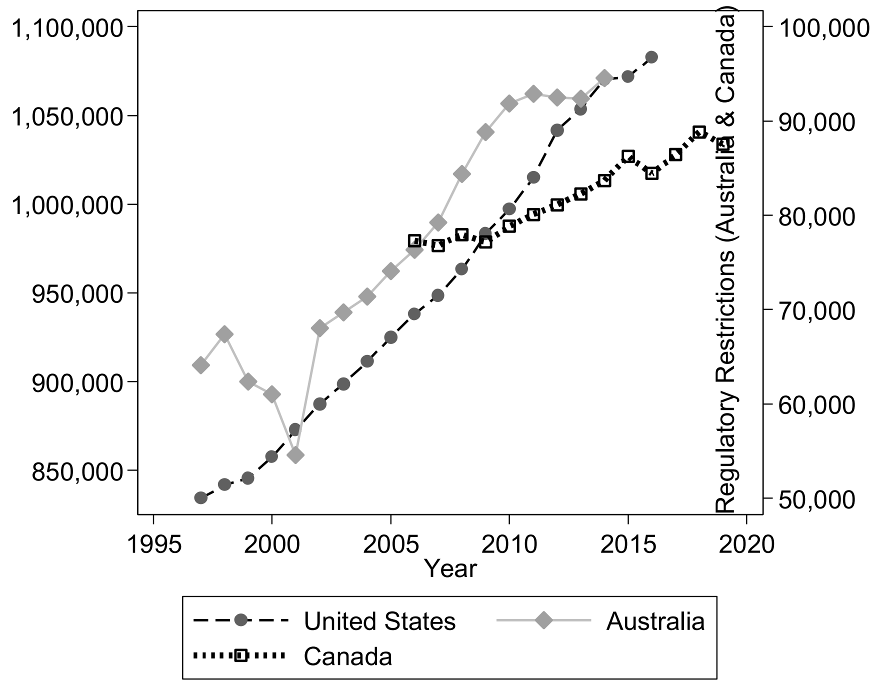
[2] Page counts of the *Code of Federal Regulations* from the website of the Office of the Federal Register, https://www.federalregister.gov/uploads/2019/04/cfrTotalPages2018.pdf. Accessed October 6, 2019.

[3] Regulatory restrictions, a metric of regulation developed by the RegData project, are words and phrases that are likely to create legal prohibitions or obligations, such as "shall," "must," and "may not." We offer more detail in Section 3 of this study and point the interested reader to Al-Ubaydli and McLaughlin (2017) and McLaughlin and Sherouse (2019), as well as the project's website (quantgov.org), for more detailed discussions of the RegData project.

[4] Glaeser and Shleifer (2003) and Mulligan and Shleifer (2005) offer two of the more prominent examples of studies of why regulatory accumulation has occurred in the past several decades.

company resource allocation, and for reduced ability to invest in innovation. The negative effect [on the economy] of regulatory accumulation actually compounds on itself for every additional regulation added to the pile" (Mandel and Carew 2013, 4).

Figure 1. Regulatory Accumulation, the United States, Australia, and Canada



Source: Authors' calculations based on RegData project, https://www.quantgov.org/state-regdata.

Two lines of literature have dealt with regulatory accumulation. The first line arose following the creation of multinational indexes that typically use some combination of expert opinion and surveys to rate how countries' regulatory systems affect the ease of doing business. The World Bank's Doing Business project and the Organisation for Economic Co-operation and Development's (OECD) Indicators of Product Market Regulation have permitted first-generation estimates of the effect of regulation (although not necessarily regulatory accumulation) on economic growth. They have generally found that macroeconomic growth can be considerably slowed by lower-quality regulatory regimes. For example, Djankov, McLiesh, and Ramalho (2006) use the World Bank's Doing Business index to examine a large panel of countries' regulations. They found that a country's improvement from the worst (first) to the best (fourth) quartile of business regulations leads to a 2.3 percentage point increase in annual GDP growth.[5]

The broad takeaway from this line of research is that regulatory quality has significant implications on economic growth. Regulatory accumulation in and of itself, however, is only indirectly implicated, because both regulatory quality and regulatory accumulation are by-products of a jurisdiction's regulatory system.

The second and more directly relevant line of research about regulatory accumulation uses metrics of regulation based on actual regulatory text. Dawson and Seater (2013) consider covariation between aggregate US macroeconomic data and a simple time series measure of federal regulation (pages of regulatory text published annually in federal regulatory code) in an endogenous growth context. They conclude that regulatory accumulation was responsible for slowing economic growth in the United States by an average of 2 percentage points per year between 1949 and 2005.

Coffey, McLaughlin, and Peretto (2020) also use an endogenous growth model to estimate the effects of federal regulation on economic growth. Instead of page counts, however, the authors use multisector panel data covering 22 industries from the RegData project. They find that regulatory accumulation slowed economic growth by approximately 0.8 percentage point annually over the approximately three decades (1980 to 2012) covered by their data.

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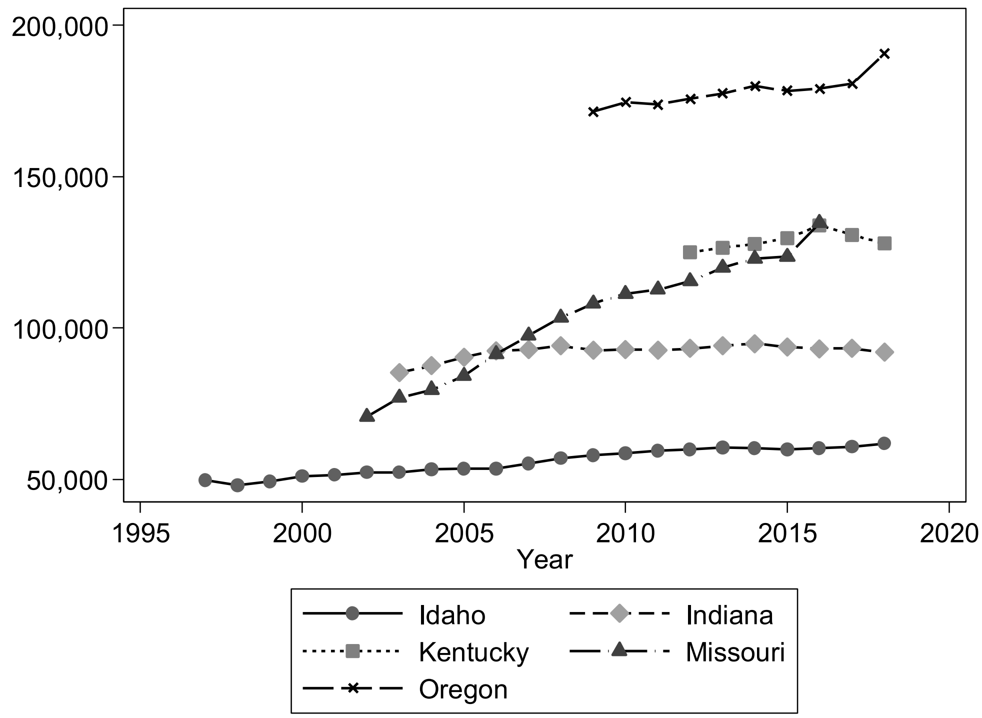
[5] Several other studies use similar World Bank or OECD panel data about regulations across countries, such as those by Aghion et al. (2010), Botero et al. (2004), and Nicoletti and Scarpetta (2003).

The endogenous model developed in Coffey, McLaughlin, and Peretto (2020) permits the study to focus on a specific mechanism: the effect of regulatory accumulation on business investment, which is a driver of long-run productivity gains and, ultimately, economic growth. This finding is consistent with other studies of the relationship between regulation and the factors that contribute to growth, such as investment, productivity, and innovation. For example, Alesina et al. (2005) examine deregulation of the transportation and telecommunications industries during the mid-1980s, finding that deregulation resulted in a significant surge in investment for the United States and the United Kingdom relative to Italy, France, and Germany. However, compared to the vast quantity of regulations that actually affect the economy, the bulk of literature about regulation and growth and the determinants of growth focuses on interventions that are limited in scope or on economic outcomes related to a narrowly defined sector, thereby perhaps missing interactive or cumulative effects.

Whereas studies of regulatory accumulation have largely been limited to national jurisdictions (e.g., US federal regulations' effect on the macroeconomy), regulatory accumulation can occur in subnational (e.g., state, provincial, or municipal) and supranational (e.g., European Union) settings as well. Although historical data for subnational jurisdictions are more difficult to find, the accumulative pattern seen at the national level also appears to be the norm at the subnational level, except in those rare cases where governments have successfully intervened to slow or even reverse the growth of regulation. Figure 2 shows time series data for the five US states for which historical data are available from the RegData project.

Figure 2. Regulatory Accumulation, Five US States



Source: Authors' calculations based on RegData project, https://www.quantgov.org/state-regdata.

To date, very few such successful interventions have occurred. Thus, British Columbia's regulatory budgeting experiment is all the more extraordinary.

2.2. British Columbia's Red Tape Reduction Program

British Columbia is the third-most-populous province of Canada, with about 4.9 million residents and a diverse economy. Leading up to the provincial election in 2001, British Columbia had a reputation within Canada for "regulatory excess" (Jones 2015, 13). A 2004 British Columbia government report lists several examples of regulations that arguably fit that description or at least seem likely to have constrained economic agents' choice sets without producing any sort of tangible benefits (Government of British Columbia, Ministry of Small Business and Economic Development, 2004). Regulations stipulated the precise size of nails that forestry companies could use when building bridges over streams. Restaurants and bars were limited to television sets of certain sizes. Golf courses were required to have a certain number of par-4 holes. The maximum guest capacity for lounges at ski resorts was a function of the vertical feet to the top of the mountain (Government of British Columbia, Ministry of Small Business and Economic Development, 2004).

Policymakers in British Columbia in the 1980s and 1990s seem to have considered regulation as the means to enact interventionist policy without incurring any budgetary outlays. After leaving office, Glen Clark, the premier of British Columbia for most of the 1990s, told a reporter, "We were an old-fashioned activist government, with no more money. So you're naturally driven to look at ways you can be an activist without costing anything. And that leads to regulation" (Jones 2015, 13).

