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The Effect of Environmental Pollution on Life Expectancy in the U.S

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Abstract

This paper studies the effect of environmental pollution on life expectancy across US counties. Controlling for the effect of socioeconomic factors such as income and smoking habits. I find that air pollution shortens life expectancy by approximately one year for every extra ten micro grams of fine particulate matters (PM2.5) per cubic meter of air, and chemical disposal shortens life expectancy by about 1 month for each standard deviation increase in pounds of chemicals disposed. The effects are stronger on males compared to females.

Keywords: Environmental pollution • Smoking habits • Chemical disposal

Introduction

The United States has long been marked by stark differences in the socioeconomic sta- tus of its citizens. Several prior studies have established robust relation between factors such as household income, race, and access to health insurance to life expectancy across the country. In addition, these studies have also related lifestyle choices such as smoking rates and exercise habits to average life expectancy. While earning a steady income and purchasing health insurance are critical to one's life expectancy, environmental factors may also affect lifespans throughout the country. A parallel stream of papers have shown the impact of environmental factors such as air pollution on life expectancy. Most prior studies have only looked at the effect of one of these sets of variables at a time, socioeconomic or environmental. However, it is not clear whether the effect of environmental variables on life expectancy is simply an artifact of socioeconomic conditions of these areas, or whether these effects persist even after accounting for these factors. In this paper, I analyze the effect of environmental pollution, both air pollution and chemical disposal in an area, on life expectancy, after separating the effects of socioeconomic factors [1].

I use county-level data from socioeconomic factors such as household income, percentage of population with health insurance, and racial composition, and merge it with environmental data obtained from the Center for Disease Control (CDC) and the Environmental Protection Agency (EPA) to conduct a comprehensive analysis of the effects of these factors of average life expectancy across different counties in the country. Con- firming the earlier analysis, I find large and significant evidence that counties with lower income, higher smoking rate, higher obesity rate, lack of access to health insurance and large black population have lower life expectancy. In addition counties with significantly higher fraction of families with single mothers have lower life expectancy as well. In the main part of the paper, I find that controlling for these factors, counties with higher air pollution have lower life expectancy [2]. For every 10 micro gram per cubic meter increase in fine Particulate Matters (PM2.5) average life expectancy comes down by 1 year. The effect is stronger for males, compared to females: almost three times larger reduction for males compared to females. Similarly, counties with higher chemical disposals at different sites within the county have significantly lower life expectancy. Every one standard deviation increase in chemical disposal is associated with about a decrease of 1 month in life expectancy, after controlling for the effects of other socioeconomic factors and air pollution. The effect of chemical disposal is approximately similar for males and females. Section 1 provides a brief literature review on the topic. Section 2 describes the sample and sources of data used in the study. Results are provided in Section 3 and Section 4 concludes [3].

Literature Review

My research work is related to two lines of literature: one relating socioeconomic factors to life expectancy, and the other relating air pollution to life expectancy. There is a vast literature studying both these issues. I briefly survey some of these articles in the paper to put my analysis in the proper context. Examine how air pollution affects cardiovascular health in Europe. The researchers show that air pollution yields an approximately 2.2 year decrease in lifespan. It

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is also responsible for about 133 out of every 100,000 deaths in the continent. They concluded that a switch from fossil fuels to more renewable energy sources would reduce air pollution mortality rates. The study also found a relationship between PM2.5 concentration and cardiovascular diseases. An increase in fine particulate matter can cause an increase in blood pressure and exacerbate non-communicable diseases such as cancer or diabetes. Overall, the paper takes an in depth looks at how environmental factors affect specific diseases in Europe [4].

In an influential work, study the association between income and life expectancy in the U.S. The research showed a 14.6 year gap in life expectancy between the richest 1% and poorest 1% of men in the country, and a 10.1 year gap between the richest 1% and poorest 1% of women in the country. The study also found that the gap in life expectancy between the rich and poor has increased over time. Overall, the researchers found that those with higher incomes tended to live longer. The study did not involve any environmental factors. Their study focused on 51 cities in the U.S for which PM2.5 fine particulate matter data was available. The researchers found that a 1 micro gram per cubic meter of air increase in PM2.5 is expected to decrease life expectancy by 0.061 years. They also found that air pollution reduction since 1980 accounted for 15% of the life expectancy increase in the U.S. The researchers also used socioeconomic factors, such as per capita income, high school graduates, black and hispanic population, and ur- ban residence. My study differs from this paper on several dimensions. First, I focus on variation across more than 1400 counties across the country, instead of focusing on 51 cities used in the paper. Second, I combine the effect of both air pollution and an important extra environmental factor: Chemical disposal.

In 1997, the researchers examined 6 cities and found a difference of 2 years in life expectancy between the city with the highest fine particulate matter concentration and lowest fine particulate matter concentration. This study only focused on the association between PM2.5 and health. I incorporate socioeconomic factors in my study, along with environmental factors such as PM2.5 concentration and chemical disposal data. The researchers found that a 1 micro gram per cubic meter of air increase in PM2.5 leads to a decrease in life expectancy by about 0.6 years. Once again, this study only focused on PM2.5 and its effect on life expectancy.

