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The Effect of the Clean Air Act and Subsequent Amendments on Air Pollution in Cleveland and Akron

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Honors Research Project

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Abstract

The Clean Air Act, passed in 1970, is a major piece of U.S. legislation that governs ambient air pollution through National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency. This piece of legislation became very effective after it was amended in 1990. This amendment allowed the Environmental Protection Agency greater power in enforcement of the Act as well as more responsibility in tracking air quality across the country. Locally, Akron and Cleveland did not attain NAAQS standards until shortly after the 1990 amendment was implemented. Why? Did the amendment cause Akron and Cleveland to lower emissions of hazardous chemicals, and would the cities maintain those standards after 1990? By examining EPA data and observing overall trends, it is clear that the concentration of hazardous chemicals dropped drastically after the passage of the 1990 amendment to the Clean Air Act and that a correlation exists between the two. Lead levels dropped by 96.3% in Cleveland from 1980-2010, with nickel and chromium concentrations dropping by 64.3% and 63.2% respectively over the same time frame.

Literature Review

Introduction

How did the Clean Air Act, passed in 1963, and its 1990 amendment effect ambient air pollution in Akron and Cleveland, Ohio? According to the Ohio Revised Code Section 3704, ambient air is defined as "the portion of the atmosphere outside of buildings and other enclosures" (Ohio Revised Code Section 3704, 2019). The Clean Air Act was created to manage ambient air pollution and establish standards for air pollution. These standards, called the National Ambient Air Quality Standards (NAAQS), were established when the Clean Air Act was first passed for six key air pollutants called "criteria" pollutants: ozone, particulates, lead, sulfur dioxide, nitrogen oxides, and carbon monoxide. (Henneman, 2019). These "criteria" pollutants were considered by the EPA to endanger public health (McCarthy). The Clean Air Act and its 1990 amendment are correlated to lower pollution levels in Akron and Cleveland.

General Attributes of Environmental Policy

Environmental policy is rarely fully effective at lowering pollution on its own. In order to address environmental problems in a meaningful way, several key characteristics must be met by the governing body. Administrative and political capacities are crucial in making policy work, such as funding to enforcement agencies, community approval, and continued governmental oversight (Koutalakis, 2010). Without these capacities, even if legislation makes its way to being implemented, it may not be followed by industries or businesses. An example of this is found in now-scrapped EU vehicle emissions regulation. Vehicles were tested before they were introduced to market, and the vehicles being inspected had been optimized for testing (Hooftman, 2018). The European Union did not continue to keep up with this program, so cars

were only tested once. This practice led to more “green” cars being manufactured for testing while the actual vehicles that were sold produced more pollutants. Since there was not continued government oversight in this program, it has since been abandoned (Hooftman, 2018). The United States tests models at random before they are mass produced, which does not allow for optimization before inspection, and continues to test vehicles after they are presented to the public, which is why this model was later adopted by the EU (Hooftman, 2018). Environmental protection and air quality are endeavors that require an international effort, since pollution doesn’t limit itself to just the country polluting its air.

In order to regulate efficiently, an environmental policy must reflect three key components: allocating resources, gathering and processing information, and implementation (Potoski, 2002). For a policy to be created and implemented in the first place requires some kind of domestic benefit for the party in question, otherwise there is no incentive for that party to implement policy on a divisive issue like pollution. Without some kind of tangible gain, whether it be economic or environmental in nature, it is unlikely a country will implement more stringent environmental policies as it would be unlikely to help with re-election (Dolsak, 2009). Without a reasonable expectation of some relative gains, there is no incentive to allocate resources to a program. For this reason, countries with higher local air pollution are associated with higher levels of global climate change regulation implementation (Dolsak, 2009). That is why countries like China, countries with a large amount of polluting industries, have begun to embrace air quality regulation.

In general, China’s air quality regulations have led to lower levels of carbon monoxide in the air (Li, 2017). By lowering the amount of this dangerous compound in the air, China has become healthier. Much of the credit for the decrease of air pollution in the country can be

attributed to institutional development in the country. Since 2000, pro-environment views have increased in China, with environmental officials generally being younger, more motivated, and more educated (Lo, 2016). This has allowed policy to not only be implemented, but also reliably enforced, furthering the decrease in air pollution referenced above. However, there is still far to go in China to completely fix the problem. Less populated areas have seen solid general improvement this century, but urban areas experience extremely heavy pollution on days with special events, highlighting the need for emergency protocols (Li, 2017). Creation and enforcement of these protocols would, in theory, allow for large events in urban centers, such as parades, to take place without massive spikes in air pollution.

