Spring 5-1-2019

# Understanding Maternal Mortality in the United States

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**A Thesis Project Submitted in Partial Fulfillment of the Requirements of the Renee Crown University Honors Program at Syracuse University**

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May 2019

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Date: 4/24/2019

# Abstract

**Background and Purpose:** The maternal mortality rate in the United States is uncharacteristically high for a developed nation. Despite a concerted effort to participate in decreasing maternal mortality rates internationally as part of the United Nation's Millennium Development Goals, the United States has failed many of its mothers when it comes to positive maternal health outcomes. The quality of health care in the United States is comparable to other developed nations, suggesting that the unusually high maternal mortality rate is not due to physician error and lack of proper physician techniques and rather due to social variables. There are many broad analyses of social causes of mortality but few investigations into associations between maternal mortality and general social variables.

**Methods:** Cross-sectional data of ten states in 2016 was collected to be analyzed in this investigation. The states were indexed by geography, total population, per capita state health care expenditure, and political affiliation of the Electoral College in 2016. Data was collected from various databases including the Census Bureau. States were given numerical identification and analyzed in STATA using an ML-Random Effects model with the panel variable "State ID".

**Results:** The social variables Male/Female Ratio, Education Level (Less than High School and High School Graduate or Equivalent), and Percent Uninsured were all statistically significant in the ML-Random Effects model used to represent the data. Specifically, women able to gain some high school education and higher percentages of women covered by health insurance caused the maternal mortality rate to decrease in this model. The variables for Median Income and Average Age of Mother were not reported as significant based on this model.

**Conclusions:** Access to education and health insurance are two social variables that are associated with maternal mortality. These variables can be manipulated through economic policy to increase access to education and access to health insurance, which in turn will lead to more positive health outcomes for women giving birth in the United States. There is a need currently to reevaluate funding for public education and commit to invest in public education as a social tool to combat maternal mortality. Further, the health insurance system in the United States needs to be examined through cost-benefit analysis to better understand shortcomings in the system and focus energy, time, and money on these areas to specifically facilitate women entering health care facilities for prenatal through postnatal care.

*Keywords:* Maternal Mortality, Health Insurance Coverage, Education Level, Economic Policy

# Executive Summary

Econometrics approaches social problems from a statistical and data-based perspective and attempts to provide solutions to these problems through analysis and interpretation of results. The maternal mortality rate in the United States is significantly higher than in other, comparable, developed nations despite the United States being a leader in health care and physician quality. There is a disconnect between the care physicians are providing and the health outcomes women are experiencing while giving birth and in the weeks following. This disconnect cannot be fully explained by medicine alone and requires an investigation into the social variables and determinants of health that play a role in the negative health outcomes mothers are experiencing. By analyzing the maternal mortality rates and social variables of ten states, associations between these variables and levels of maternal mortality can be deduced.

Through STATA analysis using a regression model to properly characterize and understand the data, education and health insurance coverage proved to be the statistically significant social variables associated with maternal mortality. These two variables were then analyzed through the lens of economics in order to recommend measures regarding policy action to be taken to improve health outcomes for mothers.

Maternal mortality in the United States is a public health issue that, because it is not considered a national emergency, has been considered low priority. Due to this status, women giving birth in the United States experience a risk factor for death that is implausible in other developed nations. Through economic policy adjustments in the provision of public education and public and private health insurance, there is opportunity to remedy this situation and achieve positive health outcomes for mothers across the United States.

# Acknowledgments

This project would not have been possible without the overwhelming academic and emotional support I received throughout the past year. Thank you to Karen Hall, who has encouraged me to pursue academics that incite curiosity within me and who has supported me on my academic journey over the past four years. Thank you to my reader, Dr. Jerry Evensky, whose insightful comments and editing shaped my thesis into its final state. Thank you to my parents for listening to me when I was excited about the intersection between economics and public health and frustrated and overwhelmed by the daunting process of completing a senior thesis. Finally, thank you to my advisor, Dr. Bhavneet Walia, who sparked my interest in econometrics two years ago and has supported me since then as I pursue my interests and attempt to understand the world through data analysis and economic policy. Your guidance has been a substantial part of my academic experience and I appreciate the time and effort you put into helping me complete this project.

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# Chapter 1: Introduction, Data, and Methods

## Introduction

Maternal mortality rates during pregnancy and shortly after childbirth have fallen worldwide as more and more nations increase access to healthcare and quality of healthcare for their citizens. The World Health Organization announced eight Millennium Development Goals in 2000, the fifth goal being a commitment to improved maternal health, specifically by reducing the maternal mortality ratio by 75% between 1990 and 2015. Since 1990, the maternal mortality ratio worldwide has been reduced by almost one half **(**"United Nations", n.d.**)**. This decrease is important and reflects an effort coordinated around the world. However, trends in maternal mortality and morbidity are moving in the opposite direction in the United States. Between 1990 and 2015, the same time period as was measured by the Millennium Development Goals, the maternal mortality ratio for the United States more than doubled from an estimated twelve to twenty-eight maternal deaths per 100,000 births (Trends, 2016). Compared with thirty-one other countries belonging to the Organization for Economic Cooperation and Development (OECD), the United States ranks 30$^{th}$ (Trends, 2016).

Health care practices in the United States are among the best in the world and the cost of maternity care in the United States exceeded 60 billion U.S. dollars in 2012 (Agrawal, 2015). Despite this fact, maternal mortality ratios in the United States have not improved over the past decade and researchers are turning to other social factors in an attempt to explain this phenomenon. There is strong evidence that less educated people are at a higher risk of death than more educated people (Ma, Siegel, Ward, & Jemal, 2018). There are persistent racial disparities in pregnancy-related mortality, specifically in non-White women (Creanga et al., 2015) Women who lack health insurance are found to be three-to-four times more likely to die

of pregnancy-related complications than their insured counterparts (Agrawal, 2015). Women also make, on average, less money than men reducing resources for prenatal care; a trend worsened with the addition of non-white women into the data set ("Women's and men's earnings", 2017). All of these factors – education, race, health insurance coverage, and income level, to name a few – have been studied to try to pinpoint combination of culprits that are holding the United States back from decreasing its maternal mortality ratio.

While there has been research done on each of these social variables separately, this research project brings them together to identify the factors that have the most significant influence on maternal mortality in the United States. Determining the societal variables that play a significant role in predicting maternal health outcomes allows for economic analysis to then be applied in order to inform future policy decisions.

