Air Pollution accountability Records around Recent Environmental Laws: Gauging Post-Legislation Emissions Rates of The Major Culprits

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I. Introduction

Starting during America's progressive era in the early twentieth century, regulatory authority became a tool of government to establish limitations on businesses.Since then, there has been much analysis in literature on the impact of regulations on certain industries (Weiland, 1998; Dagg et al., 2011; Gonzales et al., 2016), corporate America (Heffes, 2002; Burress, 2005; Kamieniecki, 2006; Helleiner & Thistlethwaite, 2013), and the national economy as a whole (Christainsen & Haveman, 1982; Ahmad, 2002; Raeburn, 2006; Alvarez et al., 2009).

The effect of regulations hasalso been studied from the perspective of international trade(Shatz, 2016) andsmall organizationsversus larger organizations (Subcommittee on Special Small Business Problems of the Committee on Small Business, 1979; Wilkinson, 2003; Boothe, 2013). Conclusions have often been drawn thatsmall businesses have been disproportionatelynegatively impacted by regulations (Brock & Evans, 1989; Crain & Crain, 2005; Root, 2006; Stel et al., 2007).As a counter-measure, the US government has responded by helping to shield these organizations from the regulations. For example, small businesses have traditionallyavoided being placed under the purview of regulations such as health care mandates, exempting businesses with less than a specified number of employees from being required toprovide health insurance to their employees.

Another sub-theme of regulations focusesthe disproportionatelynegative impact of environmental regulationson smallbusinesses. The government has also intervened on behalf of the organizationsin response to the regulations. For example, Section 8 of the Federal Water Pollution Control Act allows for loans for small businesses that are negatively affected by legislation (EPA Office of Analysis and Evaluation, 1976). Over the past decades, the adverse effects of burdensome environmental regulations on the bottom line of small businesses have prompted these organizations to actively lobby against them (Green & Buchsbaum, 1980; Bean, 2001; Bennett, 2014). However, discussion on the impact ofthese same environmental regulatory policies on large organizations has largely been absent. This study will analyzehow recent domestic environmental legislation has affected the largest organizations in terms of their productivity and pollution rates.

II. Literature Review

Environmental regulations have typically been levied on the harmful release of carbon and oil during the production process.Carbon dioxide emissions, the major form of greenhouse gas pollution,are especially harmful for the environment, and 87% of these come from the burning of fossil fuels, with 43% of fossil fuel consumption from coal and the other 36% from oil (WhatsYourImpact.org, 2017). Environmental concerns have prompted American legislationto heavily regulatethe coal industry.

One recent exampleof new regulations affecting carbon-burning organizations is in the US state of California, which has been at the forefront of political discourse regarding environmental regulations over its history (Williams, 1997; Thompson, 2014). Recently, California enacted Assembly Bill 32, which led the California Air Resources Board to adopt cap-and-trade, a comprehensive regulation of industrial organizations in California that use coal that officially took effect on January 1, 2013 (Schmalensee &Stavins, 2015). In the cap-and-trade model, the California state government determines the mandated maximum amount of polluting emissions that applicable industrial organizations can emit annually and penalizes organizations that exceed that emission allowance, with a more stringent allowance every year(EDF, 2017).An organization may obtainemissions allowances/permits for polluting at annual rates under the cap and then sell them through auctions in the open market or bank them and use those allowances in the future to cover their own emissions (Bushnell, 2008). Although this model has been used internationally, the cap-and-trade process in California has been called the US's "first economy-wide market trading system" to limit pollution (Gallagher, 2012, p. 602), and AB32 has been labeled "the state's overarching climate law" (Sperling & Nichols, 2012, p. 65). Since

its implementation, the system has been deemed a success in part because it motivates organizations to make technological innovations to limit carbon emissions: "if allowances are very expensive, the utility will be incentivized to make more expensive investments rather than risk having to buy additional allowances" (Cook, 2013, p. 16).Through May of 2015, private sector auctions for carbon credits earned California over $2 billion in revenue, which the state reinvested in clean air initiatives (Schmalensee &Stavins, 2015, p. 12). In addition, regulated emissions dropped by 4% (EDF, 2016; Fehrenbacher, 2017).