Many different policies can be effective based on how they are implemented and enforced. However, it is clear that the most important aspect of environmental regulation is the people that enforce them (Lo, 2016). In the United States and the EU, strong bureaucracies exist that allow for frequent progress checks and punishment for non-compliance. In China, massive gains were made in pollution reduction as officials became more informed and interdepartmental coordination increased (Li, 2017; Lo, 2016). Just as interdepartmental coordination in China increased, the EU adopted United States policies regarding vehicle testing (Hooftman, 2018). Capable people implementing and enforcing regulation and sharing information leads to a more informed public and, in the end, more effective policy.

The United States is in a unique position with regards to environmental policy. With both the federal government and individual states passing environmental legislation, many different approaches are taken with the same goal of air quality improvement. Some of these approaches are voluntary, such as the 33/50 program instituted by the Environmental Protection Agency (EPA), while others are mandatory, like the Clean Air Interstate Rule (CAIR) and the National

Ambient Air Quality Standards (NAAQS) established in the Clean Air Act (Carr, 2012, Glasgow, 2017). Though some states have their own policies on top of the Clean Air Act, Ohio's policy is to maintain the NAAQS in the Clean Air Act, and Ohio Revised Code Section 3704 gives the Director of the Ohio Environmental Protection Agency the power to adopt and modify rules regarding air quality standards as long as they are not more stringent than the NAAQS put in place by the federal EPA (Ohio Revised Code, 2019).

The Clean Air Act and its 1990 Amendment

Mandatory programs created by the EPA, such as NAAQS created after the Clean Air Act was passed in 1963, have also been successful. Study of these policies shows how regulation impacts more localized regions of the United States, from regions of the country to individual counties. Study of CAIR, which used the NAAQS standards implemented in the Clean Air Act, shows that facilities covered by the program reduced pollution by 57% during the life of the rule (Glasgow, 2017). Non-attainment of NAAQS standards reduced pollution if new regulations affected industry (Carr, 2012). That was the exact purpose of CAIR. Though facilities did not have a strong enough incentive to reduce pollution and new regulation may need to take into account the speed of reduction, the combination of the Clean Air Act and CAIR caused both decreases in pollution and diversification of industry to lessen pollution on a local level (Carr, 2012, Glasgow, 2017).

After the Clean Air Act was first passed in 1963 and NAAQS were established, there was little change in emissions activity. Reduced emissions over the last two decades are largely attributed to the 1990 amendments to the Clean Air Act (Henneman, 2019). These amendments added enforcement techniques that actually prompted states to attain and maintain NAAQS

standards laid out by the EPA. If states did not achieve NAAQS standards, they would risk losing federal highway funding (McCarthy, 2018). Instead of risking millions in federal funding, states like Ohio moved to comply with the federal emissions standard. States are required to develop and submit plans to attain and maintain NAAQS, and these plans are subsequently reviewed and, if sufficient, approved by the EPA (U.S. Government Accountability Office, 2005). The EPA also supplies guidance documents to states to aid them in the creation of state policies for attainment of NAAQS. These standards are also assessed by the EPA every five years to ensure that revisions are not necessary (U.S. Government Accountability Office, 2005).

The major provisions of the 1990 amendment to the Clean Air Act are contained in the first six titles of the bill, with the most important of those titles being titles I and III. Title I established a program to attain and keep NAAQS around the country. Non-attainment areas were identified and the states that contain those areas were notified that they must create a state implementation plan (SIP) to rectify the emissions problem (U.S. Government Accountability Office, 2005). Title III expanded the number of chemicals regulated by the EPA. Instead of focusing on the six "criteria" pollutants, the EPA now has to track 189 hazardous pollutants to be regulated (U.S. Government Accountability Office, 2005). This greatly expands the scope of the EPA and allows it to more closely regulate hazardous emissions.

The 1990 amendments greatly reduced air pollution. In 2002, the average national air quality was at its best from the 20 years prior for all six criteria pollutants despite energy consumption increasing by 45% and the U.S. population increasing by 36% (U.S. Congress, 2002). The rises in energy consumption and population are significant because they show that more resources were used by the population, but less hazardous chemicals ended up in the air. Consequently, many non-attainment areas attained the standards set forth in the Clean Air Act.

Following the 1990 amendments, more than two-thirds of non-attainment areas were able to attain NAAQS standards by 2002 (U.S. Congress, 2002). These states were able to develop SIPs with guidance from the EPA and successfully carry out these plans. Airborne lead levels also dropped by 98% since the implementation of the Clean Air Act in 1970 (U.S. Congress, 2002).

The Clean Air Act and its 1990 amendments made a positive impact on ambient air pollution. Though national averages of pollutants were very low, some were still unhappy. Rep. John Shimkus (IL) argued that 5,000 mining jobs had been lost since the 1990 amendments, accompanied by a downturn in the mining industry as a whole (U.S. Congress, 2002). However, this does not appear to be representative of the economy as a whole. The gross domestic product of the United States doubled from 1982-2002 (U.S. Congress, 2002). The economic cost was overstated, and massive progress was made with regards to ambient air pollution in the United States.