In 2001, concern about the economy—including uncompetitive tax and regulatory policies, deficits, and the costs of infrastructure projects—contributed to a landslide victory of the Liberal Party (a center-right coalition) over the incumbent New Democratic Party (a left-of-center party) that had been in power since 1991. Once elected, the new premier made regulatory reform a priority and set about devising a way to measure regulatory burden and to track progress toward achieving the goal of a one-third reduction. The government settled upon a very simple measure—a count of "regulatory requirements," defined as "an action or step that must be taken, or piece of information that must be provided in accordance with government legislation, regulation, policy or forms, in order to access services, carry out business or pursue legislated privileges" (Jones 2015, 15). The initial inventory tallied 330,812 regulatory requirements, a total that was inclusive of not only regulations but also statutes, guidance documents, and forms (Jones 2015).

Establishing a baseline estimate of “regulatory burden” was only part of the reform, which the province began referring to as a Red Tape Reduction program. To meet the target of a one-third reduction in three years (by 2004), the British Columbia government mandated that two regulatory requirements be eliminated for every new requirement that is introduced. This combination of actions effectively represents the first successful implementation of a regulatory budget.

Empirical analysis of regulations’ actual effects has been historically hampered by a paucity of data (Al-Ubaydli and McLaughlin 2017). This lack was also the case for British Columbia’s regulatory budgeting experiment. Although policymakers within British Columbia strongly suspected that their regulatory budget had been partly responsible for the province’s improved economic performance, data scarcity prevented formal analysis of its effect. The advent of the RegData project filled that data gap by offering a comprehensive, objective, and replicable method of quantifying regulation.

3. Data

Our data span from 1997, when data by the North American Industry Classification System (NAICS) codes became available, to 2015, which was just before other provinces began experimenting with their own regulatory reforms. The data are for the 10 provinces of Canada; economic activity in the three territories is fairly sparse for most industries. Our dependent variable is value-added to GDP by industry, which comes from Statistics Canada. Statistics Canada uses an industry classification system that is a minor adaptation of NAICS. Essentially, our strategy for selecting industries for our initial analysis of general regulatory reform was to start with the most granular industry partitions in the NAICS codes for which GDP data were available so that we could maximize sample size. We then excluded industries for natural reasons, such as having zero GDP in most provinces or being government-run industries rather than private for-profit enterprises. A panel of 135 industries in 10 provinces for a period of 18 years remained. Those industries appear in table 1 with either their GDP per capita summary statistics or the reason for their exclusion.

Table 1. Industries Selected for Analysis of General Regulatory Reforms

Statistics Canada's adapted NAICS Code	Brief description	British Columbia: Minimum GDP per capita	British Columbia: Maximum GDP per capita	Other provinces: Minimum GDP per capita	Other provinces: Maximum GDP per capita
1114	Greenhouse, nursery, and floriculture production	62.9	92.1	4.1	69.4
111A	Crop production (except 1114)	50.9	78.3	6.7	3,451.7
1125	Aquaculture	14.3	44.6	0.0	303.7
112A	Animal production (except 1125)	65.1	113.1	36.5	428.3
113	Forestry and logging	277.5	532.1	19.9	368.1
114	Fishing, hunting, and trapping	30.3	74.8	0.0	562.8
115	Support activities for agriculture and forestry	137.4	209.2	23.5	164.3
211	Oil and gas extraction	757.5	1,599.5	0.0	22,294.7
2121	Coal mining	Excluded (0s in province GDP)			
21221	Iron ore mining	Excluded (0s in province GDP)			
21222	Gold and silver ore mining	Excluded (0s in province GDP)			
21223	Copper, nickel, lead, and zinc ore mining	276.9	551.7	0.0	4,868.4
21229	Other metal ore mining	18.3	94.9	0.0	2,708.5
21231	Stone mining and quarrying	7.5	14.7	0.0	52.9
21232	Refractory minerals (e.g., sand and clay) mining	16.0	33.3	0.0	98.9
2211	Electric power generation, transmission, and distribution	399.1	603.4	296.2	1,417.0
2212	Natural gas distribution	119.5	192.6	0.0	312.3
2213	Water, sewage, and other systems	Excluded (government/nonprofit)			
23A	Residential building construction	711.3	1,512.7	304.4	2,187.2
23B	Nonresidential building construction	382.5	577.1	138.6	1,067.7
23C1	Transportation engineering construction	135.8	213.7	23.4	458.9
23C2	Oil and gas engineering construction	164.7	520.2	0.0	3,652.0
23C3	Electric power engineering construction	54.9	231.4	9.6	1,570.4
23C4	Communication engineering construction	7.2	101.2	0.7	81.8
23D	Repair construction	469.8	619.2	187.5	876.3
23E	Other activities of the construction industry	15.0	66.2	7.4	182.8
3111	Animal food manufacturing	14.7	28.9	1.4	82.7
3112	Grain and oilseed milling	3.7	12.0	0.0	628.6
3113	Sugar and confectionery product manufacturing	21.4	37.1	0.0	163.3
3114	Fruit and vegetable preserving and specialty food manufacturing	20.2	31.7	0.0	975.9

Statistics Canada's adapted NAICS Code	Brief description	British Columbia		Other provinces	
		Minimum GDP per capita	Maximum GDP per capita	Minimum GDP per capita	Maximum GDP per capita
3115	Dairy product manufacturing	31.6	60.5	31.0	263.3
3116	Meat product manufacturing	86.4	127.2	18.3	659.4
3117	Seafood product preparation and packaging	31.2	45.8	0.0	674.3
3118	Bakeries and tortilla manufacturing	28.7	52.4	12.5	124.5
3119	Other food manufacturing	25.2	85.5	2.3	141.5
31211	Soft drink and ice manufacturing	18.5	47.2	0.7	92.5
31212	Breweries	48.2	88.7	0.0	180.6
31A	Textile and textile product mills	15.6	31.8	1.1	225.2
3211	Sawmills and wood preservation	321.1	554.0	0.7	271.2
3212	Veneer, plywood, and engineered wood product manufacturing	84.1	168.1	1.3	160.0
3219	Other wood product manufacturing	79.5	159.3	4.7	184.9
3221	Pulp, paper, and paperboard mills	192.8	330.9	0.0	480.1
3222	Converted paper product manufacturing	21.1	48.7	1.1	199.0
323	Printing and related support activities	62.7	132.7	5.1	285.7
324	Petroleum and coal product manufacturing	56.2	76.9	0.0	1,212.7
3251	Basic chemical manufacturing	27.7	60.6	0.0	441.3
3252	Resin, synthetic rubber, and artificial and synthetic fibres and filaments manufacturing	6.5	24.7	0.0	161.4
3253	Pesticide, fertilizer, and other agricultural chemical manufacturing	2.2	18.5	0.0	331.7
3254	Pharmaceutical and medicine manufacturing	9.3	27.1	0.0	501.3
3255	Paint, coating, and adhesive manufacturing	5.8	38.0	0.0	59.4
3256	Soap, cleaning compound, and toilet preparation manufacturing	Excluded (0s in province GDP)			
3259	Other chemical product manufacturing	7.4	19.4	0.0	102.4
3261	Plastic product manufacturing	81.1	129.7	0.0	399.7
3262	Rubber product manufacturing	10.1	20.1	0.0	349.1
3273	Cement and concrete product manufacturing	61.5	125.9	16.3	227.1
327A	Nonmetallic mineral product manufacturing (except 3273)	34.3	65.7	1.4	105.5
3312	Steel product manufacturing from purchased steel	10.2	23.9	0.0	522.7
3313	Alumina and aluminum production and processing	Excluded (0s in province GDP)			
3314	Nonferrous metal (except aluminum) production and processing	78.1	141.3	0.0	355.6
3315	Foundaries	Excluded (0s in province GDP)			
3321	Forging and stamping	2.5	35.0	0.0	50.4
3323	Architectural and structural metals manufacturing	64.7	121.7	11.6	294.3
3324	Boiler, tank, and shipping container manufacturing	8.7	23.5	0.0	149.0
3325	Hardware manufacturing	1.8	4.6	0.0	52.3
3326	Spring and wire product manufacturing	4.0	12.5	0.0	35.1

Statistics Canada's adapted NAICS Code	Brief description	British Columbia		Other provinces	
		Minimum GDP per capita	Maximum GDP per capita	Minimum GDP per capita	Maximum GDP per capita
3327	Machine shops, turned product, and screw, nut, and bolt manufacturing	33.1	53.3	2.8	145.6
3328	Coating, engraving, cold and heat treating, and allied activities	8.3	14.0	0.0	87.3
3331	Agricultural, construction, and mining machinery manufacturing	19.4	48.3	0.0	579.5
3332	Industrial machinery manufacturing	24.7	78.5	0.7	77.4
3333	Commercial and service industry machinery manufacturing	1.1	19.4	0.0	106.1
3334	Ventilation, heating, air-conditioning, and commercial refrigeration manufacturing	21.1	39.3	0.0	89.8
3335	Metalworking machinery manufacturing	12.4	21.3	0.0	145.5
3336	Engine, turbine, and power transmission equipment manufacturing	7.5	34.2	0.0	66.9
3339	Other general-purpose machinery manufacturing	37.4	71.9	0.4	253.9
3341	Computer and peripheral equipment manufacturing	21.5	65.3	0.0	69.8
3342	Communications equipment manufacturing	7.6	40.4	0.0	575.5
3344	Semiconductor and other electronic component manufacturing	7.6	61.8	0.0	127.1
3351	Electric lighting equipment manufacturing	10.2	15.7	0.0	35.7
3352	Household appliance manufacturing	0.6	3.9	0.0	43.1
3353	Electrical equipment manufacturing	8.5	25.5	0.0	100.4
3359	Other electrical equipment and component manufacturing	7.5	46.3	0.0	160.7
3361	Motor vehicle manufacturing	0.0	42.4	0.0	857.9
3362	Motor vehicle body and trailer manufacturing	13.9	35.5	0.0	210.1
33631	Motor vehicle gasoline engine and parts manufacturing	0.1	1.4	0.0	163.3
33632	Motor vehicle electrical and electronic equipment manufacturing	Excluded (0s in province GDP)			
33634	Motor vehicle brake system manufacturing	0.2	1.9	0.0	40.9
33635	Motor vehicle transmission and power train parts manufacturing	Excluded (0s in province GDP)			
33636	Motor vehicle seating and interior trim manufacturing	0.2	2.0	0.0	122.8
33639	Other motor vehicle parts manufacturing	11.9	22.5	0.0	156.4
3364	Aerospace product and parts manufacturing	9.6	37.5	0.0	633.4
3365	Railroad rolling stock manufacturing	Excluded (0s in province GDP)			
3366	Ship and boat building	21.1	46.9	0.0	177.7
3369	Other transportation equipment manufacturing	1.2	6.3	0.0	71.4
3371	Household and institutional furniture and kitchen cabinet manufacturing	56.0	84.7	0.7	315.2
3372	Office furniture (including fixtures) manufacturing	6.7	20.6	0.0	158.4
3379	Office furniture-related product manufacturing	6.0	8.7	0.0	33.8
3391	Medical equipment and supplies manufacturing	21.5	40.4	2.2	87.5