The United States currently focuses more on international maternal mortality as a pressing public health concern. Even though mothers in the United States are not dying at rates that warrant a national emergency, the maternal mortality rate is alarmingly high when money spent on health care and national health care quality are taken into account. The presence of this public health issue in the United States affects other areas of society, such as utilization of insurance, likelihood to visit health care facilities, and maternal health as a whole and the benefits of changing policy to better support women and ensure positive health outcomes greatly outweighs the costs of implementation.

## Hypothesis

The hypothesis to be tested is that there is an association between maternal mortality in the United States and identified social variables. A necessary precondition for this hypothesis is

that healthcare quality in the United States is at the same level as other developed nations providing comparable health care, meaning medical conditions and complications are not enough to explain the disparity in maternal mortality rate in the United States as compared with other developed nations. The two hypothesis for this project are the null and alternative hypotheses.

**Null Hypothesis: $H_o$** : There is no association between the identified social variables and maternal mortality in the United States.

**Alternative Hypothesis: $H_A$** : There is an association between the identified social variables and maternal mortality in the United States.

The social variables included in this hypothesis are Male/Female Ratio, Education Level, Average Age of the Mother, Median Income, Unemployment Rate, Percent Uninsured, Gini Coefficient, Population Living Below the Poverty Level, and Political Leaning (Electoral College), all analyzed at the state level in the year 2016. The null hypothesis will be supported or rejected by the data analysis. If there is a statistically significant correlation between the identified social variables and maternal mortality in the United States, there should be policy measures in place to combat this issue. This research does not use the quantity of data and variables necessary to determine causation.

## Definitions

To understand the full picture of maternal mortality in the United States and its analysis, it is vital to fully comprehend the terms used in describing this public health and social issue ("World Health Organization", 2014).

Mortality: rate of death in a population

Morbidity: incidence of a disease across a population and/or geographic location during a single year

Fertility Rate: ratio of live births in an area to the population of that area (per 1,000 population)

Maternal Mortality: the number of deaths from any cause related to or aggravated by pregnancy or its management during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 births

By understanding the differences between mortality and morbidity and understanding the way maternal mortality is classified, researchers are better able to categorize maternal deaths and better explain the situation occurring in relation to maternal death rates in the United States.

## Literature Review

A literature review is a survey of books, scholarly articles, and other relevant sources to a particular issue or area of research in an effort to provide background information on the issue and explain the pertinence of the proposed research investigation. To fully understand any issue, social, economic, or otherwise, it is critical to explore the work of prior research teams and build a new research question from their conclusions and questions.

The research reviewed here was published between 1996 and 2015. Vital statistics, including maternal mortality data, is published two years after the reporting year. This means that in 2018, state public vital statistics, including maternal mortality data for 2016 became available. While some states report vital statistics more rapidly, currently there is no

comprehensive data for the year 2017 with regard to vital statistics and related social variables. All of these studies focus on the state of maternal mortality in the United States and social variables such as education level and income and their effect on mortality. An understanding of the social variables that affect general mortality and morbidity provided the foundation to comprehend how and which social variables may impact maternal mortality.

Maternal mortality and morbidity in the United States of America (Agrawal, 2015)

This paper is an overview of the issue of rising maternal mortality and morbidity in the United States and discusses factors behind this trend. The author identifies three factors that can be used to account for the rising trend in maternal mortality and morbidity. The first is inconsistent obstetric practice. There is no standard approach to managing obstetric emergencies and complications of pregnancy and childbirth are often identified too late. The second is an increase in chronic conditions. There are more women who present at antenatal clinics with chronic conditions such as hypertension, obesity, and diabetes. These women would benefit from closer coordination of antenatal and primary care. The third is a lack of robust data and related analysis on maternal health outcomes. A policy introduced to combat this factor was the Affordable Care Act of 2010, which included antenatal and maternal care as essential health benefits that insurance plans must cover.

Maternal Mortality and Morbidity in the United States: Where Are We Now? (Creanga et al., 2014)

This brief study conducted by the Division of Reproductive Health (DRH) at the Centers for Disease Control and Prevention (CDC) focuses on severe maternal mortality and morbidity in

the United States. The DRH has been conducting surveillance for pregnancy-related mortality since 1987. This study contains 52 reporting areas: the fifty states, New York City, and Washington D.C. These reporting areas voluntarily submitted de-identified copies of death certificates for all deaths of females occurring within one year of pregnancy. Matching birth/fetal death certificates were also sent if the information was available. Epidemiologists reviewed the information provided and defined a pregnancy-related death as "the death of a woman during or within 1 year of pregnancy that was caused by a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy." (Creanga et al., 2014) Deaths had to meet a temporal and causal association to be deemed pregnancy-related.

The pregnancy-related mortality ratio increased steadily from 7.2 deaths per 100,000 live births in 1987 to 17.8 deaths per 100,000 live births in 2009. Most notably, pregnancy-related mortality ratios are 3-4 times higher among black women when compared to white women. The paper asserts that the addition of a pregnancy checkbox on the 2003 standard U.S. death certificate has likely improved the identification of pregnancy-related deaths over time.

Women are increasingly being affected by Severe Maternal Morbidity (SMM) according to this study. A combination of factors, including increases in maternal age, pre-pregnancy obesity, preexisting chronic medical conditions, and cesarean delivery, can account for this increase in SMM in the United States. The economic consequences for increased SMM include higher utilization of health services, higher direct medical costs, extended hospitalization, and long-term rehabilitation.

Inequality in income and mortality in the United States: Analysis of mortality and potential pathway. (Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996)

There is a known inverse association between socioeconomic level and risk of disease. Socioeconomic level is measured by income, education, occupation, or social class and can be used to understand an individual's availability and access to quality food, housing, and medical care. This paper looks into using the distribution of wealth in a society as an indicator of health. To do this, the degree of income inequality, defined as the percentage of total household income received by the less well off 50% of households, and changes in income inequality between 1980 and 1990 were calculated for 50 states. This data was compiled using U.S. Census data and state mortality data from the National Center for Health Statistics. Calculated Pearson correlation coefficients determined the association between measures of income inequality and mortality rates. The references to median income or total medical care expenditure in the data refer to the natural log of these variables. The researchers used this data to analyze age-adjusted mortality from all causes.

The data showed that income inequality is associated with mortality trends in the United States. Income inequality was significantly associated with homicide, violent crime, work disability, expenditures on medical care and police protection, smoking, and sedentary activity. All correlations were significant. The researchers were able to conclude that variations between states in the inequality of the distribution of income are significantly associated with variations between states in a large number of negative health outcomes. They were also able to assert that it was unlikely these differences were due only to changes in average income between states. Declines in mortality in the 1980's were experienced by all states, but states with higher income inequalities had smaller declines.