Data

The data used in this study has been collected from three sources. The Centers for Disease Control (CDC), and the US Environmental Protection Agency (EPA). Most factors are socioeconomic, as described later in the paper. In addition, I consider two important environmental factors, one capturing the extent of air pollution and the other the extent of chemical disposal in an area. All my analyses are at the county level, covering over 1400 counties of the U.S. for which I was able to collect the data. Note that my sample does not contain counties for which data is not available. Fine Particulate Matter (PM2.5) measures the concentration of air pollutants with aero- dynamic diameters of 2.5 micrometers or less. Data for fine particulate matter has been taken from the CDC. Particulate matter is a mixture of solid particles and liquid droplets in the air. Long-term exposure to PM2.5 can yield harmful effects on cardiovascular health. Lung and heart conditions can be worsened from exposure to large concentrations of par- ticulate matter, and it is most likely to impact children and the elderly. Cars, buses, and other modes of transportation, as well as industrial emissions, release PM into the atmo- sphere. Another way in which particulate matter can be formed is from chemical reactions of sulfur dioxide and nitrogen oxides. The reason PM is so dangerous is that its particles are often very small and fine, and stay in the air longer than most other particles. Data taken from the EPA's Geography US County Report gives information regarding onsite and offsite disposals of toxic chemicals into the environment for each county. These are chemicals that may damage human health or the environment. The data captured waste dumps from manufacturing, electric power generation, chemical manufacturing, metal mining, and hazardous waste treatment facilities. Table 6 provides the details on variable construction and data sources [5].

Results

I use a linear regression model to study the effect of each of the environmental and socioe- conomic factors on life expectancy outcomes across different counties in the U.S. All my analyses are conducted at the county level. Three dependent variables are used: the average age of all the residents in a county, and the average age of males and females separately. I separately analyze the impact of these factors on males and females because prior studies have documented disparate life expectancy outcomes for men and women in the country.

Descriptive statistics

Table 1 provides the descriptive statistics of all the key variables used in the study. Aver- age life expectancy across every county in the sample ranges from 78.2 years to 87.1 years, with a mean of 82.5 years. Figure 1 plots the distribution of average life expectancy across the country. As expected, there is a lot of variability in key factors across the country. For example, the highest-earning county in the U.S has an average household income of $71,795, compared to $18,101 for the poorest county. Similarly, there are drastic differences in lifestyle choices. For example, the smoking rate ranges from 0% to 42.5%, and the exercise rate ranges from 46.8% to 92.0%. The mean percentage of obese people for every county is 27.3% with a standard deviation of 6.4%. On average, 83% of people in every county are insured, with a standard deviation of 5.11%. The mean percentage of kids with single moms is 20.5% with a standard deviation of 5.7%. On average, counties have a black population of 9% with a standard deviation of 12.6%.

Statistic	N	Mean	St. Dev.	Min	Max
Income (in $ thousands)	1,427	35.129	7.452	18.101	71.795
Smoking Rate (%)	1,425	0.206	0.05	0	0.425
Exercise Rate (%)	1,425	0.74	0.068	0.468	0.92
Obesity Rate (%)	1,425	0.273	0.064	0.112	0.587

Health Insurance Rate (%)	1,427	82.968	5.111	61.906	96.375
Families w/ Single Mothers (%)	1,427	0.205	0.057	0.074	0.504
Black Population (%)	1,427	9.039	12.566	0.038	69.455
Fine Particulate Matter Concentration	1,427	12.226	1.677	8.07	14.86
Chemical Disposal (log(lbs + 1)	1,427	11.663	3.311	0	18.82

Table 1. Summary statistics for each variable used in the regressions.

The mean amount of fine particulate matter across every county is 12.2 micro grams per cubic meter of air, and the standard deviation is 8.07 micro grams per cubic meter of air. This provides rich variation in the extent of air pollution across counties in the U.S. Similarly, there is wide variation in chemical disposal. On average, 11,663 lbs of chemicals are disposed of in a county in the U.S, and the standard deviation is 3,311 lbs. Figure 1 provide the distribution of the pollution variables across the country.

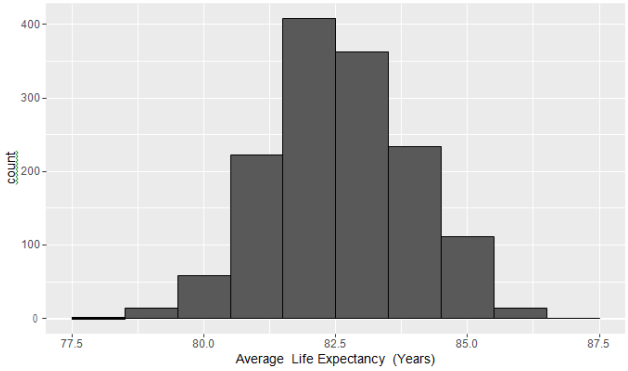

Figure 1. Life expectancy distribution for counties across the U.S.

Regression results

I begin my analysis by analyzing the relation between some of the most basic socioeconomic factors and life expectancy. For this model, I consider the following factors: household income, smoking habits, exercise habits, obesity rates, and availability of health insurance. The estimates show that longevity increases by 4 more months for every $10,000 increase in household income. Male smokers, on average, lose 8 years and female smokers lose 6 years. Males typically live 8 years longer if they exercise regularly, and females typically live about 4.5 years longer. Obese males live for 4 less years, and obese females live for 2 less years. The next analysis adds some additional socioeconomic variables such as the fraction of families with single mothers, and the fraction of African Americans for each county in the sample. Interestingly, the fraction of kids with single mothers makes a big impact on the estimates. Counties with a large fraction of families raised by single mothers tend to have a lower average life expectancy by about 3 years. For every 10%increase in African American population, average life expectancy declined by 2 months. The model has an adjusted R2 value of 0.681, indicating that these do a reasonable job in explaining variation in life expectancy.

Conclusion

This paper shows the effect of environmental factors on life expectancy after controlling for socioeconomic variables. Both air pollution and chemical disposal affect life expectancy more significantly than factors such as income or access to health insurance. These findings show that policy makers can improve life expectancy by limiting levels of air and chemical pollution in their counties.

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