Fuels such as gasoline, diesel, and natural gas were not originally covered under this act. However, afterobservers deemed cap-and-trade a success, an increasingly vocal coalition advocated that the oil industry in California also be subject to the standard cap-and-trade provisions (Clarke, 2014; McGuinty, 2015). These constituencies claimed that since oil is also a major contributor to greenhouse gas pollution, like the carbon/coal industry, this fossil fuel should also be subject to cap-and-trade. As such, starting on January 1, 2015, industrial energy sources such as gasoline, diesel and natural gas were added under the cap-and-trade program in California. At that time, the California Air Resources Board (2017, para. 4) stated that placing the oil sector being under the thumb of those rules "ensures equity between sectors…reducing our dependence on oil and thus our exposure to volatile oil prices". Fehrenbacher (2017) called the addition ofoil to cap-and-trade a "signature component of California's plan to cut emissions". By March of 2017, 449 California oil companies were in compliance with the new regulations, putting 83 million emissions allowances up for sale on the market (Grady, 2015). In July of 2017, the bill was extended through 2030 (McGreevy, 2017), prompting California Governor Jerry Brown to state that the extension enables a "decarbonized sustainable future" (Megerian, 2017).

Because of the unique nature of cap-and-tradeand its implementation, this study will utilize large California oil organizations and carbon-emitting organizations to address how this recent environmental legislation in California has affected the largest oil and carbon-emitting organizations in terms of their productivity and pollution rates.

Another economic region in the US that has been impacted by environmental changes that has prompted shifts in organizational modelsis the Rust Belt. Also referred to as the Manufacturing Belt, the Rust Belt consists of Midwest American states, generally from Iowa to Pennsylvania (Lopez, 2004). The Rust Belt economies became economically strong from the coal mined and used there, which was "cheaply fueling the factories of the Rust Belt and lighting up homes across the country" (Davenport, 2013, p. 1).However, the decline of US manufacturing and increase in regulations has been specifically intertwined with job loss attributed to plant closings in these communities (Eisinger, 1990; Brady &Wallace, 2001; Samuelsohn, 2009; Kowalski, 2016; Saunders, 2016; Williams, 2017; Deakin& Edwards, 1993; Chase, 2003; Brown, et al., 2008; Bernero & Peduto, 2016).

In 2015, the US Environmental Protection Agency (EPA)released three distinct regulations for carbon-emitting power plants "from new, modified, and existing…sources", comprising key areas of the 2015 Clean Power Plan (McCubbin, 2014). Through the broad executive powers of the Clean Air Act (a seminal environmental guideline expanded in 1970 to include a federal mandate), the Clean Power Plan more strictly regulated greenhouse gas emissions from coal-burning power plants, which then accounted for 40% of all US carbon emissions(McCubbin, 2014). This law especially impacted Rust Belt power plants, because those regulations targeted power plants that rely on electric generators or coal as their main fuel. Scholarsthereforeclaimed that the legislation had "an uneven impact on the energy industry, boosting…some regions…while biting others" (Smith &Miller, 2015, p. 1).

The Clean Power Plan may have been the most controversial energy-related act of the last generation(Rosenbaum, 2016). Critics claimed that national coal production would decrease by 242 million tons as a result (NMA, 2017).Various factions have been vehemently opposed to this policy, particularly Rust Belt union leaders (O'Brien et al., 2016). The political debate around coal was popularly labeled the "war on coal" and has been an issue on which politicians in the Rust Belt are in agreement (Waxman, 2010; Dieterich-Ward, 2016). In recent decades, Rust Belt politicians from both parties sought to protect "their constituents from economic loss (rather) than protecting them from pollution" (Schoenbrod, 2008, p. 216).

The Rust Belt's rise in financialstrength during the late nineteenth and early twentieth centuries is attributed to the coinciding rise of the steel industry (Stiglitz, 2017), and the importance of steel to the economies of Midwest states meant that the Rust Belt was also referred to as the Steel Belt (Neumann, 2016). Since coal is a necessary energy source for the production of steel, many anticipated that the Rust Belt's steel industry in particular would be one of the biggest losers from the Clean Power Plan's regulations.Wilson (2014, p. 3) pointed out that "steel production is fundamentally dependent on the large-scale use of coal". Further, the Clean Air Act has been seen as negatively affecting the ability of American steelmakers to compete globally. One American company said that "there is no way of making new steel without coal" (Fitzsimons, 2013, p. 2) and Wilson (2014) stated that"Calls to fully dismantle the coal industry must consider how we can make steel without coal, because currently no methods seem particularly feasible"(p. 4). Even union leadershave split with historical party

stances and have vehemently opposed these regulations due to their negative impact on the Rust Belt steel industry (Lopez, 2004; Goldsmith& O'Brien, 2016).