Akron's Rubber Industry

The city of Akron, for much of the 20th century, was widely regarded as the rubber capitol of the world. However, late in the 20th century, this began to change. Firestone, a company that accounted for a large chunk of rubber production in Akron, was purchased by a Japanese company by the name of Bridgestone in 1989 (Associated Press). This merger caused the company to move its headquarters out of Akron, to Nashville, Tennessee (Associated Press).

Hypotheses/Variables

1.) Lead air pollution in Akron and Cleveland will decrease after the 1990 amendment to the federal Clean Air Act.

After the Clean Air Act was initially passed, the USEPA established the NAAQS to show what concentrations of certain air pollutants would be deemed to comply with the federal standard. By 1990, many states had not attained federal compliance with regards to many criteria pollutants, such as lead. The initial legislation had very little to incentivize compliance with federal air quality standards. The 1990 Amendment to the Clean Air Act allowed the federal government to withhold highway funding from noncompliant states. This should lead to a decrease in lead air pollution after the 1990 amendment.

2.) Nickel air pollution in Akron and Cleveland will decrease after the 1990 amendment to the federal Clean Air Act.

Many states were not in compliance with the Clean Air Act two decades after its implementation. Though less important, non-criteria pollutant levels are an indicator of the depth of a state's environmental program. Since these pollutants, such as nickel, receive less attention from legislators, a decrease in their ambient air concentrations shows a commitment to decreasing pollution. After the 1990 amendment to the Clean Air Act and the stringent policies with regards to federal highway funding, states more than likely cracked down on polluting industries in order to keep highway funding. This crackdown would include nickel, as it is covered under the Clean Air Act and high levels could cause a loss of highway funding.

3.) Chromium air pollution in Akron and Cleveland will decrease after the 1990 amendment to the federal Clean Air Act.

Similar to nickel, chromium is not a “criteria” pollutant. However, data was reliably collected for both chromium and nickel and serves to show whether Cleveland and Akron achieved full compliance to the Clean Air Act. If chromium and nickel concentrations are federally compliant, then they likely serve as indicators for full compliance.

4.) Air pollution in Akron will decrease after Firestone is purchased and begins its move to Nashville in 1989.

By removing one of the largest industrial powers in Akron from the city, air pollution should go down. Firestone was one of the largest rubber companies in the United States and was headquartered in Akron, Ohio. By removing this large manufacturing plant from the region, air quality should improve.

Research Design

The Cleveland area has a complex mix of industrial sources (Pasch, 2011). Therefore, many different pollutants are present and fluctuate with industrial production. Carbon monoxide emissions in Cleveland, for example, fluctuate greatly with the season; over double the carbon monoxide is produced during the winter than during the summer (Pasch, 2011). Therefore, carbon monoxide is an unreliable measure of the effectiveness of the Clean Air Act. Some chemicals vary less than others, and lead emissions tend to vary little over the course of the year in Cleveland (Pasch, 2011). This makes lead reliable to study over the course of multiple years, as seasonal differences have less of an effect on emissions levels.

Air pollution data from 1980-2010 is available on the USEPA website. Using this data, overall trends can be observed. Using a chosen set of EPA monitor locations in Akron and Cleveland, local air pollution data can be obtained. Through the examination data trends before and after the 1990 amendment to the Clean Air Act, it can be determined whether a correlation exists between the amendment and lower air pollution levels in Akron and Cleveland. If pollution levels drop after 1990, a positive correlation exists between air pollution and the 1990 amendment to the Clean Air Act. If pollution levels rise, then a negative correlation exists between the amendment and air pollution. If no discernable pattern emerges, then no correlation between the two exists.