Statistics Canada's adapted NAICS Code	Brief description	British Columbia		Other provinces	
		Minimum GDP per capita	Maximum GDP per capita	Minimum GDP per capita	Maximum GDP per capita
3399	Other miscellaneous manufacturing	33.9	89.5	7.5	191.8
41	Wholesale trade	1,339.1	1,922.1	500.1	3,707.9
44–45	Retail trade	1,774.4	2,677.7	1,351.3	3,121.7
481	Air transportation	186.3	326.8	10.2	276.3
482	Rail transportation	187.4	325.3	0.0	508.7
483	Water transportation	125.4	198.1	0.2	403.9
484	Truck transportation	300.3	446.6	158.3	1,064.0
4851	Urban transit systems	Excluded (government/nonprofit)			
4853	Taxi and limousine service	25.9	36.6	9.7	53.2
486A	Crude oil and other pipeline transportation	63.1	146.4	0.0	693.6
4862	Pipeline transportation of natural gas	30.3	49.0	0.0	391.7
488	Support activities for transportation	412.6	545.9	109.7	394.5
491	Postal service	Excluded (government/nonprofit)			
492	Couriers and messengers	58.5	102.9	22.0	136.5
493	Warehousing and storage	57.3	93.1	3.8	223.7
511	Publishing industries (except internet)	177.5	448.5	82.3	347.7
51213	Motion picture and video exhibition	10.7	15.5	6.9	25.0
5121A	Motion picture and video industries (except exhibition)	45.9	78.3	0.3	101.6
5122	Sound recording industries	4.7	13.7	0.0	22.1
5151	Radio and television broadcasting	49.6	80.7	55.7	127.4
517	Telecommunications	633.0	943.3	387.2	1,224.2
519	Other information services	38.6	60.2	7.7	79.9
521	Monetary authorities—central bank	Excluded (government/nonprofit)			
52213	Local credit unions	129.2	160.3	11.5	262.9
5221A	Banking and other depository credit intermediation	798.4	1217.7	480.6	2021.3
5241	Insurance carriers	282.6	399.7	154.7	866.9
5242	Agencies, brokerages, and other insurance related activities	165.1	203.0	79.1	244.3
52A	Financial investment services, funds, and other financial vehicles	244.5	480.5	16.1	747.9
5311	Lessors of real estate	1392.6	2067.7	554.7	1560.0
5311A	Imputed rent for homeowners	Excluded (nonmarket)			
531A	Office of real estate agents and brokers and real estate activities	326.0	549.3	58.6	531.9
5321	Automotive equipment rental and leasing	84.0	125.3	22.0	138.6
532A	Rental and leasing services (except 5321)	110.2	207.9	39.2	728.2
5413	Architectural, engineering, and related services	499.9	722.4	87.7	1605.0
5415	Computer systems design and related services	137.0	440.9	25.8	765.9
5418	Advertising, public relations, and related services	58.7	95.2	6.2	174.7
541A	Legal, accounting, and related services	519.4	679.2	228.1	818.8
541B	Other professional, scientific, and technical services	291.8	681.5	93.3	977.2

Statistics Canada's adapted NAICS Code	Brief description	British Columbia		Other provinces	
		Minimum GDP per capita	Maximum GDP per capita	Minimum GDP per capita	Maximum GDP per capita
55	Management of companies and enterprises	240.4	311.1	79.4	646.6
5615	Travel arrangement and reservation services	78.4	109.4	11.0	86.0
5616	Investigation and security services	68.3	123.4	20.6	120.4
5617	Services to building and dwellings	168.1	257.3	43.3	293.1
562	Waste management and remediation services	Excluded (government/nonprofit)			
61-62	Educational services, health care, and social assistance	Excluded (government/nonprofit)			
7132	Gambling industries	42.2	101.7	3.6	107.4
713A	Amusement and recreation industries	137.7	207.7	31.8	216.9
7211	Traveller accommodation	373.9	430.5	151.4	472.3
721A	RV parks, recreational camps, and such	52.8	73.3	21.0	167.5
722	Food services and drinking places	684.4	736.4	318.3	866.8
8111	Automotive repair and maintenance	149.5	191.6	84.5	320.7
8122	Funeral services	14.7	21.3	16.9	45.4
8123	Dry cleaning and laundry services	26.2	33.4	5.7	48.0
812A	Personal care services and other personal services	143.2	175.1	84.4	196.8
813	Religious, grant-making, civic, and professional and similar organizations	Excluded (government/nonprofit)			
91	Public administration	Excluded (government/nonprofit)			

Source: Statistics Canada, https://www.statcan.gc.ca/eng/start.

For our subsequent analysis of regulatory reforms for specific industries, we rely on measures of the number of regulatory constraints likely applicable to each industry taken from the publicly available files of the RegData project (discussed later in this section). We focus on industries at the level of 3-digit NAICS codes in order to maintain the highest quality measure of our treatment variable. However, we still must exclude some industries owing to inadequate data quality, as well as some government-run and nonprofit industries. Table 2 includes various industry-level summary statistics together with F1 scores that indicate the cross-validated quality of RegData for that industry.

Table 2. Industries Selected for Analysis of Industry-Specific Regulatory Reforms, British Columbia and Ontario

NAICS Code	Brief description	F1 score	Mean	Minimum	Maximum
111	Crop production	0.9265	351.60	128.82	582.56
112	Animal production	0.9034	248.55	89.39	875.93
113	Forestry and logging	Excluded (quality below minimum performance threshold)			
114	Fishing, hunting and trapping	0.8869	86.06	19.18	179.51
115	Support activities for agriculture and forestry	0.6812	43.39	21.15	69.20
211	Oil and gas extraction	0.7786	257.68	187.91	1,490.43
212	Mining (except oil and gas)	0.9159	278.49	41.78	558.61
213	Support activities for mining, oil and gas	0.7398	141.56	53.63	1,359.80
221	Utilities	0.6334	1,098.62	360.55	2,283.16
236	Construction of buildings	0.6593	208.21	123.39	286.85
237	Heavy and civil engineering construction	Excluded (quality below minimum performance threshold)			
238	Specialty trade contractors	Excluded (quality below minimum performance threshold)			
311	Food manufacturing	0.9519	287.19	145.45	433.83
312	Beverage and tobacco product manufacturing	0.8776	433.19	146.55	875.84
313	Textile mills	Excluded (quality below minimum performance threshold)			
314	Textile product mills	Excluded (quality below minimum performance threshold)			
321	Wood product manufacturing	0.6175	528.36	244.67	972.55
322	Paper manufacturing	0.7458	1,764.24	805.06	3,630.89
323	Printing and related support activities	Excluded (quality below minimum performance threshold)			
324	Petroleum and coal products manufacturing	0.8029	520.93	25.59	1,290.99
325	Chemical manufacturing	0.7756	505.91	82.85	1,027.74
326	Plastics and rubber products manufacturing	0.7204	161.92	20.50	477.30
327	Nonmetallic mineral product manufacturing	0.7345	106.45	33.40	144.63
331	Primary metal manufacturing	0.6454	408.66	131.79	760.60
332	Fabricated metal product manufacturing	Excluded (quality below minimum performance threshold)			
333	Machinery manufacturing	0.7237	248.82	15.96	507.48
334	Computer and electronic product manufacturing	0.8501	146.34	35.14	414.82
335	Electrical equipment, appliance, and component manufacturing	0.7230	275.38	42.67	528.10
336	Transportation equipment manufacturing	0.6626	607.35	130.48	1,686.18
337	Furniture and related product manufacturing	Excluded (quality below minimum performance threshold)			
339	Miscellaneous manufacturing	Excluded (quality below minimum performance threshold)			
423	Merchant wholesalers, durable goods	0.8554	112.70	24.84	238.96
424	Merchant wholesalers, nondurable goods	0.8462	117.70	43.85	249.65

NAICS Code	Brief description	F1 score	Mean	Minimum	Maximum
425	Wholesale electronic markets and agents and brokers	0.8743	65.27	35.51	102.27
441	Motor vehicle and parts dealers	Excluded (quality below minimum performance threshold)			
443	Electronics and appliance stores	Excluded (quality below minimum performance threshold)			
444	Building materials and garden equipment and supplies dealers	Excluded (quality below minimum performance threshold)			
445	Food and beverage stores	0.5419	723.08	166.30	1,467.98
446	Health and personal care stores	Excluded (quality below minimum performance threshold)			
447	Gasoline stations	Excluded (quality below minimum performance threshold)			
448	Clothing and clothing accessories stores	Excluded (quality below minimum performance threshold)			
451	Sporting goods, hobby, musical instrument, and book stores	Excluded (quality below minimum performance threshold)			
452	General merchandise stores	Excluded (quality below minimum performance threshold)			
453	Miscellaneous store retailers	Excluded (quality below minimum performance threshold)			
454	Nonstore retailers	0.6625	92.76	11.19	233.92
481	Air transportation	0.9802	448.34	130.49	777.88
482	Rail transportation	0.7423	175.34	20.69	597.52
483	Water transportation	0.7478	121.31	35.49	290.42
484	Truck transportation	Excluded (quality below minimum performance threshold)			
485	Transit and ground passenger transportation	Excluded (quality below minimum performance threshold)			
486	Pipeline transportation	0.7407	481.77	181.25	1,543.37
487	Scenic and sightseeing transportation	Excluded (quality below minimum performance threshold)			
488	Support activities for transportation	0.9243	197.88	96.33	324.15
493	Warehousing and storage	0.6478	31.50	8.36	60.42
511	Publishing industries (except internet)	Excluded (quality below minimum performance threshold)			
512	Motion picture and sound recording industries	0.6379	340.75	69.48	495.54
515	Broadcasting (except internet)	0.9601	663.32	145.27	1,312.91
517	Telecommunications	0.9082	139.58	16.14	346.54
518	Data processing, hosting, and related services	0.8867	22.99	9.93	38.64
519	Other information services	0.6696	47.41	19.24	90.41
521	Money authorities—central bank	Excluded (government/nonprofit)			
522	Credit intermediation and related activities	0.9060	1,233.99	677.01	1,717.17
523	Securities, commodity contracts, and other financial investments and related activities	0.6814	650.64	183.73	1,207.00
524	Insurance carriers and related activities	0.6883	609.42	112.43	4,529.45
525	Funds, trusts, and other financial vehicles	0.6249	1,543.28	165.57	2,788.28
531	Real estate	0.7053	20.31	6.87	36.00