While the correlation between median income and total mortality is weak, the correlation between income inequality and total mortality is strong. The government can alter the level of income inequality through taxation policy, benefits, income transfers, investment incentives in an attempt to alter mortality. The effects of policies to reduce income inequality may be felt sooner at the bottom of the income distribution than at the top.

Relationship between Education and Adult Mortality in the United States (Lleras-Muney, 2001)

The study conducted by Lleras-Muney analyzes the positive correlation between education and positive health outcomes in terms of mortality. She asserts that investments in education may prove to be cost-effective means of achieving better health and that, in contrast, access to healthcare insurance and expenditures on healthcare have been shown to have little effect on health outcomes. Previous research has not been able to identify if the relationship between health outcomes and education level is causal and Lleras-Muney uses this paper to explore the relationship between these two variables.

Between 1915 and 1939, at least 30 states changed their compulsory schooling laws and child labor laws, creating a natural experiment. Using data from the U.S. Census taken in 1950, 1970, and 1980, Lleras-Muney matched individuals from 1% random samples of the population to the compulsory attendance and child labor laws that were in place in their state of birth. Information on age, sex, race, education level, and state-of-birth were used to estimate group death rates. An econometric model, $H_i = X_i \beta + E_i \pi + \varepsilon_{i\text{ß}}$, was used to analyze the data. An Ordinary Least Squares (OLS) model was the initial analysis technique used and biases in this model were corrected with efficient Wald estimates, a two-stage least squares with aggregate data model, and a mixed two-stage least squares estimation. Evidence shows that only three

aspects of compulsory attendance and child labor laws had an actual effect on mortality. These three aspects are the age at which a child had to enter school, the age at which the child could get a work permit and leave school, and whether the state required children with work permits to attend school on a part-time basis. The younger the age at which a child had to enter school, the older the age at which the child could get a work permit and leave school, and a state requirement that children with work permits attend school on a part-time basis are all consistent with better outcomes.

The results of this analysis support the theory that laws are good predictors of educational attainment both at the individual and aggregate level and they can be used as instruments to positively affect health outcomes. From the estimations presented in this paper, the effect of education on health outcomes is causal and much larger than earlier predictions. Lleras-Muney asserts that one more year of education increased life expectancy at age 35 by as much as 7 years.

State-level educational disparities in mortality in the United States, 2010-2014 (Ma et al., 2018)

In the United States, most health policies are designed and implemented at the state level with large variations in the coverage, extension, and strength of these policies. Ma et al. investigated educational disparities in mortality for 49 states and Washington D.C. to understand the relationship between state health policy and education. Research supports the claim that educational attainment affects a person's income and occupation and alters health behaviors. In this study, educational attainment is used as a marker of socioeconomic status to examine disparities in mortality by race/ethnicity in each state during the time period from 2010 to 2014.

Mortality data comes from the National Center for Health Statistics of the CDC between 2010 and 2014. Individual data for deaths occurring between ages 25-74 years was included and data from Rhode Island was excluded from the analysis due to the absence of education information on death certificates.

Based on the analysis, from 2010 to 2014, the death rate at the lowest end of the educational hierarchy was 5.2 times higher than that for highest end of the educational hierarchy in the United States. In every state, there was a higher prevalence of death found in less educated people for all risk factors studied.

Educational information on death certificates is reported by next of kin and tends to be higher than self-reported information. In this study, data labeled 'less than high school education' and 'high school education' were combined to mitigate the impact of misclassification on the data interpretation. All deaths occurring after 75 were also excluded from the data set. Despite these limitation, regardless of race/ethnicity, mortality is strongly correlated with educational disparities.

Is the United States Maternal Mortality Rate Increasing? Disentangling trends from measurement issues. (Trends, 2016)

In 2003, a pregnancy question was added to the U.S. standard death certificate to improve the ascertainment of maternal deaths. Some states delayed adoption of this question, which led to data incompatibilities and impeded accurate trend analysis. The goal of this paper was to develop methods for trend analysis and to provide an overview of U.S. maternal mortality trends from 2000 to 2014. This paper used an observational study of all states and used piecewise of segmented regression to analyze trends for groups of states with similar pregnancy questions

over time. In this analysis, California and Texas were separated because they were the only states that had enough data to run individual tests. Data was collected from the CDC's National Center for Health Statistics.

There were discrepancies in the reporting of maternal deaths by states. Thirty-two states and Washington D.C. did not have a pregnancy question on their unrevised death certificate, but forty-five states had revised their death certificates by 2014. By this date, all states except California, Colorado, Massachusetts, Virginia, and West Virginia were supplying pregnancy data for a standard 42-day time frame.

Based on the analysis, the estimated maternal mortality rate for 48 states and Washington D.C. increased 26.6% from 2000-2014. Texas had a sudden increase from 2011 to 2012 after a moderate increase from 2000 to 2010. The state revised their death certificate question in 2006. There were major changes in the provision of women's health services in Texas from 2011 to 2015 including the closing of several women's health clinics. Overall, the paper concludes that the maternal mortality rate for the United States form 2000-2014 was higher than previously reported.

## Description of Data

The data collected for this research analysis is cross-sectional. Cross-sectional data is a type of data collected by observing many subjects, in this case states, at the same point in time. By holding time constant, these subjects can be compared and contrasted with one another. Ten states were selected to make up the subjects of the data set. They were indexed by geography, total population, per capita state health care expenditure, and political affiliation of the Electoral College in 2016. Ten states were selected encompassing different political leanings, geography,

population, and state expenditure on healthcare per person to represent the diversity in the United States. All of the data collected on these states is from 2016. The states were given numerical identification and their political leaning was given numerical identification for ease of analysis in STATA. Summary statistics describing the data can be seen in Figures 1 and 2.

The U.S. Census Bureau completed a census in 2010 and will complete another in 2020. Between these decade markers, the Census Bureau provides detailed estimates of population for the country, states, counties, and cities. The data set includes overall population estimates, male and female population estimates, and a calculated variable of Male/Female ratio (Data Access and Dissemination Systems, 2010). The mortality rate and maternal mortality rate inputs were taken from the CDC Wide-ranging Online Data for Epidemiologic Research (WONDER) database. This database is a public resource that makes health-related data sets available to individuals working on public health, program evaluation, and resource allocation research (CDC WONDER [Pamphlet], 2018). The mortality rate reported is the number of deaths per 100,000 population and the maternal mortality is the number of deaths from any cause related to or aggravated by pregnancy or its management during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 births ("World Health Organization", 2014). The fertility rate and birth rate data was also collected from CDC WONDER and the birth rate is reported as the number of births per 1,000 population.