Individual Research

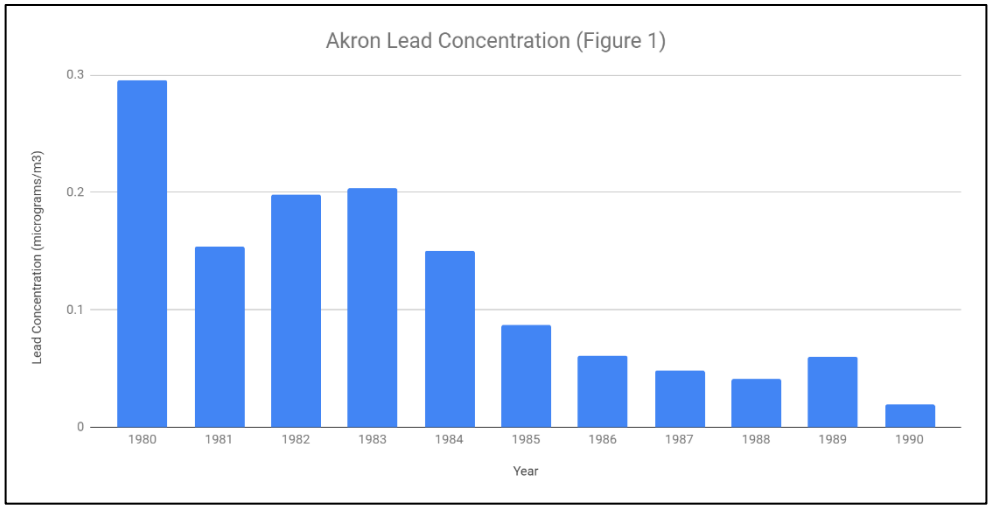
Historically, as an industrial center, the city of Cleveland has had pollution problems. There are well-documented cases, such as the Cuyahoga River catching on fire, of this pollution causing problems for the local population. However, through strict governmental regulation, this pollution was curtailed. Through the Clean Air Act of 1970, Congress allowed the EPA to establish the National Ambient Air Quality Standards (NAAQS) and divided the country into air quality regions with goals for ambient air quality in terms of the concentration of key pollutants (Carnegie Mellon University, 2003). After many regions did not meet these standards initially, the Clean Air Act was amended in 1977 and again in 1990. The 1990 amendment required tech standards for major pollution sources (Carnegie Mellon University, 2003). Major sources, defined by the EPA as having the potential to emit 10 tons per year of hazardous air pollutants such as lead, chromium, and nickel, required the EPA to establish emissions standards that require the maximum degree of reduction of hazardous air pollutants.

By studying the amount of criteria air pollutants, or the six most common air pollutants, the improvement over time can be distinguished. Both Akron and Cleveland were chosen because of their statuses as large industrial centers of Northeast Ohio. When the Clean Air Act was revised in 1990, the United States Environmental Protection Agency (USEPA) focused its attention Cleveland, making pollution data for that city the more reliable of the two. The only chemical consistently representing complete data over the data set (1980-2010) was lead. The USEPA defines complete data as meeting 75% completeness based on the monitor's operating schedule and frequency (United States Environmental Protection Agency, 2019). Chromium and nickel, the other two most complete data sets over the time frame, almost always had complete

data as well, but are not considered “criteria” pollutants, so data was not collected expansively until after the 1990 amendment to the Clean Air Act.

The monitoring station in Akron was located at 1010 Gorge Boulevard, this is where all data pertaining to lead was collected from 1980-1990. The NAAQS requirement for lead is below 0.15 micrograms of lead per cubic meter of ambient air, on average, over a three-month period. In Akron during 1980, the average lead concentration was .29592 micrograms per cubic meter of ambient air. Even ten years after the initial passage of the Clean Air Act (CAA), lead levels were nearly double the maximum federal standard. Though data is only available from 1980 to the present, it is clear that the 1977 amendment to the CAA was more effective than the initial bill. In just five years, Akron moved from nearly double the federal standard to only 0.08728 micrograms per cubic meter, representing a 70.5% decrease in lead pollution in only half of a decade. This trend only continued, as lead levels continued to decline until the site was abandoned after the 1990 amendment. In 1990, the lead concentration was 0.01957, a decrease of 93.4% over just ten years, as shown in figure 1 below.

Akron lead data collected by the USEPA from 1980-1990.