Because of the impact of environmental regulations in the Rust Belt, this study will alsoutilize large Rust Belt steel organizations as well as large Rust Belt carbon-emitting organizations to address how this recent federal environmental legislation has affected the largest steel and carbon-emitting Rust Belt organizations in terms of their productivity and pollution rates.

III. Data and Methodology

This study will examine the production and pollution rates of the largest culprits, both before and after recent environmental regulations for these four subsets: 1)California oil organizations, 2) California carbon-emitting organizations, 3) Rust Belt steel organizations, and 4) Rust Belt carbon-emitting organizations.

The number of polluting companies was extracted from the Toxic Release Inventory (TRI), a publicly-available EPA database that contains information on the release of toxic chemicals into the atmosphere and the waste management concentration activities reported annually by certain industries as well as federal facilities (EPA, 2010).

Utilizing Lopez's (2004) construct of the Rust Belt as the region spanning from Iowa to Pennsylvania, the seven states in the Rust Belt (Iowa, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and Michigan) comprise the Rust Belt for the purposes of this study. Trends in data were analyzed from 2009-2016, since 2009 is considered to be the first full yearof recovery from the recession. The number of companies emitting any chemicals in California is presented in Table 1 and the Rust Belt states is presented in Table 2.

Table 1.
Number of Production Organizations Emitting Toxic Chemicals in California, by year

2009	4,001
2010	3,933
2011	3,872
2012	3,923
2013	3,913
2014	3,901
2015	3,813
2016	3,657

Table 2.
Number of Production Organizations Emitting Toxic Chemicals in the Rust Belt, by state

	Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
2009	1651	3944	3327	2944	5496	4175	2813
2010	1684	4021	3388	3007	5495	4126	2920
2011	1676	4052	3445	2994	5523	4140	2951
2012	1657	4078	3474	3016	5453	4088	2895
2013	1671	4091	3524	3078	5382	4084	2901
2014	1742	4069	3539	3043	5319	4083	2912
2015	1719	3963	3497	2991	5231	3944	2828
2016	1699	3781	3492	2959	5130	3838	2774

In order to ascertain the types of carbon-emitting organizations polluting during the production process, any organization emitting "carbon" (using column AD, the chemical pollutant column, or the 30th column of 111 total columns) was mined. Table 3 below lists the number of carbon-polluting organizations in its facility name or parent company name operating in California and in Table 4 for Rust Belt companies

Table 3.
Number of California Organizations Emitting Carbon (Parent Company or Facility Name)

2009	32
2010	32
2011	35
2012	32
2013	29
2014	29
2015	31
2016	31

Table 4.
Number of Rust Belt Organizations Emitting Carbon, by state (Parent Company or Facility Name)

	Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
1987	0	9	6	4	10	3	1
2009	1	20	14	5	33	9	2
2010	1	19	15	6	30	10	3
2011	1	18	14	5	33	10	2
2012	1	19	13	5	36	11	2
2013	1	19	14	5	33	12	2
2014	1	19	15	5	33	10	2
2015	1	18	14	6	35	11	2
2016	1	16	12	5	34	10	2

In order to ascertain the companies constituting large oil organizations, or "Big Oil", the top 10 California-based oil companies by million metric tons of carbon dioxide equivalent (Los Angeles Department of Water and Power, 2017) were selected from the "facility name" column (column AD) as well as the "parent company name" column (column DD) since there were multiple locations listed for most of the companies.Table 5 lists the number of companies determined to be "Big Oil" for purposes of this study. No companies with the word "refinery" in their name were included in the sample set.

Table 5.
California Organizations Whose Facility Name or Parent Company Name includes "oil"

2009	406
2010	406
2011	358
2012	393
2013	394
2014	386
2015	330
2016	313

In order to ascertain the number of Rust Belt steel-producing organizations emitting chemicals into the air during the production process, any organization with "steel" in its "facility name" (Column D) or "parent company name" (Column AD, or the 30th of 111 columns) was included in the subset. Table 6 below lists the number of polluting organizations with steel in the facility name or parent company name.