NAICS Code	Brief description	F1 score	Mean	Minimum	Maximum
532	Rental and leasing services	Excluded (quality below minimum performance threshold)			
541	Professional, scientific, and technical services	0.6899	1,703.90	867.89	2,513.63
551	Management of companies and enterprises	0.7315	21.33	9.00	58.73
561	Administrative and support services	0.5562	369.24	145.93	793.66
562	Waste management and remediation services	Excluded (government/nonprofit)			
611	Educational services	Excluded (government/nonprofit)			
621	Ambulatory health care services	Excluded (government/nonprofit)			
622	Hospitals	Excluded (government/nonprofit)			
623	Nursing and residential care facilities	Excluded (government/nonprofit)			
624	Social assistance	Excluded (government/nonprofit)			
711	Performing arts, spectator sports, and related industries	Excluded (low-quality F1 score)			
712	Museums, historical sites, and similar institutions	0.6318	912.92	341.15	1,440.02
713	Amusement, gambling, and recreation industries	0.9333	34.15	7.84	67.78
721	Accommodation	Excluded (quality below minimum performance threshold)			
722	Food services and drinking places	Excluded (quality below minimum performance threshold)			
811	Repair and maintenance	Excluded (quality below minimum performance threshold)			
812	Personal and laundry services	Excluded (quality below minimum performance threshold)			
813	Religious, grantmaking, civic, professional, and similar organizations	Excluded (government/nonprofit)			
814	Private households	Excluded (government/nonprofit)			
921	Executive, legislative, and other general government support	Excluded (government/nonprofit)			
922	Justice, public order, and safety activities	Excluded (government/nonprofit)			
924	Administration of environmental quality programs	Excluded (government/nonprofit)			
928	National security and international affairs	Excluded (government/nonprofit)			

Note: Summary statistics are from available data for British Columbia and Ontario.
Source: Authors’ calculations based on RegData project, https://www.quantgov.org/state-regdata.

Since 2012, the RegData project, housed at the Mercatus Center at George Mason University, has used custom-made computer programs to perform text analytics and to apply machine-learning algorithms designed to quantify several features of the actual text of regulations in a jurisdiction. The RegData series of datasets supply several decades of annual panel data about US federal regulations, including variables that measure regulatory quantities, origins, and applicability. Several other datasets include other jurisdictions. National and subnational datasets currently cover the United States, Canada, and Australia. All RegData datasets are publicly available at https://www.quantgov.org/.

Because of the central role that RegData plays in our analysis of the effect of British Columbia's regulatory budget, we explain the dataset in some detail. Readers who would like more details should consult Al-Ubaydli and McLaughlin (2017), McLaughlin and Sherouse (2019), and the project's website, https://www.quantgov.org/.

Regulation generally refers to a body of law known as *administrative law*. Administrative law comes about when a legislature delegates lawmaking authorities and obligations—often jointly referred to as statutory mandates—to one or more regulatory agencies, which then create and administer regulations to fulfill the mandate. In the US federal government, for example, the term *regulation* refers to the administrative rules created by the executive branch agencies, such as the Department of Transportation and the Department of Labor, as well as the rules promulgated by independent regulatory agencies, such as the Securities and Exchange Commission and the Federal Trade Commission.

RegData datasets offer industry-specific panel data for many jurisdictions. Conceptually, those industry-specific panel datasets measure the level of regulation relevant to each industry in each year of coverage. The several series of industry-specific regulation data are actually composites that have been created by combining two separate metrics: regulatory *restrictions* and *industry relevance*.

Restrictions is a cardinal proxy for the number of regulatory restrictions contained in regulations. Quantifying restrictions will entail tallying the occurrences of specific words and phrases, such as "shall" or "must," that frequently are used in legal language to create binding obligations or prohibitions.[6] The database also includes a secondary measure of volume—the total *word counts*—as an alternative measure of the volume of regulations over time. Figures 1 and 2 (shown earlier) depict the growth of restrictions in various jurisdictions as a demonstration of regulatory accumulation.

As a way of measuring obligations and prohibitions, the RegData methodology of quantifying federal regulation contrasts starkly with some rougher proxies used in research preceding RegData's creation (see, for example, Coffey, McLaughlin, and Tollison 2012; Coglianese 2002; Dawson and Seater 2013; and Mulligan and Shleifer 2005). Al-Ubaydli and McLaughlin (2017) offer a critique of several of those previously used metrics, such as counting pages in the *Federal Register*. They note, for example, that raw page counts from the *Federal Register* "may measure bureaucratic activity more than regulatory growth" because of the multitude of documents published there that do not add—and sometimes may even subtract—regulatory texts to the existing stock of regulations (Al-Ubaydli and McLaughlin 2017, 111).

The second key element in RegData is *industry relevance*, a variable that reports the probability that regulatory text is relevant to the different sectors and industries in the US economy. RegData uses the industry definitions of NAICS, which categorizes all economic activity into different industries. For example, in one version of NAICS (the two-digit version),

[6] The specific set of terms that are tallied includes "shall," "must," "may not," "prohibited," and "required."

the US economy is divided into approximately 20 industries, whereas the most granular version of NAICS (the six-digit version) divides the economy into more than 1,000 industries. To illustrate, NAICS code 51 signifies the "Information" industry, while NAICS code 511191 signifies a much narrower segment of the information industry, "Greeting Card Publishers."

The RegData project has developed machine-learning algorithms to assess the probability that a unit of regulatory text targets a specific NAICS-defined industry. That assessment requires two steps. The first step involves using a compilation of training documents to program the algorithm to recognize the words, phrases, and other features that can best identify when a unit of text is relevant to a specific industry. Training documents, in the case of RegData, are documents that are known to be relevant to one or more explicitly named industries. Tens of thousands of training documents were collected from the *Federal Register*, a daily publication of the US federal government that includes rules, proposed rules, presidential documents, and a variety of notices of current or planned government activity. Some of those documents are specifically labeled with relevant NAICS codes, and the language they use is similar to that of regulations. The result is an algorithm that can classify a document into one or more NAICS categories by assigning each category a probability that the document contains language that is relevant to the category.

Once the algorithm is trained, the second step is the deployment of the classifier on the target documents.[7] For this study, the target documents are the regulations of the provinces of British Columbia and Ontario. Most of those documents were collected from the website of the Office of the Queen's Printer for each province. The full set of regulations in effect at a point in

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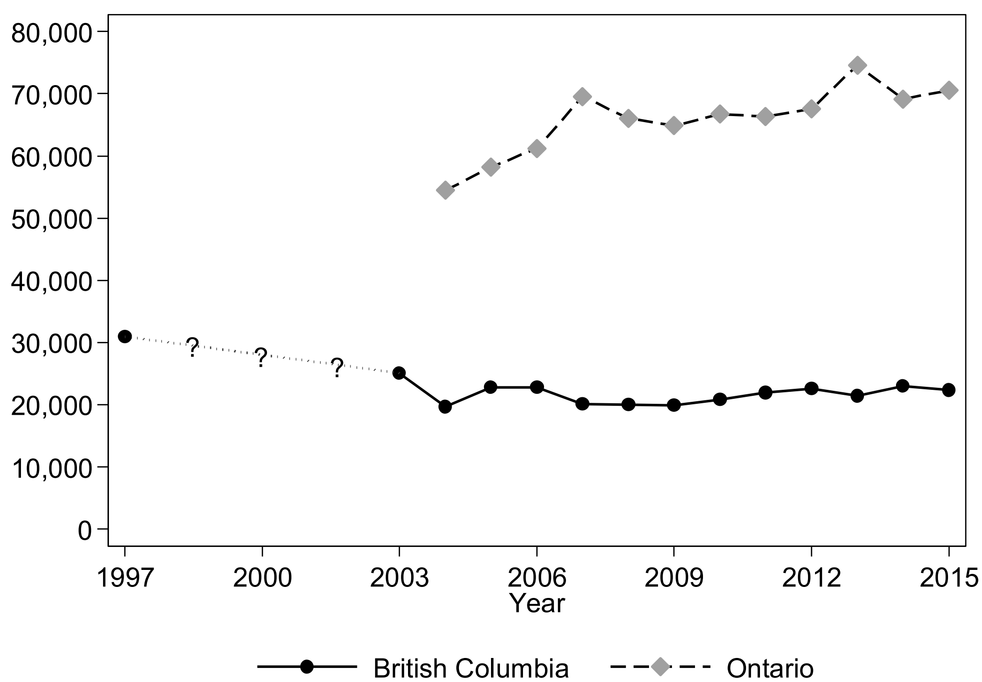
[7] The performance of the NAICS classifier algorithm is presented in detail in McLaughlin and Sherouse (2019) and on the project's website, https://www.quantgov.org/.

time in each year was available from those websites for 2004–2015 for Ontario and 2003–2015 for British Columbia. In addition, the 1997 point-in-time regulations for British Columbia were obtained in hard copy from the courthouse library in Vancouver. Those hard copies were scanned and digitized with optical character recognition software, thereby permitting the use of RegData software on that year's regulations as well. Regulations for other years were unavailable for the two provinces.