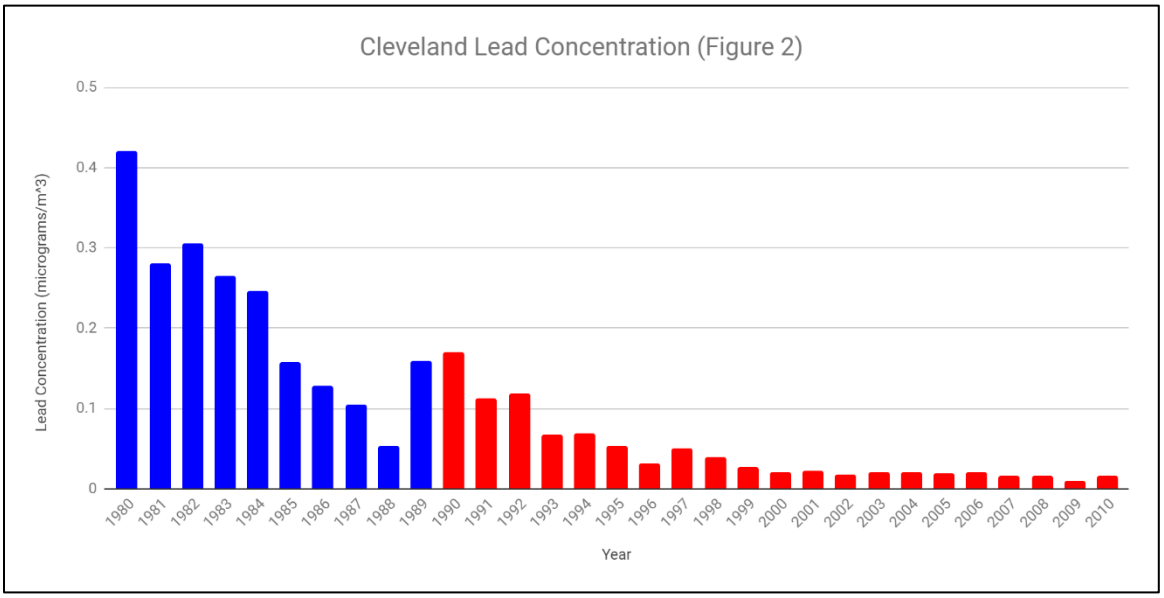


The city of Cleveland, being a much larger industrial center, did not lose its testing site. The USEPA has complete data on nearly every chemical they tested from 1980-2010, and

possesses complete data on lead, chromium, and nickel concentrations over the time frame. Initially, the main testing site for these chemicals was the Cleveland Health Museum. However, in 1989, the USEPA began testing five miles down the road at 4950 Broadway Avenue in Cleveland. Later, in the year 2000, testing moved again to 2547 Saint Tikhon Avenue, only two miles from the Broadway Avenue location. Though a large difference is noted between the Cleveland Health Museum site and the Broadway Avenue test site, there is no way to determine whether the change in testing location accounts for the 296.3% spike in lead concentration, though it appears likely to be a factor. The lead concentration moved from only 0.05371 micrograms per cubic centimeter in 1988 to 0.15916 micrograms per centimeter in 1989, and out of federal compliance, with the new testing site. The move from Broadway Avenue to Saint Tikhon Avenue does not show any significant abnormalities between data sets, as the lead concentration changed by only .01 micrograms per cubic centimeter with the move.

Cleveland's lead concentration, on average, was 0.42111 micrograms per cubic meter in 1980. This clearly shows that Cleveland was a much larger polluting threat than the city of Akron, as it produced 29.7% more pollution than its counterpart to the southeast. The city reached an average lead concentration of 0.12802 micrograms per cubic meter in 1986 and a 1980s low of .05371 micrograms per cubic meter in 1987, representing a decrease of 87.2% over those seven years. With the move to the Broadway site, however, this number shot back up to over the federal standard of .15 micrograms per cubic meter and would be addressed in the 1990 amendment to the CAA.

The 1990 amendment to the Clean Air Act of 1970 had a swift impact on lead pollution in Cleveland. In the first year of action, lead concentrations dropped from 0.17016 micrograms per cubic meter in 1990 to 0.11291 micrograms per cubic meter in 1991, making them federally compliant in just one year. Over the next two decades, the lead concentration would steadily decline. By the conclusion of the study, in 2010, the average lead concentration at 2547 Saint Tikhon Avenue was only 0.0157 micrograms per cubic meter, well below federal limits. From 1980 to 2010, the entire range of the study, lead concentrations in Cleveland dropped 96.3%, making the CAA appear to be a huge success in Cleveland, as shown in figure 2 below.



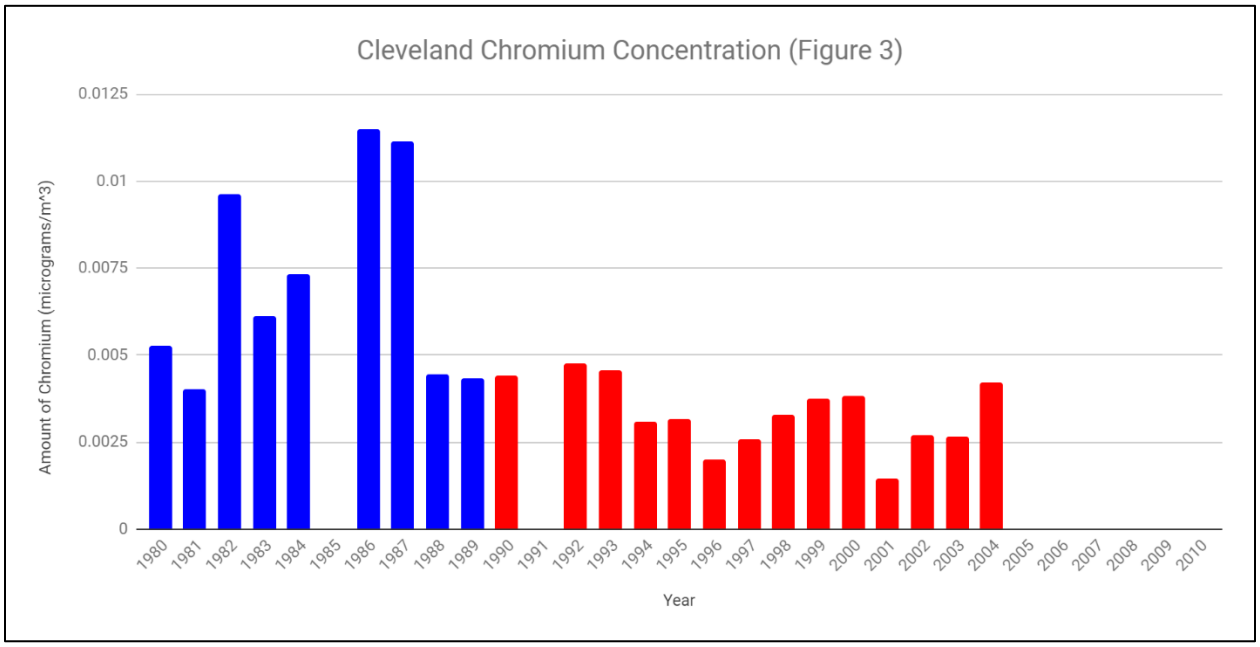
Blue indicates data collected by the USEPA before the 1990 amendment to the Clean Air Act, red indicates data collected by the USEPA after the 1990 amendment to the Clean Air Act.