Level of completed education data was compiled from the United States Department of Agriculture Economic Research Service, which included both state and county specific numbers **(**Completion Rates, 2013-2017, 2019). The percentage data on health care coverage is from the Henry J. Kaiser Family Foundation, a non-profit, non-partisan organization focusing on national

health issues and publication of facts and analysis (The Henry J. Kaiser Family Foundation, 2019). The median income, unemployment rate, and population living below the poverty line data was compiled from the U.S. Census Bureau's American FactFinder site. The FactFinder site is a database consisting of population and income facts about communities in the United States (Data Access and Dissemination Systems, 2010). The unemployment rate is limited to estimates of the population 16 years and older. The population living below the poverty level is based on an individual's economic status in the past 12 months. The Gini coefficient is a statistical measure of the distribution of income that is used to gauge economic inequality and wealth distribution among a population. The Gini coefficient data was collected from an American Community Survey Brief issued in 2017 (Guzman, 2017). This brief was overseen by the U.S. Census Bureau.

Several scatterplots were created to gain an initial visualization of the data. Figure 3 shows the relationship between Fertility Rates and Electoral College designation of the states. Red States were given the designation of 0 and Blue States were given the designation of 1 based on the Electoral College votes from the 2016 presidential election. This is a general variable to determine the overall political leaning of the states in an effort to understand state policy within the terms of Conservative and Liberal states. This scatter plot show that Red States, on average, have higher fertility rates than Blue States. Figure 4 shows the relationship between Educational Attainment and Mortality Rate. The plot shows a negative correlation trend between the number of people whose education is labeled as 'High School Graduate or GED' and mortality. This means that as more members of the population attain a high school diploma or its equivalent, the state mortality rate decreases. Figure 5 shows the relationship between Mortality Rate and Median Annual Income. There is an apparent negative correlation between these two variables,

meaning as median income increases in a state, the mortality rate decreases. Figure 6 shows the relationship between the Uninsured Population and the Average Age of the Mother at childbirth. There is a negative correlation visible between these two variables, suggesting that women who have children when they are slightly older are more likely to have health insurance coverage. These scatterplots follow general trends surrounding maternal health and general mortality present in peer-reviewed literature. This signifies that the data collected is representative of the population in the United States.

## Methodology

All analyses were conducted using STATA 15, a statistical software for data science. A paired t-test was run comparing the variables State ID and Maternal Mortality Rate. This procedure was used to determine whether the mean difference between these two sets of observations was equal to zero. The reported p-value is 0.0003, which is less than the confidence interval .05, meaning this t-test is significant. Based on the results of the paired t-test, the null hypothesis that the mean difference between maternal mortality rates across the ten states analyzed can be rejected and the ML-Random Effects model can be used with the variable State ID as the panel variable.

The Ordinary Least Squares (OLS) method is widely used to estimate the parameter of a linear regression model. OLS estimators minimize the sum of the squared errors. The squared errors are the difference between the observed and predicted values. There are several underlying assumptions to the OLS method that are required for the model to be unbiased. The assumptions are the linear regression model is linear in the parameters; the data are collected through independent, random sampling; there must be sample variation in the independent

variable; the error term has zero mean; the error term is not correlated with the independent variable or any function of the independent variable; and the error term has constant variance (Hilmer & Hilmer, 2014). Often, not all of the assumptions will be satisfied and there is a need for another statistical test to be used to understand the data in the right way.

The data compiled for this analysis is considered 'Cross-Sectional' data. All of the data was collected for a single year across multiple variables. There is a distinguishing feature of panel data – certain assumptions are made about the error term. Error terms are different in each time period, and in panel data there is concern as to whether the composition of the error term changes over time. To allow for the possibility that some components of the error term change over time while other components remain constant, the assumption of the error term includes time-invariant and time-variant components. Time-invariant components are terms that vary across individuals but do not vary over time periods. Time-variant components vary across both individuals and time periods (Hilmer & Hilmer, 2014). In panel data, the assumption is that the time-invariant component of the error term is correlated with the independent variable in a population regression model, or an OLS model. This is a clear violation of the OLS assumption that the error term is uncorrelated with the independent variable. This means the OLS estimate is biased and an OLS model is not the best regression fit for the data. The solution to generate unbiased estimates in this case is to remove the time-invariant term from the OLS regression. The Random-Effects model is a method of removing this time-invariant component of the error term when using panel data.

The Random-Effects model assumes that the variation across entities is random and uncorrelated with the independent variable in the model. This model allows the inclusion of time invariant variables, such as State ID in this data set, and controls for this component in the error

term. The random effects model allows for time-invariant variables to play a role as explanatory variables and increases the efficiency of the estimates because it retains the information that is lost if the time-invariant term is removed altogether.

# Chapter 2: Regression Results and Analysis

Figure 8 shows the ML-Random Effects regression model. The LR Chi-squared test is greater than 10 (21.90>10) and the Chi-squared probability is less than the 0.05 confidence interval (0.05>0.0026). The regression results therefore are statistically significant and the individual variables represented can be interpreted. There are four variables with significant coefficients (Male/Female Ratio, Education Level (Less than High School), Education Level (High School Graduation or Equivalent), Percent Uninsured) and three variables with insignificant coefficients (Unemployment Rate, Median Income, Average Age of Mother). A Paired T-Test was run to determine whether the mean difference between the variables State ID and Maternal Mortality Rate was equal to zero. The T-test in Figure 9 shows that the null hypothesis can be rejected and the ML-Random Effects model can be used to understand the data.

To capture the state level effects, literacy rates were presented for men and women combined. To confirm the validity of the significant variables in the overall statistical model, the female-only literacy rate for each state was tested against the same variables. Excluding the Male/Female Ratio variable, the results of this modified ML-Random Effects were the same as the overall model, as seen in Figure 10. This shows that education and insurance coverage play important and statistically significant roles in understanding the trends of maternal mortality in the United States.