The text analysis and machine-learning algorithm from RegData 3.1 were thus used on the entire regulatory code of British Columbia for 1997 and for 2003–2015 and on the entire regulatory code of Ontario for 2004–2015. Figure 3 shows the annual *restrictions* counts for each province for those years.

Figure 3. Total Regulatory Restrictions Over Time, British Columbia and Ontario



Note: Question marks in data line for British Columbia indicate years for which data are unavailable.
Source: Authors' calculations based on RegData project, https://www.quantgov.org/state-regdata.

We use the *industry regulation index* introduced by Al-Ubaydli and McLaughlin (2017) and subsequently used in most studies that use RegData (e.g., Coffey, McLaughlin, and Peretto, 2020; Ellig and McLaughlin 2016; Gutiérrez and Philippon 2019). This industry regulation index is designed to measure regulations relevant to industry i in a piece of regulatory text p in year y. Following the notation of Al-Ubaydli and McLaughlin (2015), industry-relevant restrictions, r_{pyi}, is a function of the restrictiveness of a piece of regulatory text, R_{py}, and the applicability of the piece of regulatory text, a_{pyi} (i.e., the probability that the restrictions apply to industry i):

$$r_{pyi} = f(a_{pyi}, R_{py}) \quad (1)$$

where the partial derivatives f_a, f_R, and their cross-partial are positive. We operationalize the function by multiplying restrictions by probability,

$$f(a_{pyi}, R_{py}) = a_{pyi}R_{py}, \quad (2)$$

and summing across all pieces of regulatory text for each province in each year,

$$r_{yi} = \sum_p r_{pyi}. \quad (3)$$

The development of the RegData 3.1 classification algorithm involved a race among three different types of classification models: regularized logistic regression (logit) with l2-penalty, k-nearest neighbors, and random forests. Those models were selected because they could avoid overfitting and could produce probability scores.

Those classification algorithms produce a probability that a unit of analysis (i.e., a regulation) is relevant to an NAICS-defined industry. Evaluation results from fivefold cross-validation for the three-digit NAICS classification are described in table 2; those results use weighted average F1 scores as our primary evaluation metric. F1 scores are commonly used to gauge the performance of machine-learning algorithms because they balance recall and precision in a combined score.

Recall is the percentage of true positive documents that are classified as positive in cross-validation (i.e., out-of-sample prediction). For the sake of model evaluation, a positive classification is considered to have occurred when the algorithm assigns to a regulation a probability of 0.5 or greater for a specific industry. *Precision* measures resistance to false positives and is calculated as the percentage of positively classified documents that are true positives.

In other words, a good recall score indicates that the classifier does a good job of detecting when a document belongs to a specific class. But because a classifier could report that all documents belong to all classes and receive a perfect recall score, we also want to know how well the classifier avoids false positives, which is indicated by the precision score. By combining precision and recall, an F1 score balances the two and allows easy comparison of models on both dimensions simultaneously.[8] The highest-performing model was the regularized logit model.[9]

We use the machine-learning algorithms developed and trained for the RegData project to produce industry-specific regulatory data for most industries of the 3-digit level of NAICS for the provinces of British Columbia and Ontario. However, some industry classifiers outperform

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[8] Precision is calculated as TP/(TP + FP), where TP is *true positives* and FP is *false positives*. Recall is calculated as TP/(TP + FN), where FN is *false negatives*. In both cases, the highest possible score for a model along the single dimension equals one. The F1 score, therefore, also has a maximum possible score of one, but that score is not necessarily desirable. There is usually a tradeoff between the two dimensions. A model can have very high precision *because* it creates many false negatives. F1 scores are useful in comparing models for a given classification project while balancing between those two dimensions. However, the machine-learning community typically cautions against comparing one project to another by using F1 scores because precision or recall may be valued in different ways in different projects.

[9] Regularized logistic regression attained the highest weighted average F1 score:

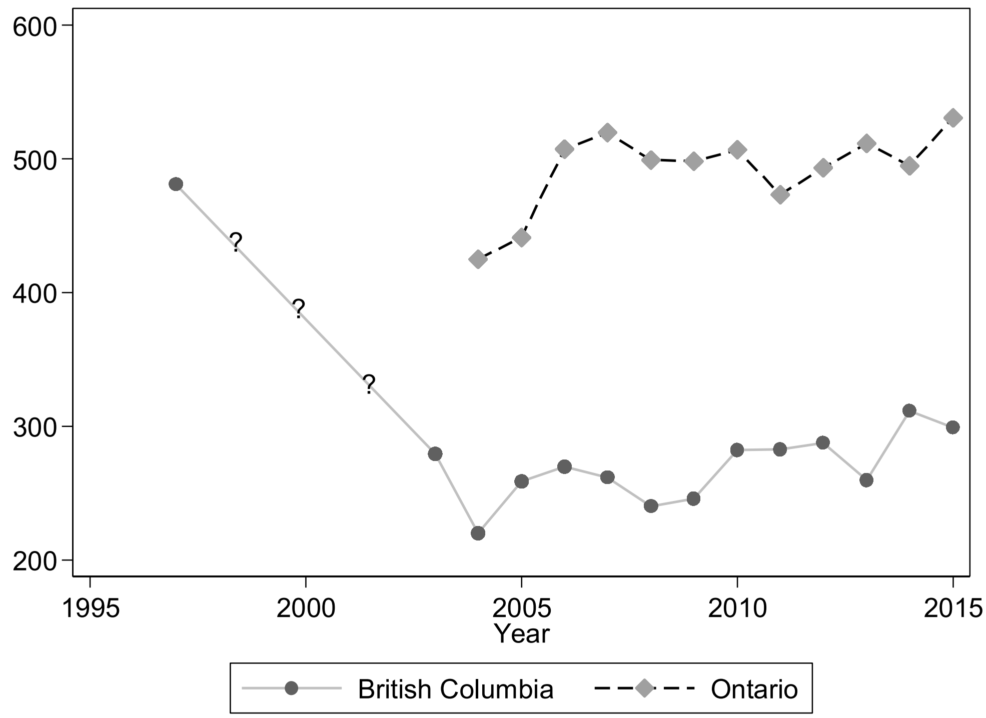
Classifier	Parameters	Weighted average F1	Standard deviation
Regularized logistic regression	$C = 1{,}000$	0.8808	0.0100
K-nearest neighbors	$k = 1$	0.8581	0.0097
Random forests	$n = 251$	0.7540	0.0088

others. To filter out low-performing algorithms, we adopt the minimum performance threshold developed and recommended by the RegData project for the RegData 2.2 release.

For minimum performance testing, each industry classifier is evaluated in terms of the area under the receiver operating characteristic curve (often referred to as the ROC AUC—**R**eceiver **O**perating **C**haracteristic curve's **A**rea **U**nder the **C**urve—score), a method of assessing the predictive accuracy of machine-learning algorithms (Fawcett 2006). An ROC AUC score measures the degree to which true positives generally have a higher predicted probability than do true negatives; it is calculated as the area under a curve plotting the false positive rate (percentage of true negative documents classified positive) against the recall at every possible probability threshold from 0 to 1. For an industry to be included in our dataset, its classifier had to achieve an ROC AUC score of 0.75 or greater.

In figure 4, we also graphically present our series of *industry regulation index* data. Figure 4 shows the mean across all 54 industries of industry regulation index for the provinces of British Columbia and Ontario. For British Columbia, as illustrated in figure 3, we show the missing years of data as question marks. RegData covers years 1997 and 2003–2015 for British Columbia and years 2004–2015 for Ontario.

Figure 4. Mean of Industry Regulation Index, British Columbia and Ontario



Note: Question marks in data line for British Columbia indicate years for which data are unavailable.
Source: Authors' calculations based on RegData project, https://www.quantgov.org/state-regdata.

4. Regression Results

We analyze the effect of British Columbia's regulatory budget on its economic growth rate in three ways. First, we use a simple difference-in-differences approach as we compare the industries' value-added to GDP in British Columbia to that of the other provinces before and after the regulatory budget went into effect. The simple difference-in-differences approach effectively weights every other province equally as part of a control group, but this method may inadvertently place undue weight on volatile percentage changes in fine industry slices (e.g., aquaculture) in small provinces (e.g., Prince Edward's Island, population 150,000). Therefore, we also compare the industries of British Columbia (i.e., our treatment group) to synthetic controls: weighted averages across the other provinces of the corresponding industry's value-added to GDP with weights selected to match the pretreatment time paths of the synthetic control to British Columbia. Although the use of synthetic controls addresses concerns about whether our control group is reasonable, it does not control for other policy changes in British Columbia that coincide with regulatory reform. In particular, we should be concerned that some of the growth gains in British Columbia during the treatment period may actually be due to the simultaneous tax reforms in the province. This problem presents a prime opportunity for deploying RegData. It allows us to measure the correlation of downstream gains in GDP owing to heterogeneous treatments in the form of changes in regulatory constraints while effectively controlling for the homogeneous treatment of changes in the tax code that affect all industries the same way. Hence, we directly account for regulation as a potential determinant in the two provinces for which we have historical data: British Columbia and Ontario.

4.1. Simple Difference-in-Differences Regressions

Our first set of regressions uses a basic difference-in-differences approach. British Columbia's regulatory budget went into effect shortly after the election of 2001. We thus look for a post-2001 change in the difference in the growth of output per capita between British Columbia and the other provinces. Our first specification is simply,

$$\Delta \ln\left(\frac{GDP_{jpt}}{Pop_{pt}}\right) = \alpha_{jt} + \beta 1\{p = BC\} + \gamma 1\{t \geq 2001\} + \delta[1\{p = BC\} \times 1\{t \geq 2001\}] + \varepsilon_{jpt} \quad (4)$$

where the outcome variable is the growth rate of the industry's value-added to GDP per capita, α_{jt} are industry and year fixed effects, β is the difference in the growth rate in British Columbia versus other provinces in the preperiod, γ is the difference in the growth rate for other provinces in the postperiod, and δ is the treatment effect. Thus, we estimate the difference between British

Columbia's gain from preperiod to postperiod and the corresponding gains of the other provinces.