It appears as though the 1990 amendment to the Clean Air Act made a substantial impact on the ambient air concentration of lead in Cleveland. By reinforcing the CAA with more strict penalties for non-compliance with federal standards, such as the suspension of federal highway funds, it appears that Cleveland has seen sufficient reason to cut down pollution (McCarthy, 2018).

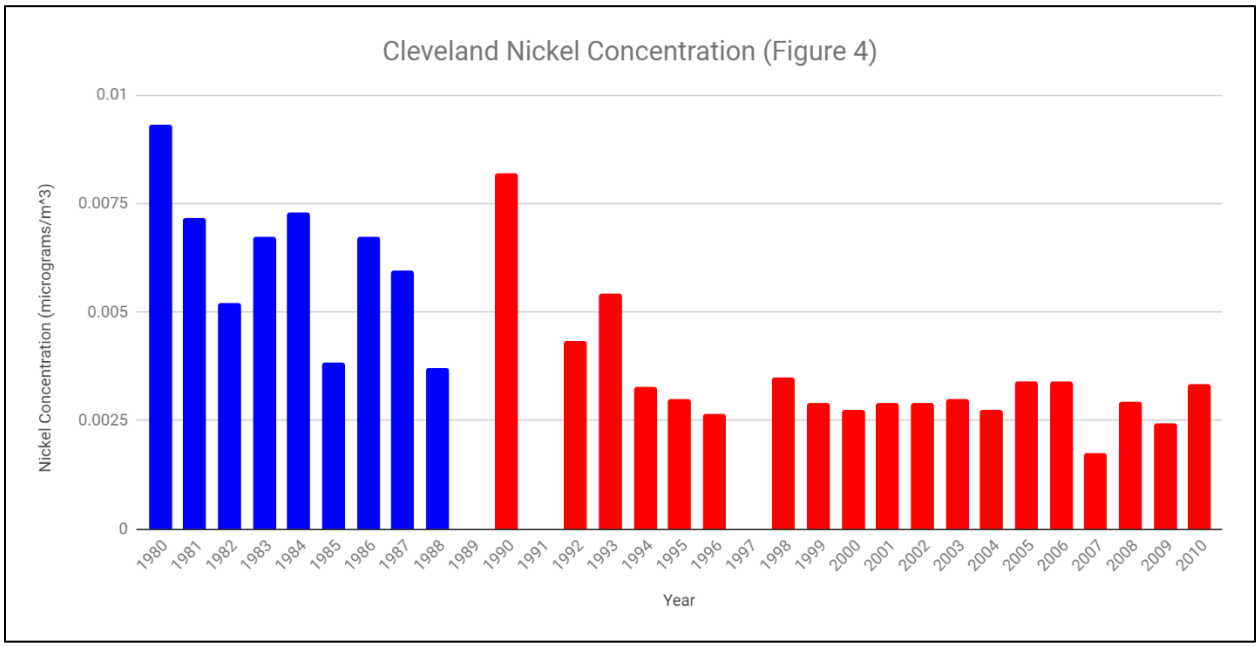
The Clean Air Act appears to have been light on enforcement initially. In 1980, the first year data was available, neither city in this study was federally compliant despite a decade having passed from the Act's implementation. However, both cities moved closer to noncompliance in 1989, as both Akron added 33% to its 1988 total while Cleveland added over 300% to its 1988 total and became noncompliant, though other factors were also important in that development, as previously stated. After the 1990 amendment, these relative spikes in lead pollution were clearly addressed. Though Akron's data ended in 1990, Cleveland's data shows an immediate reduction in lead pollution that continued at a steady pace until the end of the study in 2010. By 2000, the average lead concentration in Cleveland was just 0.02 micrograms per cubic meter, as shown in figure two above. In just a decade after the 1990 amendment, Cleveland was once again well within federal guidelines and would stay there through the end of the study.