Significant Coefficients: Male/Female Ratio, Education Level (Less than High School), Education Level (High School Graduate or Equivalent), and Percent of Population Uninsured

The coefficient for the variable Male/Female Ratio is 176.3735 according to the ML-Random Effects Model. The z-value for this variable is 2.06, which is greater than |2|, and the p-value is .039, which is less than the confidence level of .05. When the Male/Female Ratio is increased by one unit, the coefficient for this variable shows a significant increase in the maternal mortality rate. This occurs because as there are more women in a given area, the number of women giving birth in that area increases and, therefore, the number of women dying during childbirth increases. There is a trend in published literature focusing on the differences in urban and rural accessibility to health services. Yang found that medical accessibility in centralized urban areas is better than in suburban and rural areas (Yang, Chen, Hu, Wu, & Chao, 2016). Goldstein found that hospitals in rural locations experience disadvantages in delivering healthcare to their populations. In these cases, the cost of supplying certain medical services to rural areas exceeds the financial benefits, particularly for capital-intensive services that are commonplace in a hospital setting (Goldstein, Ward, Leong, & Butler, 2002). Not only are rural hospitals unable to provide the same type of care as their urban counterparts, they are often inaccessible to the rural population. There are an average of 2.97 hospitals per 1,000 square miles across the United States, and while this statistic is not broken down by density of hospitals in urban versus rural areas, as previously mentioned, these hospitals are often located in highly populated urban centers (Dyrda, L. 2017). Further, there are, on average, 2.96 hospitals per 100,000 females compared to 3.05 hospitals per 100,000 males. The Male/Female ratio data compiled for this research paper shows that there are more females than males in every state analyzed. This is consistent with the number of average hospitals per 100,000 females and males and these numbers indicate less access for women than men to hospitals. This could manifest in wait times or doctor availability, which could both negatively affect female health outcomes.

The way to combat this would be identifying areas of the United States that have larger concentrations of women and localizing healthcare centers and health resources in these areas. Those health resources might include health centers that specifically serve women, such as Planned Parenthood.

The coefficient for the variable Education Level (Less than High School) is -.0000135 with a z-value of -2.46 and a p-value of .014. In the context of this model, for every one unit increase in the number of people with an education level less than high school, there is a .0000135 reduction in the maternal mortality rate. This can be interpreted to mean that increasing the number of individuals with at least some high school education has an effect on reducing maternal mortality.

Research into the relationship between education and health has found a positive correlation between education and health outcomes, specifically in terms of mortality. Estimations from Lleras-Muney assert that the effect of education on health outcomes is causal and much larger than earlier predictions. Between 1915 and 1939, at least thirty states changed their compulsory schooling laws and child labor laws, creating a natural experiment. Evidence Lleras-Muney analyzed from this natural experiment showed only three aspects of compulsory attendance and child labor laws had an effect on mortality: the age at which the child had to enter school, the age at which the child could get a work permit and leave school, and whether the state required children with work permits to attend school on a part-time basis (Lleras-Muney, 2001). Through analyzing this natural experiment, evidence showed that laws are good predictors of educational attainment both at the individual and aggregate level. This means there is immense potential for policy to increase the academic achievement in the United States, which can positively affect health outcomes.

Complications occur in the variation of health policies and their implementation by states in the United States. Most health policies are designed and carried out at the state level, leading to wide variations in coverage, extension, and efficacy of these policies (Ma et al., 2018). In a longitudinal mortality study of 400,000 men and women, Backlund found that mortality may be primarily a function of income at the low end of the socioeconomic continuum but primarily a function of education at the middle and high ends (Backlund, Sorlie, & Johnson, 1999). The attainment of educational credentials serves as a way to quantify acquired knowledge, which can be used to achieve better health outcomes. The completion of high school or higher education places a person in a different status of society and evidence shows this correlates to better health (Backlund et al., 1999). This idea that educational attainment affects an individual's income, occupation, and by extension, health, is a fundamental construct of socioeconomic status. Individuals with lower socioeconomic status and lower educational attainment lack social resources and are more likely to adopt unhealthy behaviors (Ma et al., 2018). This adoption of unhealthy behaviors is often exacerbated in the United States due to the presence of food deserts and expensive fresh produce. More broadly, across Asia, Latin America, and Africa, lower levels of maternal education are associated with higher maternal mortality (Karlsen et al., 2011). This trend holds true even amongst women able to access facilities providing maternal and prenatal care. An increase in the levels of educational attainment are likely to enhance the capacity of women to obtain, process, and understand their personal health information and the decisions relating to their health and the health of their baby.

The coefficient for the variable Education Level (High School Graduation or Equivalent) is .0000106 with a z-value of 2.39 and a p-value of .017. For every one unit increase in the number of people with an education level of high school graduation or equivalent, in this model,

there is an increase in maternal mortality by .0000106. The slight increase in maternal mortality due to completing high school or its equivalent can be interpreted by understanding the socio-economic position of an individual fitting that education profile. This individual may qualify for higher paying employment opportunities, which provide very basic or high-cost insurance plans. Further, these individuals are not likely to be in the income categories that qualify them for Medicaid coverage. If they are not covered by the government and are unable to afford their employer-provided health insurance plan, they fall into a grey area in the health insurance world may be unable to afford quality maternal health care before, during, and after their pregnancy (Whellan, 2017). In contrast to men, women experience the same decrease in mortality associated with the attainment of high school and college diplomas (Backlund et al., 1999). When a woman attains a higher education degree, while this provides some returns through employment opportunities and higher income, there is the possibility that these effects are counterbalanced by other stressors such as maintaining a demanding job and familial relationships and expected roles and other discomfort in the workplace. Additionally, the risk of mortality for non-high school graduates is larger for women than for men and women, meaning that obtaining some high school education, at the very least, has a positive effect on women in a greater sense than it does for men.

The coefficient for the variable Percent Uninsured is 1.453501 with a z-value of 2.66 and a p-value of .008. When there is a one unit increase in the percentage of uninsured individuals in the population, there is a 1.453501 increase in the maternal mortality rate.

Lack of health insurance is associated with younger age, minority race/ethnicity, unemployment, smoking, exercise, self-rated health, and lower levels of education and income. When data is adjusted for age and gender, a lack of health insurance is significantly associated

with mortality and significantly increases the risk of mortality in individuals who are uninsured (Wilper et al., 2009). This evidence supports the assertion that uninsured populations are more likely to go without needed care than insured populations and are more likely to die because of this. There is a substantial body of research which supports the hypothesis that having health insurance improves health (Hadley, 2003). When more of the population has access to health insurance and quality health insurance coverage, strides are made in health outcomes that lead to higher labor force participation and higher income levels, on the order of 15-20% higher than current rates (Hadley, 2003).