Column (1) of table 3 presents the simple difference-in-differences results. The growth rate of industries in British Columbia averaged around 0.6 percent in the preperiod and 1.4 percent in the postperiod, resulting in a gain of 0.8 percentage point. The growth rate of industries in other provinces was 4.3 percent in the preperiod and 0.7 percent in the postperiod, resulting in a loss of 3.6 percentage points. Under the logic that British Columbia's industries would have followed the same trend as their counterparts in other provinces but for the regulatory reforms, the difference between those preperiod and postperiod differences is the treatment effect of the regulatory reforms on British Columbia's economy: 4.4 percentage points. As reflected by the asterisks in table 3, this positive estimate of the treatment effect is highly unlikely to occur just by chance. The estimated treatment effect is significantly different from 0 at any conventional level of statistical significance (i.e., even the lower bound of a 99 percent confidence interval on the treatment effect is strictly positive). We should note that we weight the industries in all of our regressions by their share of British Columbia's GDP, up-weighting the effects on larger industries and down-weighting the effects on smaller industries. This weighting also yields an estimate of the aggregate effect of the post-2001 (regulatory) regime reason on British Columbia's aggregate GDP, as can be seen from a simple calculus derivation:

$$\frac{dGDP_{pt}}{dt} = \frac{d}{dt}\sum_j GDP_{jpt} = \sum_j \frac{dGDP_{jpt}}{dt} \times \left[\frac{GDP_{jpt}}{GDP_{pt}}\right] \tag{5}$$

Columns (2), (3), and (4) of table 3 present the results when we include year fixed effects, province fixed effects, and both, respectively. This approach serves mostly as a robustness check to ensure that our results are not driven by a time-invariant heterogeneity in the industries or a common shock experienced by all industries in a given year. The only notable change in the results from including those fixed effects is a change in the parameter on the dummy for the postperiod. This change suggests that our controls (the industries in different provinces) might be somewhat noisy or not well paired with our treatment (the industries in British Columbia).

Table 3. Simple Difference-in-Differences Regressions

$\Delta \ln\left(\frac{GDP_{jpt}}{Pop_{pt}}\right)$	(1)	(2)	(3)	(4)	(5)
β:1{p = BC}	–0.037***	–0.037***	–0.036***	–0.036***	–0.038***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
γ:1{t ≥ 2001}	–0.037***	–0.068***	–0.039***	–0.071***	0.160
	(0.003)	(0.008)	(0.003)	(0.008)	(0.136)
δ:1{p = BC} × 1{t ≥ 2001}	0.044***	0.044***	0.044***	0.044***	0.046***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
Fixed effects					
Year	No	Yes	No	Yes	Yes
Industry	No	No	Yes	Yes	Yes
Industry by year	No	No	No	No	Yes
Provinces	10	10	10	10	10
Industries	135	135	135	135	135
Observations	22,681	22,681	22,681	22,681	22,681
R-squared	0.005	0.013	0.015	0.022	0.202

Note: Standard errors are in parentheses. *** $p < 0.01$.
Source: Authors' calculations.

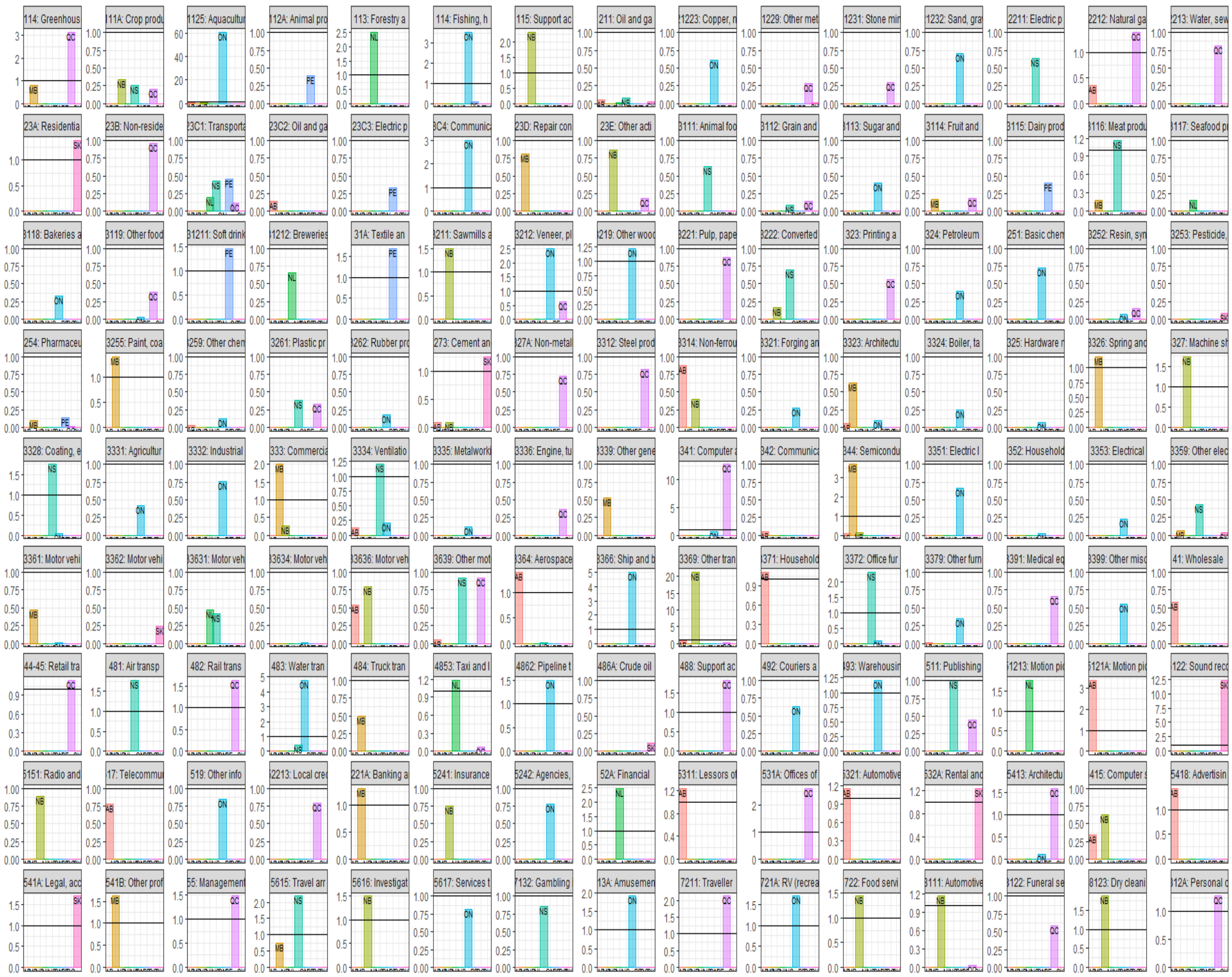
Column (5) of table 3 presents an even stronger robustness check by including industry-by-year fixed effects, which effectively control for nonlinear industry-specific trends. To be clear, those fixed effects are equivalent to adding 2,429 (18 years × 135 industries – 1) dummy variables to our specification. Mechanically, this approach increases R^2 (by slightly more than a factor of 40 from 0.005 in column (1) to 0.202 in column (5) because a larger fraction of the variation in the outcome variable is explained. That reduction in noise tends to tighten standard errors on point estimates of parameters, but those point estimates themselves may change because the fixed effects reduce the variation in the data that can identify the point estimates. In effect, those fixed effects take each GDP per capita observation and net off the mean (across provinces) for that industry in that year. Hence, the demeaned observations result in identifying the parameters from the variation within industry in that year across provinces. Again, the only notable change in the results is the parameter on the postperiod dummy, which again draws our controls into question and motivates our next analysis.

4.2. Difference-in-Differences Regression with Synthetic Controls

Our next set of regressions applies an analogous difference-in-differences specification but with a synthetic control province that we construct as industry-specific weighted averages of other provinces' value-added GDP per capita (where the weights are not constrained to sum to 1 in case the industry's GDP per capita is larger in British Columbia than in any other province). We find those weights via Lasso regressions of the industry's GDP per capita in British Columbia on the same industry's GDP per capita in other provinces. The regressions essentially use the L1 norm on the estimated parameters to penalize the econometric objective function, and that approach tends to favor corner solutions so that the synthetic controls are constructed from relatively few provinces. The size of the penalty is selected via a cross-validation procedure. There are 89 industries for which the Lasso-selected synthetic control is merely a rescaling of that same industry in a single province. The top six provinces with non-zero weights in the synthetics for the 135 industries are Ontario (41 industries), Quebec (34 industries), Alberta (24 industries), New Brunswick (20 industries), Nova Scotia (19 industries), and Manitoba (16 industries). The weights selected by the Lasso regressions are presented in figure 5.

The difference-in-differences regressions with synthetic controls are qualitatively similar to the difference-in-differences regressions when we use the industries in all the provinces (equally weighted within industry) as our controls. The quantitative difference appears in the magnitude of the treatment effect. Using these more carefully selected weights, we find that the growth rate of industries in British Columbia is 1.4 percentage points higher post-2001 than it would have been had the industries followed the same trend as their corresponding controls. This rate is almost one-fourth of the treatment effect found by the simple difference-in-differences where all the industries in all provinces are treated equally as controls. Depending on the fixed effects included in the synthetic control regressions, the estimated treatment effect is statistically significant with 90 percent to 95 percent confidence (i.e., a 5 percent to 10 percent probability of making a Type I error if the null hypothesis of zero treatment effect were true). Note that the standard errors appear much smaller when we use synthetic controls instead of using the industry in every province as a control, despite the fact that we are using only one-fifth as many observations. This decrease is because our synthetic control procedure has successfully reduced the noise in the control outcomes so that the informal signal in the data can be better isolated and extracted via our difference-in-differences model, as reflected in the considerably higher values for R^2.

Figure 5. Industry-Specific Weights on Other Provinces' GDP per Capita for Synthetic Controls



4.3. RegData Regressions

Although the results presented in table 4 are certainly consistent with the hypothesis that British Columbia's regulatory budgeting experiment led to a dramatic increase in its growth rate, they cannot rule out the possibility that other simultaneous changes in British Columbia (e.g., tax reforms) could explain our findings. Our final set of regressions is designed to more directly account for the effect of growth in the stock of regulations on economic growth.