The Clean Air Act clearly had a positive impact on the environment and air quality in larger cities. The amount of lead in the air in Cleveland dropped by over 96% over the three decades of the study, and the amount of lead in the air in Akron dropped by over 93%, shown above in figure 1. In addition to lead, chromium and nickel air concentrations also drastically decreased over the time period in both Akron and Cleveland. Though less important to human health than lead, both of these chemicals are generally bad for the environment and humans who may breathe them in daily. Chromium dropped from an average of 0.0115 micrograms per cubic meter in Cleveland in 1986 to an average of 0.00423 micrograms per cubic meter in 2004, which was the last year that chromium data was available in that city. This represents a drop of 63.2%, yet another win for the Clean Air Act, though on a less prominent chemical. Nickel was similarly impacted, dropping from .00933 micrograms per cubic meter on average in Cleveland in 1980 to just .00333 micrograms per cubic meter on average in 2010, a full 64.3% difference over the

thirty-year time period. Chromium and nickel data collected by the USEPA in Cleveland is shown below in figures 3 and 4, respectively.



Chromium data collected by the USEPA in Cleveland from 1980-2010. Blue indicates data collected before the 1980 amendment to the Clean Air Act, red indicates data collected after the amendment.



Nickel data collected by the USEPA in Cleveland from 1980-2010. Blue indicates data collected before the 1980 amendment to the Clean Air Act, red indicates data collected after the amendment.

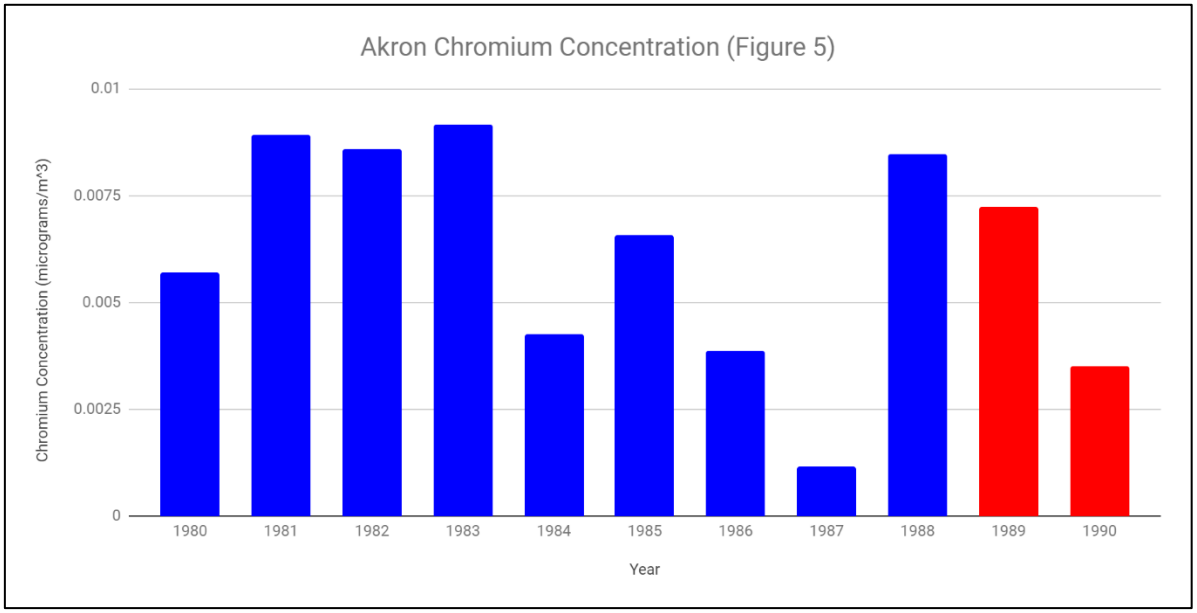
These chemicals, nickel and chromium, are governed under a different but similar standard than lead: The National Emissions Standards for Hazardous Air Pollutants (NESHAP). The standard for chromium is slightly different than the federal standard, as the Occupational Safety and Health Administration (OSHA) has placed a more stringent limit on the amount of chromium allowed. The OSHA limit is five micrograms per cubic meter of air, while the amendment to the Clean Air Act in 1990 made the federal limit 10 micrograms per cubic meter.