An interesting trend appears in elderly populations in regard to insurance coverage and health outcomes. Declining health is often reported by uninsured individuals until they reach the age of 65 when they qualify for Medicare coverage (Wilper et al., 2009). This shows a clear relationship between positive health outcomes and insurance coverage, which is echoed in the statistically significant coefficient in this research model. Higher mortality is reported in populations with public insurance and this reflects a mix of social determinants including existing health status, educational attainment, access to medical care, and income level (Sorlie, Johnson, Backlund, & Bradham, 1994). While insurance is a significant variable in this research model, there are many other external factors that play into its effect on health outcomes.

Insignificant Coefficients: Unemployment Rate, Median Income, and Average Age of Mother

While these coefficients are important indicators of social determinants of health, they are not significant in predicting and explaining maternal mortality according to this study. Median income and unemployment rate are related to education level. Individuals with higher levels of education are typically employed in higher paying jobs and experience less frequent job

insecurity. The Affordable Care Act includes a mandate for employer-provided health insurance to be provided to employees, demonstrating the interconnectedness of employment and insurance coverage. Those who qualify for higher paying jobs due to more years of education are more likely to have insurance. The variables that affect median income and unemployment are significant in this model, but that is not to say that median income and unemployment rate do not play a role in understanding the overall public health issue of maternal mortality. The average age of the mother is also important in understanding health risks going into a pregnancy, but it is not enough to explain the current national maternal mortality rate. Often, women who choose to become pregnant later in life have higher education levels, income, and insurance and are flagged as potentially riskier patients as they enter a hospital due to their age alone. Maternal deaths due to age are more likely due to medical complications and emergencies than social determinants of health such as education.

# Chapter 3: Economic Policy Applications

The regression model shows that lack of educational attainment and lack of insurance coverage are two social factors significantly and negatively impacting the maternal mortality rate in the United States. Currently in the United States, public education is available to all individuals and public health insurance is available on a means-tested basis. However, there is wide variation on the quality and accessibility of these public goods at the state level. States have the most control over the provision of education and health insurance and it is important to understand the situation in 2016, when the data was collected, and the current state of affairs regarding funding, implementation, and efficacy of these goods in order to propose legitimate policy to improve them. More than half of state tax revenues fund education and health care, so the investment in these two public goods is an extremely important topic with far-reaching consequences, both positive and negative ("Policy Basics", 2018). Among the long-term goals of enacting policy to improve educational attainment and increase health insurance coverage by population are reducing the maternal mortality rate in the United States and improving health outcomes.

## Education Policy

There are many different ways to approach education reform. In this case, economic policy options will be considered over curriculum changes as these are out of the scope of an economist's perspective. In 1900, 34 states had compulsory schooling laws in effect. These laws required school attendance until age 14. Compulsory schooling laws in the early 20$^{th}$ century, including the comprehensive requirement that students complete elementary school passed in 1918, meant that 72% of American children attended some sort of schooling during

this time period. The Progressive Era, or the turn of the 20th century in the United States, brought considerable expansion of the public education system to all states. Due to families rapidly moving to urban centers and populating fast-growing metropolitan cities, there was an increased need for higher quantities of schools. The new focus on education resulted in 50% of young adults earning a high school diploma by 1940. After World War II (WWII), there was an intense interest in using public schools and education to support and foster creativity in children. In the 1980's, this ideology was overshadowed and replaced by public policy emphasizing the importance of test scores as metrics used to compare public schools and students nationally and internationally. The focus on nurturing creativity through education was further undermined by the 'No Child Left Behind' Act passed by Congress in 2001 which set up a system to categorize failing and non-failing schools based on standardized tests (Peterson, 2016). The mandate for student standardized testing was continued under the Obama administration with the Every Student Succeeds Act. More recently in the United States, there has been a push by parents, educators, and politicians to reincorporate arts, music, recess, and creativity into the public education curriculum (Weingarten, 2016).

In 1955, Milton Friedman proposed a private initiative to quicken the pace of progress in public education (Peterson, 2016). The voucher system he proposed provides aid for students to attend private schools. The 1955 idea that introducing competition to public schools, especially within big cities, resulted in the creation of charter schools. Albert Shanker, a leader of both the United Federation of Teachers and the American Federation of Teachers, in 1988 proposed charter schools as a way for teachers to be more creative and help students succeed (Ravitch, D., 2018). Charter schools receive funding primarily from federal sources and are authorized by a government agency to be run by a private management company. More than half of states

currently have some form of public subsidy available for religious and privately operated charter schools. In 1993, Shanker walked back his opinion on charter school, saying "vouchers, charter schools, [and] for-profit management schemes are all quick fixes that won't fix anything" (Ravitch, D., 2018).

The private management of charter schools means they are not subject to the same laws and transparency as traditional public schools. The Civil Rights Project at UCLA in 2010 called charter schools a "major political success" but a "civil rights failure," citing the fact that charter schools are more segregated than public schools and about 90% are nonunion (Ravitch, D., 2018). In many states, they are not bound by civil rights laws in the way traditional public schools are and may exclude students based on religion, disability, and LGBTQIA+ status. While the aggregate percentage of minority students in charters schools is similar to that of the sending districts, charter school enrollment falls into a bimodal distribution. There is either a high concentration of minority students at a given charter school, or a high concentration of white students (Miron, Mathis, & Welner, 2015). Further, there is substantial evidence that charter schools are accelerating segregation by race, class, measured achievement, special education status, and English as a Second Language (ESL) status. In 2010, only 4.4% of students in charter schools were classified as ESL students, compared with 11% of all students nationally enrolled in public education (Miron et al., 2015). The NAACP went so far as to call for a moratorium on new charter schools in 2016 until they are held to the same accountability standards as traditional public schools.

There is further argument against charter schools in terms of the funding they receive. When students leave traditional public schools to attend charter schools, they take some resources previously allocated solely to those traditional public schools. To accommodate these

reductions in available funds, public schools must fire teachers, reduce course offerings, and increase class size. Despite this, charter schools, when they are established in high-need areas, are helpful to communities that would otherwise have to commute for an education.

The overall goal of charter school introduction into the public schooling system was to create competition and improve student academic performance and achievement. On average, charter schools do not attain better academic results than public schools and only those that control their demographic to favor high-scoring students see significant academic achievement (Ravitch, D., 2018).