Table 4. Difference-in-Differences Regressions with Synthetic Controls

$\Delta \ln\left(\frac{GDP_{jpt}}{Pop_{pt}}\right)$	(1)	(2)	(3)	(4)	(5)
β:1{p = BC}	–0.010	–0.010*	–0.010	–0.010*	–0.010*
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
γ:1{t ≥ 2001}	–0.008	0.002	–0.011**	–0.002	0.086
	(0.005)	(0.010)	(0.005)	(0.010)	(0.146)
δ:1{p = BC}×1{t ≥ 2001}	0.014*	0.014**	0.014*	0.014**	0.014**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Fixed effects					
Year	No	Yes	No	Yes	Yes
Industry	No	No	Yes	Yes	Yes
Industry by year	No	No	No	No	Yes
Provinces	10	10	10	10	10
Industries	135	135	135	135	135
Observations	4,590	4,590	4,590	4,590	4,590
R-squared	0.001	0.051	0.036	0.087	0.595

Note: Standard errors are in parentheses. ** $p < 0.05$, * $p < 0.1$.
Source: Authors' calculations.

A major obstacle in this study is missing data. For reasons beyond our ken, historical regulations are very difficult to find. As mentioned in our data discussion, British Columbia's office in charge of printing laws and regulations has made historical regulations available online from only 2003 onward, while Ontario's regulations are available online from only 2004 onward. We were able to obtain British Columbia's regulations for 1997 only by physically visiting the courthouse library in Vancouver, British Columbia, and by scanning hard copies.

Thus, for British Columbia, we have a significant gap in our data on regulation (as shown in figures 3 and 4). Nonetheless, we do know that significantly more regulation existed in 1997—before the regulatory budget was implemented in 2001—than at any point afterward. Our specifications are written as if we use the first-differencing of log data, which is the growth rate in a time series with sequential observations. To manage our regulation data gap in British Columbia, we simply calculated the log difference in *industry regulation index* from 1997 to 2003 and divided by six for that observation (because it is a six-year gap).

We regress the growth rate of GDP per capita by industry (i.e., the percentage change in GDP per capita) on the growth rate of RegData's industry regulation index (i.e., the percentage change in regulation),

$$\Delta\, ln\left(\frac{GDP_{jpt}}{Pop_{jpt}}\right) = \alpha_{jt} + \delta\Delta\, ln\left(RegIndex_{jpt}\right) + \varepsilon_{jpt}, \tag{6}$$

where α are industry and year fixed effects and $\Delta\, ln(RegIndex)$ is the first-differenced log of the industry regulation index (except where noted before for the earliest British Columbia observation) and where ε is the stochastic disturbance term. The regression reported in columns (1) and (2) of table 5 includes all 35 industries (at the 3-digit level of NAICS) with adequate data quality to rely on the RegData measure. Column (2) differs from column (1) because of the inclusion of industry-by-year fixed effects, which effectively control for industry-specific nonlinear trends.

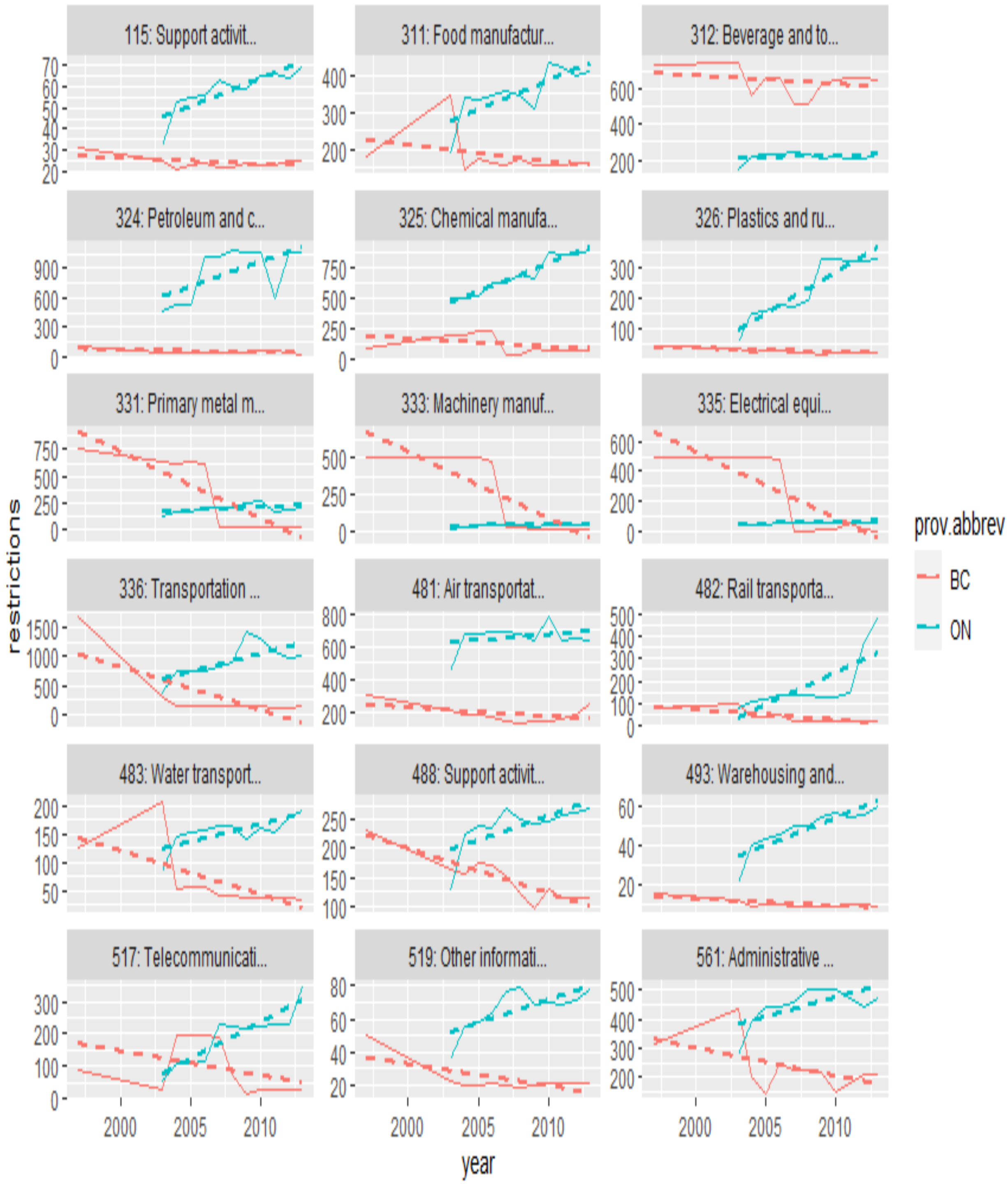
Table 5. RegData Regressions for 3-Digit NAICS Data, British Columbia and Ontario

$\Delta\, \mathbf{ln}\left(\frac{\boldsymbol{GDP_{jpt}}}{\boldsymbol{Pop_{pt}}}\right)$	(1)	(2)	(3)	(4)
δ:$\Delta\, \boldsymbol{ln}\left(\boldsymbol{RegIndex_{jpt}}\right)$	–0.014*	–0.025**	–0.019*	–0.019**
	(0.009)	(0.010)	(0.008)	(0.009)
Fixed effects				
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Industry by year	No	Yes	No	Yes
Provinces	2	2	2	2
Industries	35	35	18	18
Observations	760	760	414	414
R-squared	0.232	0.727	0.268	0.721

Note: Standard errors are in parentheses. ** $p < 0.05$, * $p < 0.1$.
Source: Authors' calculations.

Our results are again consistent with our hypothesis. In both of the regressions on all 35 industries, we observe a negative coefficient estimate on our metric of regulation, industry regulation index. That estimate is statistically significant at the 10 percent level without the industry-by-year fixed effects and is significant at the 5 percent level with them. Columns (3) and (4) further restrict the sample to a subset of those 35 industries. Qualitatively similar results appear in columns (3) and (4) but with considerably less sensitivity of the point estimate to the inclusion of industry-by-year fixed effects. Taken as a whole, the results indicate that a 1 percent increase in the quantity of regulation in British Columbia and Ontario is associated with an approximately 0.02 percentage point decrease in the growth of GDP. The subsample used in columns (3) and (4) is restricted to the 18 industries that appeared to our inspection to have the cleanest time paths for the treatment and control (i.e., regulatory restrictions are rising in Ontario but falling in British Columbia). Figure 6 presents the time paths of those industries.

Figure 6. Three-Digit NAICS Industries with Regulatory Restrictions That Appear to Be Treated in British Columbia



Source: Authors' calculations based on RegData project.

5. Discussion of Policy Implications

The concept of regulatory budgeting has existed among experts in regulation since at least the 1970s.[10] Advocates note that regulations, like taxation and direct government expenditure, are a mechanism for transferring wealth and have economic effects that are similar to those of taxes and spending. As explained in Fichtner, Mclaughlin, and Michel (2018, 44): "Assessing a tax on carbon has many of the same impacts on energy prices as requiring the installation of a new environmental protection technology at power plants—however, the tax would appear in government budgets and the regulatory requirement is not systematically accounted for. In its most simple form, a regulatory budget treats regulatory costs as equivalent to government spending and accounts for each annually in the budget process."

Regulatory budgets, like other types of budgets, work only if they force the spender to identify and prioritize the most valuable options. The behavior of an agency with a budget differs from that of an agency without a budget. In a no-budget world, an agency's objective is to fulfill its mission with the creation of rules. The effectiveness and efficiency of those rules are not evaluated in hindsight, and prospective evaluation of effectiveness and efficiency occurs for only less than 1 percent of all new rules.[11] In contrast, an agency with a regulatory budget would act differently. First, the agency would avoid new regulations that would not achieve high benefits relative to their budgetary cost. Second, the agency would have incentive to eliminate old regulations that do not achieve benefits that justify their social costs. In other words, a regulatory

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[10] Robert Crandall (1978) first mentioned "shadow budgets" as a form of tabulating regulatory costs to the private sector in 1978. See also Litan and Nordhaus (1983).

[11] Furthermore, many studies have questioned the quality of prospective evaluation of new rules as performed by agencies in the existing regulatory process. See, for example, Ellig and McLaughlin (2011); Ellig, McLaughlin, and Morrall (2012); and Hahn et al. (2000).

budget process would resemble an error-correction process: it would lead to fewer new errors and to the diagnosis and correction of existing errors.