Table 6.
Number of Rust Belt Organizations Producing Steel, by state (Parent Company or Facility Name)

	Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
1987	26	151	55	179	292	234	30
2009	26	112	163	113	218	182	48
2010	25	109	166	116	221	188	51
2011	28	113	170	123	233	197	52
2012	31	126	173	124	228	212	56
2013	29	123	179	126	225	215	64
2014	29	121	177	130	223	216	59
2015	28	117	177	128	216	201	59
2016	23	81	163	123	199	199	58

This study then isolated the largest polluters in the California and Rust Belt carbon-utilizing sector as well as the California oil sector and the Rust Belt steel sector in order to determine how their pollution and productivity was affected after recent environmental legislation. In order to determine which organizationsconstitute the largest polluters, this study utilized macro rates of air emissions as a benchmark. As such, Table 6 summarizes the number of Rust Beltsteel and carbon-emitting organizations emitting over 1,000 fugitive or stack emissions, and Table 7summarizes the number of California oil and carbon-emitting organizations emitting over 1,000 fugitive or stack emissions. Analysis for the Rust Belt organizations focus on trends before and after 2013, since the 2011 Clean Air Act, which was the impetus of anti-coal legislation, fully took effect in 2013. Since the California 2011 low-carbon fuel standard in a cap-and-trade styled approach was adopted in 2009 but officially took effect in 2011, analysis compared data from 2009-2010 versus 2011-2016 for California oil companies, and since similar legislation took effect in 2013 for carbon-emitting organizations, analysis compared data from 2009-2012 versus 2013-2016 for California carbon-emitting organizations. As such, the red font in the subsequent tables signify data after legislation took effect.

Table 6.
Number of Steel and Carbon-Emitting Organizations in the Rust Belt, Over 1,000 Annual Fugitive or Stack Emissions

	Steel	Carbon	Total	Change, After Regulations Vs. Before Regulations
2009	150	2187		
2010	164	2201		
2011	170	2208		
2012	191	2230	8826	
2013	175	2215		
2014	178	2220		
2015	152	2192		
2016	141	2180	8807	0.997847

Table 7.
Number of Oil and Carbon-Emitting Organizations in California, Over 1,000 Annual Fugitive or Stack Emissions

	Oil	Average # of Companies per year	Carbon	Average # of Companies per year	Total Companies	Change, After Regulations Vs. Before Regulations
2009	32		12			
2010	33	32.5	13			
2011	34		13			
2012	33		12	12.5	45	
2013	35		14			
2014	36		12			
2015	37		13			
2016	34	34.8	13	13	47.8	1.062963

Further, this study wished to analyze overall air pollution. Providing assistance in this analysis was Nathan Byers, from the Office of Pollution Prevention and Technical Assistance at the Indiana Department of Environmental Management, defined fugitive air emissions as "all releases to air that are not released through a confined air stream including equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems, from Section 5.1 on the TRI Form R" (personal communication, 2010).

In order to compare apples to apples for air emissions, Byers suggested combining columns: "This will be taking into account what is leaving the facility via air no matter what the process is. In this way, you can fairly compare facilities in one industry to facilities in another" (personal communication, 2010). He indicated that the "Total Air Emissions" column was the combination of types of air leaving a facility. As such, "Total Fugitive Air Emissions" and "Stack Air Emissions" were added for purposes to create the "Total Air Emissions" (Tanoos, 2012). Table 8 summarizes the total air emissions for the sample set of Rust Belt steel and carbon-emitting organizations (from Table 6), and Table 9summarizes the total air emissions for the sample set of California oil and carbon-emitting organizations (from Table 7).

Table 8.
Total Air Emissions for the Sample Set of Steel and Carbon-Emitting Organizations in the Rust Belt

Year	Rust Belt Steel Organization Air Emissions	Rust Belt carbon-emitting, Air Emissions	Total Annual Air Emissions (Oil and Carbon)	Average Annual Air Emissions (Steel and Carbon)	Change, After Regulations Vs. Before Regulations
2009	4,273,806	10,864,027	15,137,834		
2010	2,723,183	8,959,795	11,682,978		
2011	3,587,285	9,894,470	13,481,755		
2012	4,024,068	9,913,169	13,937,237	13,559,951	
2013	3,532,934	9,578,256	13,111,189		
2014	3,848,610	9,583,605	13,432,214		
2015	3,229,547	9,377,024	12,606,571		
2016	2,531,465	9,975,026	12,506,491	12,914,116	.0952372

Table 9.
Total Air Emissions for the Sample Set of Oil and Carbon-Emitting Organizations in California

Year	California Oil Organization Air Emissions	Annual Average Air Emissions, Oil Organizations		California carbon-emitting, Air Emissions	Annual Average Air Emissions, Carbon-Emitting Organizations	Average Annual Air Emissions (Oil and Carbon)	Change, After Regulations Vs. Before Regulations
2009	844,431		2009	41,551			
2010	893,761	869,096	2010	51,302			
2011	793,464		2011	47,507			
2012	863,429		2012	43,530	45,973	457,534	
2013	860,790		2013	60,271			
2014	1,024,867		2014	51,561			
2015	972,335		2015	95,071			
2016	938,460	908,891	2016	85,798	73,175	491,033	1.073215