Cleveland is clearly federally compliant in this area and also falls well within state standards as well. Nickel, like chromium, is most stringently regulated by OSHA. That limit is 1.0 micrograms per cubic meter. Ambient air rarely, if ever, reaches this relatively high concentration. The risk of nickel is much more prevalent within the walls of factories where nickel dust can build up over time an cause health problems. Nickel is not produced on a scale that could harm someone outside in most areas. However, trace amounts of this chemical show the general decrease in its production. Nickel concentrations outside factory walls still serve as an indicator of how much is being produced, and less nickel overall means less nickel within a factory. With this in mind, it appears that the nickel concentration represents another victory for the Clean Air Act.

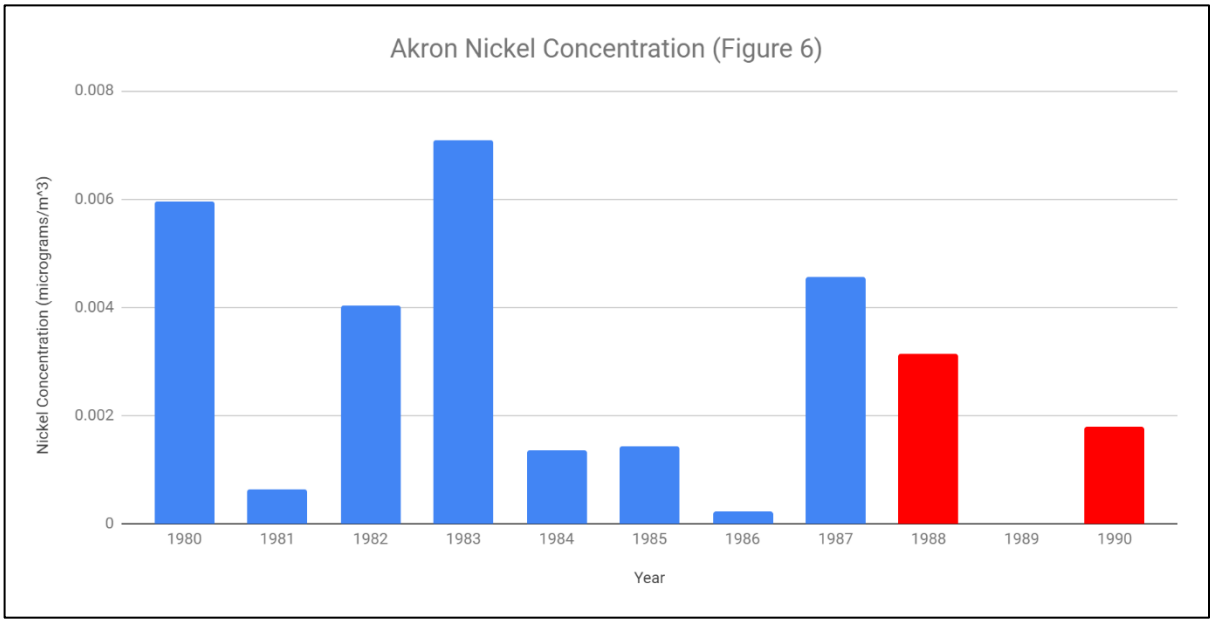
Firestone's Relocation

There is a clear correlation between the relocation of Firestone after its merger with Bridgestone and a decrease in air pollutants. As seen in figure one above, Akron's lead concentration in ambient air decreases by over 60% from 1989-1990, directly after the merger and when Firestone was in the process of closing their headquarters in the city. This closure appears to have had an impact on chromium and nickel as well. Chromium concentrations in

Akron drop by over 50% from 1989-1990 and nickel concentrations drop by over 40% from 1988-1990, as shown in figures 5 and 6, respectively.



Chromium ambient air concentrations for the City of Akron from 1980-1990. Red indicated values taken after Firestone merged with Bridgestone.



Nickel ambient air concentrations for the City of Akron from 1980-1990. Red indicates values taken both a year prior and the year after Firestone merged with Bridgestone.

Clearly there is a correlation between the Firestone-Bridgestone merger, their subsequent move to Nashville, and lower air pollutant concentrations in Akron. Despite spikes in pollution in 1987 for chromium and nickel, concentrations for both chemicals dropped significantly from 1988-1990.

Conclusion

In totality, it appears as though the Clean Air Act and its 1990 amendment has created positive changes with regards to air pollution in Cleveland and Akron representative of the findings of the House Committee on Energy and Commerce (U.S. Congress, 2002). The average decrease of hazardous chemical emissions was 79.3%. Lead, the most dangerous emission chemical in the study, and the only "criteria" pollutant studied, dropped by over 96% from 1980 to 2010. The two "non-criteria" pollutants, nickel and chromium also greatly decreased in concentration from 1980-2010. It also appears that the Clean Air Act will continue to have an impact in the future. In the final decade of the study, 2000-2010, lead levels continued to decrease. Though these decreases were very small, there was also very little room for further reduction. The Clean Air Act appears to have been very successful in its role of limiting air pollution, especially after the 1990 amendment.

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