One of the obstacles to implementing a regulatory budget in any jurisdiction is the difficulty of quantifying regulatory burden. Although they are not necessarily used in a formal regulatory budget, a variety of methods for estimating or quantifying regulatory burden have been developed over the years, and arguably, any of them could be adapted for use in a regulatory budget.

The simplest approaches to measuring regulation are text-based metrics, wherein one or more dimensions of the actual text of regulations can be quantified and tallied. For example, regulatory restrictions are obligations or prohibitions created by regulations that can be quantified by humans or computer programs. Measurement of regulatory restrictions depends simply on the text of regulations, rather than on any estimation of cost associated with regulations. The use of such text-based metrics in a regulatory budget is fairly straightforward: a regulatory budget could contain targets for the number of restrictions permitted in regulatory code at a given point in time. Each agency could have a set budget. Alternatively, a budget could apply to a portfolio of regulatory programs related to one subject, such as education or railroad transportation.

A second possible unit of measurement is administrative burden, which is similar to the paperwork costs approach that is used in Regulatory Flexibility Act analyses in the United States. Administrative burden typically refers to paperwork and other information-related activities required by regulations, such as the completion and submission of forms or the retention of data.[12] Current practices in the United States for Regulatory Flexibility Act analyses are to assess the number of paperwork hours associated with a rule—a figure that can be monetized using industry-specific wage and overhead data. But neither the estimation of hours nor its monetization is required. One can simply count the number of regulatory requirements that impose any amount of administrative burden, which is the method used in Canada's ongoing federal Red Tape Reduction Action Plan.

Another unit of measurement, business costs, focuses on direct compliance costs imposed on businesses. As such, it is a more comprehensive measure of costs than paperwork costs, because it would include other direct costs such as those incurred by the purchase of equipment or by allocation of labor to compliance activities. Business costs are the unit of measurement used by the United Kingdom's form of regulatory budgeting.

Finally, the most comprehensive unit entails the measurement of social costs. Social costs include those elements of regulations that apply to businesses, such as the paperwork burden or compliance costs. But social costs also include the hidden costs that accompany government intervention and that apply to other segments of society, rather than to business owners only. Some examples include potential negative effects on innovation and on entrepreneurship, both critical drivers of economic growth. Regulations—and regulatory accumulation in particular—tend to have deleterious effects on innovation and, in some cases, on competition (Coffey, McLaughlin, and Peretto 2020; Gutiérrez and Philippon 2019).

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[12] As part of its Red Tape Reduction legislation, the Treasury Board of Canada Secretariat—the entity responsible for overseeing the project's administrative burden counts—produced a guide titled "Counting Administrative Burden Regulatory Requirements." This guide defines administrative burden as follows: "Administrative burden includes planning, collecting, processing and reporting of information, completing forms and retaining data required by the federal government to comply with a regulation. This includes filling out license applications and forms, as well as finding and compiling data for audits and becoming familiar with information requirements." See http://www.tbs-sct.gc.ca/hgw-cgf/priorities-priorites/rtrap-parfa/abb-brfa/cabrr-derfa-eng.asp#app2 (accessed July 1, 2016).

A regulatory budget must actually constrain regulators in order to be effective. The regulatory budget processes that have been applied in Canada and the United Kingdom rely on a rule-based approach, such as one-in, one-out or one-in, two-out. The logic is simple: regardless of the unit of measurement, for each new cost added to a regulatory budget, some quantity of costs must be eliminated. The rule-based approach has the merits of simplicity and relevance, because any new intervention (regulatory or legislative) will require some amount of reprioritization. However, the rule-based approach's simplicity is accompanied by some degree of inflexibility. A design element to consider with any rule-based approach would be a means for dealing with cases of emergency.

An alternative approach described in Fichtner, McLaughlin, and Michel (2018) entails the creation of a process that is similar to existing budget processes for outlays. Legislatures or executives would set regulatory budgets for regulators as a part of the normal budgeting process, and the regulatory budget would exist as a parallel cost ledger. The regulatory budget could change from year to year, depending on the budgeter's perception of regulatory needs, effectiveness, importance, or other factors. This approach would allow for a regulatory budget to expand for some regulators in some years, while possibly contracting elsewhere.

6. Conclusion

This study empirically examines the relationship between regulation and economic growth by exploiting data from British Columbia's experiment in regulatory budgeting. In 2001, following several years of subpar economic growth, the newly elected government of British Columbia implemented a regulatory budget designed to reduce overall regulatory burden by at least one-third within three years. That goal was achieved and even surpassed: RegData statistics for

British Columbia indicate that regulatory restrictions fell by about 36 percent, going from 30,943 in 1997 to 19,673 by 2004, three years after the budget's implementation.

We use a difference-in-differences approach to show that after this policy intervention, British Columbia's growth rate increased dramatically, rising by about 25 percent relative to other provinces. However, because our difference-in-differences approach could not control for other possibly relevant changes that could have occurred simultaneously, we also present a set of regressions that directly account for changes to the stock of regulations as a possible determinant of economic growth. The results of our industry-specific regulatory reforms also indicate that regulatory budgeting, at least as implemented in British Columbia, is associated with improved economic performance. We find that a 1 percent increase in the stock of regulations is associated with a 0.028 percent decrease in year-to-year economic growth. Thus, if British Columbia's regulatory budget experiment led to a 36 percent decrease in the stock of regulations, the implied effect on growth is a gain of about 1 percentage point.

References

Aghion, Philippe, Yann Algan, Pierre Cahuc, and Andrei Shleifer. 2010. "Regulation and Distrust." *Quarterly Journal of Economics* 125 (3): 1015–49.

Al-Ubaydli, Omar, and Patrick A. McLaughlin. 2017. "RegData: A Numerical Database on Industry-Specific Regulations for all United States Industries and Federal Regulations, 1997–2012." *Regulation and Governance* 11 (1): 109–23.

Alesina, Alberto, Silvia Ardagna, Giuseppe Nicoletti, and Fabio Schiantarelli. 2005. "Regulation and Investment." *Journal of the European Economic Association* 3 (4): 791–825.

Botero, Juan C., Simeon Djankov, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Schleifer. 2004. "The Regulation of Labor." *Quarterly Journal of Economics* 119 (4): 1339–82.

Coffey, Bentley, Patrick A. McLaughlin, and Pietro Peretto. 2020. "The Cumulative Cost of Regulations." *Review of Economic Dynamics* 38: 1–21.

Coffey, Bentley, Patrick A. McLaughlin, and Robert Tollison. 2012. "Regulators and Redskins." *Public Choice* 153: 191–204.

Coglianese, Cary. 2002. "Empirical Analysis and Administrative Law." *University of Illinois Law Review* 2002 (4): 1111–38.

Crandall, Robert. 1978. "Federal Government Initiatives to Reduce the Price Level." Brookings Papers on Economic Activity No. 2, Brookings Institution, Washington, DC.

Dawson, John W., and John J. Seater. 2013. "Federal Regulation and Aggregate Economic Growth." *Journal of Economic Growth* 18 (2): 137–77.

Djankov, Simeon, Caralee McLiesh, and Rita Maria Ramalho. 2006. "Regulation and Growth." *Economic Letters* 92 (3): 395–401.

Ellig, Jerry, and Patrick A. McLaughlin. 2011. "The Quality and Use of Regulatory Analysis in 2008." *Risk Analysis* 32 (5): 855–80.

Ellig, Jerry, and Patrick A. McLaughlin. 2016. "The Regulatory Determinants of Railroad Safety." *Review of Industrial Organization* 49 (2): 371–98.

Ellig, Jerry, Patrick A. McLaughlin, and John Morrall III. 2012. "Continuity, Change, and Priorities: The Quality and Use of Regulatory Analysis Across Administrations." *Regulation and Governance* 7 (2): 153–73.

Fawcett, Tom. 2006. “An Introduction to ROC Analysis.” *Pattern Recognition Letters* 27 (8): 861–74.

Fichtner, Jason J., Patrick A. McLaughlin, and Adam Michel. 2018. “Legislative Impact Accounting: Incorporating Prospective and Retrospective Review into a Regulatory Budget.” *Public Budgeting & Finance* 38 (2): 40–60.

Glaeser, Edward L., and Andrei Shleifer. 2003. “The Rise of the Regulatory State.” *Journal of Economic Literature* 41 (2): 401–25.

Government of British Columbia, Ministry of Small Business and Economic Development. 2004. *Ministry of Small Business and Economic Development Deregulation Report*, October.

Gutiérrez, Germán, and Thomas Philippon. 2019. “The Failure of Free Entry.” NBER Working Paper No. 26001, National Bureau of Economic Research, Cambridge, MA, June.

Hahn, Robert W., Jason Burnett, Yee-Ho I. Chan, Elizabeth Mader, and Petrea Moyle. 2000. “Assessing Regulatory Impact Analyses: The Failure of Agencies to Comply with Executive Order 12,866.” *Harvard Journal of Law and Public Policy* 23(3): 859–71.

Jones, Laura. 2015. “Cutting Red Tape in Canada: A Regulatory Reform Model for the United States?” Mercatus Research, Mercatus Center at George Mason University, Arlington, VA, November.

Litan, Robert F., and William Nordhaus. 1983. *Reforming Federal Regulation* (New Haven, CT: Yale University Press).

Mandel, Michael, and Diana G. Carew. 2013. “Regulatory Improvement Commission: A Politically Viable Approach to U.S. Regulatory Reform.” Policy Memo, Progressive Policy Institute, Washington, DC, May.

McLaughlin, Patrick A., Scott Atherley, and Stephen Strosko. 2019. “RegData Canada: An Overview.” Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, February.

McLaughlin, Patrick A., Jason Potts, and Oliver Sherouse. 2019. “RegData: Australia.” Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, June.

McLaughlin, Patrick A., and Oliver Sherouse. 2019. “RegData 2.2: A Panel Dataset on US Federal Regulations.” *Public Choice* 180 (1): 43–55.

Mulligan, Casey B., and Andrei Shleifer. 2005. "The Extent of the Market and the Supply of Regulation." *Quarterly Journal of Economics* 120 (4): 1445–73.

Nicoletti, Giuseppe, and Stefano Scarpetta. 2003. "Regulation, Productivity and Growth: OECD Evidence." *Economic Policy* 18 (36): 9–72.