Another focus of this study concerned the coinciding annual output or production rates of these organizations. Timothy Antisdel (2017), Specialist/Database Administrator for the EPA described how production rates can be determined. Antisdel (2017) noted that in addition to collecting air pollution rates, the EPA also "collects a production or activity index which indicates the change in production or activity at the facility from year to year", which are included in column DB. As such, average annual productivity rates (as they compare to their productivity from the prior year) for the sample set of organizations were extrapolated from the TRI. Tables 10 and 11 below summarize the average productivity rates of these organizations. Since there was a major outlier in 2010 for carbon-emitting Rust Belt companies, that year was designated as having a production of 1.

Table 10.
Productivity for the Sample Set of Steel and Carbon-Emitting Organizations in the Rust Belt

Year	Rust Belt Carbon, Avg. Prod'n	Avg. Prod'n, Before/After Legislation		Rust Belt Steel, Avg. Prod'n	Avg. Prod'n, Before/After Legislation	Avg. Prod'n, Carbon and Steel, Before/After Legislation	
2009	0.790537			0.790537			
2010	1			1.433333			
2011	0.957188			0.957188			
2012	0.990238	0.934491		0.990238	1.042824	0.988657	
2013	1.042084			1.042084			
2014	1.024286			1.024286			
2015	0.943886			0.943886			
2016	0.97	0.99585		0.973143	0.99585	0.99585	1.007275

Table 11.
Productivity for the Sample Set of Oil and Carbon-Emitting Organizations in California

Year	California Oil, Avg. Prod'n	Avg. Prod'n, Before/After Legislation		California Carbon, Avg. Prod'n	Avg. Prod'n, Before/After Legislation	Avg. Prod'n, Carbon and Steel, Before/After Legislation	
2009	0.961613		2009	0.923			
2010	1.033438	.997526	2010	1.009231			
2011	.994412		2011	1.003846			
2012	1.010909		2012	1.029167	0.991311	0.994418	
2013	1.022059		2013	1.017857			
2014	0.966111		2014	1.006667			
2015	1.408919		2015	1.015385			
2016	1.053529	1.07598983	2016	0.968462	1.0020928	1.039041	1.044874

IV. Results And Reactions

In terms of the sheer number of organizations, there were 8,826 carbon-emitting and steel organizations in the Rust Belt emitting more than 1,000 lbs. of stack or fugitive air emissionsbefore the legislation took effect, and 8,807 after the legislation took effect, ora decrease of .22%. There were 45 California carbon-emitting and oil organizations before the legislation took effect and 47.8after the legislation took effect, an increase of 6.3%. In average, that amounts to an increase in organizations emitting a large amount of chemicals into the air of 3.04% after legislation took effect. Further analysis might ascertain why the number of high-emitting California organizations actually increased after the legislation.

The average air annual air emissions of Rust Belt organizations both before the legislation took effect was 13,559,951lbs. and 12,914,116 lbs. after the legislation took effect, a decrease of 4.76%. The average annual air emissions of California organizations before the legislation took effect was 457,534 lbs. and 491,033 lbs. after, an increase of 7.32%. In average, that amounts to an increase in emissions of 6.04% after legislation took effect. However, one might question why Rust Belt organizations emitted more air pollution after the legislation took effect.

The average annual production of Rust Belt organizations before the legislation took effect was 0.989 and 0.996 after the legislation took effect, an increase of .73%. The average production of California organizations before the legislation took effect was 0.994 and 1.039 after the legislation took effect, an increase of 4.49%. In average, that amounts to an increase in productivity of 2.61% after legislation took effect. It may be surprising that production/output of these organizations actually increased after the legislation.

As such, it can be concluded that after legislation, average air emissions actually increased, and average productivity increased, but by a lesser amount. Further, the number of organizations emitting a large number of chemicals into the air actually increased. Organizations emitting carbon, as well as oil and steel organizations, had to make some changes to their organizational models in light of recent environmental legislation. However, the legislation did not have the intended affect on decreasing emissions, as was the goal of the legislation. Also, claims that productivity rates would suffer have also been inaccurate, as productivity has increased. Finally, the number of largest culprits, or the organizations emitting over 1,000 lbs. of stack and/or fugitive air emissions also increased.

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