Charter school implementation, as with the majority of public education implementation, is overseen by each individual state. When it comes to charter schools, each state has a different year in which legislation approving the introduction of charter schools into the public education system was passed and a different number of schools currently serving students. The Arizona State Board for Charter schools was created in 1994 and since then 535 charter schools have been established serving 15.9% of total public school enrollment in the state. Illinois, Massachusetts, New York, Ohio, and Texas all passed charter school legislation in the 1990's and have between 3% and 7% of total public school enrollment covered by charter schools. California and Michigan passed charter school legislation in the early 1990's and both have around 9% of total public school enrollment covered by charter schools. Californian charter schools are classified as dependent and independent, with dependent schools being operated by school districts and independent schools being operated by for-profit organizations. Alabama and Iowa are outliers, having respectively only two charter schools as of 2018 and legislation from 2015 and 3 charter schools in 2016 following 2002 legislation ("Main Page", 2019).

The different levels of implementation and expansion of charter schools by state is an example of the immense variation by state in terms of overall public education. A case brought in front of the Supreme Court, San Antonio Independent School District v. Rodriguez, further established the power of each individual state to set standards and raise revenue for public education (Turner, 2016). The justices ruled that the federal government has no obligation to make the public education system fair and balanced, and the consequence of this decision can be easily seen in disparities in funding and educational attainment across states.

Disparities in funding for public education across states account for the lack of a cohesive educational attainment level in the United States. Across the states included in this research, New York spends the most at $22,366 per student and Arizona spends the least at $7,613 per student ("Annual Survey", 2016). The United States average is $11,762 spent per student and states occupy the full range of values between New York and Arizona's levels of spending per student.

Public education is funded through three sources: the federal government, the state, and local governments. In the federal budget passed each year, Congress sets aside enough money to fund approximately 10% of public schools' operating costs ("How are the Local", n.d.). This money almost always comes with strings attached, generally in the form of standards that must be met by states. The No Child Left Behind Law was not enforceable by the federal government, but all fifty states elected to participate in the standardized testing in order to continue to receive federal funding. Title I of the Every Student Succeeds Act provides added federal financial assistance to local educational agencies and schools with high percentages of students from low-income families in their student body ("Title I", 2018).

Funding at the state level accounts for slightly less than half of public schools' operating costs. This funding comes primarily from sales and income tax revenues and accounts for, on average, a quarter of all state spending ("Policy Basics", 2018). Forty-two states and the District of Columbia also generate revenue for public education from state-run lotteries. However, instead of supplementing other revenue sources, earnings from lotteries replace other taxpayer money. Finally, local school boards and municipalities collect property taxes on homes and business to fund public schools ("How are the Local", n.d.). In 2016, the total elementary-secondary public education revenue was $670,949,469, with 8.1% coming from federal sources, 47.4% coming from state sources, and 44.5% coming from local sources ("Public Elementary-Secondary", 2016).

The local level of taxation introduces exemptions, affluence of a community, and a disparate tax rate as variable factors that affect the quality and maintenance of public education infrastructure and systems. For the states included in this research, property tax rates vary from a low of .33% in Alabama to a high of 1.81% in Texas ("Property Taxes", 2019). Property values fell sharply after the 2008 national recession, which made it difficult for many local school districts to raise additional revenue for public education through the property tax to make up for state budget cuts (Leachman, Albares, Masterson, & Wallace, 2016). In 2019, many property taxes fail to reflect the improvement in property values that has occurred over the past ten years. This puts strain on local governments and school boards trying to adequately fund their public schools and students.

Texas is an outlier in state funding formulas for public education. The income tax accounts for a sizeable portion of public education funding in most states however, there is no

income tax in Texas. To compensate for this absence of revenue, an increase on the motor fuel tax in Texas was suggested (Knight & DeMatthews, 2018).

General state funding per student in 2016 was still lower than pre-2008 levels, indicating a hesitance by fiscal policy makers to increase tax rates post-recession, even in light of a then-recovering and now-thriving economy (Leachman et al., 2016). Spending per student has been stagnant between 2007 and 2016 for half of the states analyzed in this research and the same trend is observable as an average trend in the United States (www.governing.com/gov-data/education-data/state-education-spending-per-pupil-data.html). Alabama, Arizona, and Texas report 17.3%, 14.9%, and 10.5% less funding per student in 2016 than in 2007 (Leachman et al., 2016). This is all because state revenues have been slow to recover from the 2008 national recession. States relied heavily on spending cuts to combat the effects of the recession. Between fiscal years 2008 and 2012, states closed 45% of their budget gaps through spending cuts as compared to only 16% through taxes and fees. The remaining gaps were closed with federal aid and reserve money. The consequences for these actions include significant negative effects on children's earning potential and high school graduation rate, specifically for low-income communities.

When there are cuts in revenue and spending, education reform is severely undermined. Improving teacher quality requires higher wages, which are often the first area of spending eliminated. Trimming class sizes to increase the teacher-to-student ratio is forgotten as teachers are let go and classes merged to accommodate the lack of sufficient staff. High quality early education, an evidence-supported necessity for students to succeed later on in school, is also one of the first items on the chopping block (Levin, 2017). Without sufficient revenue and funding,

public schools and policy makers are placed in a position of stagnation lacking the resources to move forward and improve education for students.

More recent attempts over the past decade aimed at reform have focused on the international education gap between the United States and other nations (Zhao, 2009). One of the largest cross-national tests to compare educational attainment is the Proramme for International Student Assessment (PISA) (DeSilver, 2017). This test measure reading ability, math and science literacy, and other skills among 15-year olds in developed and developing nations. In 2015, the most recent results, the United States placed 38th internationally. Among the 35 Organization for Economic Cooperation and Development (OEDC) nations, the United States ranked 30th in math.

There has also been renewed interest in the domestic education gap present between different subgroups of the United States population. This so-called 'achievement-gap' represents the education performance gap between minority students and their white peers and between low income and wealthy students (Zhao, 2009). There have been many different national and statewide policies implemented in an attempt to increase educational attainment and decrease this achievement gap. The No Child Left Behind Act introduced the regulatory strategy of test-punish-repeat. The law relied on standardized tests as a metric for whether a student was allowed to advance to the next grade level. This policy met harsh criticism as it frustrated parents, de-professionalized and demoralized teachers, and made class either stressful or boring for underperforming and over-performing students respectively. The Obama administration introduced the Every Student Succeeds Act as a continuation and refinement of the No Child Left Behind Act. It gave states the power to administer standardized tests and set their passing

guidelines (Weingarten, 2016). This further intensified the stratification between states in terms of educational attainment by grade level.

On a state level, New York piloted two educational reform policies to better understand their efficacy in increasing educational attainment (Geng, 2018). The first policy was a grade retention policy meant to incentivize students. Beginning in 2004, students were required to demonstrate a minimum proficiency level on standardized tests in math and English/Language Arts to advance to the next grade. The second policy was an accountability scheme meant to incentivize schools. Starting in 2007, additional weight was place on the performance of low-achieving students within each grade and school. Schools that were rated poorly under this system faced risk of closure. The state found that when these two policies, one focusing on student incentives and one focusing on administrator incentives, were applied separately, no meaningful change was detected. However, when applied at the same time, there was a significant increase in test scores and reductions in absences and suspension rates (Geng, 2018).

Research evidence shows the need for multiple strategies targeting students, teachers, and administrators together to begin the process of reforming education. To attain the goal of closing the educational attainment gap between the United States and other nations, uniform education standards across the United States must be implemented. Geography is currently an important predictor of educational attainment and by extension positive health outcomes and this variable needs to be eliminated from the formula. To attain the goal of closing the domestic 'achievement' gap, renewed investment in education must be a policy priority.

Economists analyze problems and prioritize solutions based on cost-benefit analysis. In the case of educational attainment and reform, the benefits of obtaining a quality high school education must outweigh the costs to society. The long-term benefits of educational intervention

include increased tax revenue, increases in productivity and earnings, reductions in the cost of public assistance, reductions in the cost of public health, and as demonstrated above more positive health outcomes including decreased maternal mortality (Levin, 2017). When individual educational attainment increases, there is an increase in employment options and a causal increase in average salary (Levin, 2017). This translates to more productivity in the workforce (a lower unemployment rate) and more tax revenue based on more individuals in higher income brackets. This also translates to lower receipt of public assistance payments or subsidies across society and reduced eligibility for means-tested programs. In terms of this research, the most significant impact of increased educational attainment comes with regard to health outcomes. There is an established positive correlation between education and mortality and maternal mortality follows this trend (Lleras-Muney, 2001). Health behaviors also change with added education. Financially, there is less of a burden in Medicaid and other public health insurance programs that rely on means-tested eligibility requirements. A healthier and more educated population with higher wages either does not qualify for public insurance or is less likely to be an expensive burden on that public insurance.

The most direct way to begin this process of reform and reinvestment is through tax policy. States use general funding models to distribute revenue and support public education. Foundation grants are used to ensure an equal financial foundation for all districts. In this model, the state decides the minimum amount spent per student, calculates the ability of each district to pay this amount per student, and then fills the financial gaps that are left over. The state, in this case, will require a base level property tax to be levied on the districts and will provide more aid to property-poor districts who need extra help reaching the spending per student minimum. Local districts under this model can elect to increase property tax rates. In this case, the state's

contribution is the same even as districts increase their revenue. This means all districts exceed the minimum, but the increase in property tax significantly and disproportionately affects the property-wealthy districts as opposed to the property-poor districts. There is breakdown in this model when districts face budget constraints and are unable to fully fund property-poor districts who cannot make up for this loss of funding through their tax base (Tilsley, Blagg, & Chingos, 2017).

States that use a guaranteed tax base balance local contributions to public education. This allows each individual district to tax at the level they see fit and the state commits to providing a minimum amount for each percentage of property tax levied on the districts. This means that any percentage increase in the tax rate generates the same financial hike in almost every district, regardless of tax base (Tilsley, Blagg, & Chingos, 2017). This incentivizes property-poor districts to raise local taxes because this will in turn increase the amount of state funding they receive. Property-wealthy districts are able to raise well above the minimum amount spent per student and this often leads to a 'recapture' system (Swaby, 2019). This has manifested in Texas as more urban and suburban school districts, which serve large populations of low-income students, being required to pay recapture as they exceed the minimum amount spent per student due to their increased property values.

Both of these funding models are imperfect and are applied at the state level in many different ways and to varying degrees. In many cases, a mix between the two is where states find a happy medium. Property taxes were relied upon heavily during and after the 2008 recession as a way to maintain state revenue. Despite the property tax base declining during the recession, the 2011 base remained greater than the pre-2007 base as housing prices began to rise (Collins & Propheter, 2013). There is consensus among economists that the national economy has

recovered and steady growth has been occurring over the past few years. However, tax rates have remained stagnant and increases in revenue are from increases in property value instead of increases in tax rates. There needs to be a commitment to raising, even slightly, property tax rates to then increase the minimum amount spent per student. This investment will have major payoffs in the long-run as the quality of education improves and increased numbers of students, especially low-income students, are able to graduate from high school.

Having a sole reliance on property and income taxes in many states as a source of revenue for public education is shortsighted and only allows for so much revenue to be raised and fairly distributed around the state. In order to keep property values high, recapture of property tax revenue must be eliminated. When recapture is implemented, property-wealthy districts do not see their property taxes re-invested in their neighborhood and district schools and will be inclined to leave those areas, devaluing their property. Instead of taking extra tax revenue from wealthier districts, the state needs to change other areas of revenue to better financially support poorer districts.

There has been recent national and state support for tax cuts as a method of boosting the economy out of the 2008 recession and stimulating growth. While research shows that well-designed tax cuts can achieve these goals in the short run, they have a modest impact in the long-run, and this impact is positive only if they are fully paid for. If tax cuts are not paid for, as is the case currently in the United States, they are likely to have modest negative effects on the economy in the long-run due to the negative effects of increased deficits ("Tax Cuts", 2017). The tax cuts introduced in 2017 also disproportionally favored Americans in high-income brackets. The tax cuts have made the distribution of take-home pay more unequal, which only exacerbates the inequality gap in before-tax income that is exponentially increasing in the United

States. When the income tax cuts are fully in effect, households with incomes above $1 million will receive tax cuts equivalent to a 7.5% increase in their after-tax income as compared with households in the middle-income brackets who will receive tax cuts equal to 2.3% of their income ("Tax Cuts", 2017).

Revenue from the income tax, approximately 70% of total federal revenues, comes primarily from the top 10% of income earners in the United States ("SOI Tax Stats", 2016). This means increasing or decreasing tax rates for the majority of Americans does not have a significant effect on total revenue. This can be seen clearly in the ways that wealthy and poor districts levy property taxes. Wealthier districts are able to keep tax rates low and still raise enough revenue to cover operating costs and special programs costs in public schools. Poorer districts often tax at much higher rates and in many cases cannot raise taxes any higher by law (Swaby, 2019). A more progressive income tax must be levied in all states and tax cuts, if levied, must be short term in order to continue to promote economic growth. Higher revenues from income taxes can be used to increase the minimum amount spent per student, which is a metric of quality of education.

Another source of revenue that could be explored is the tax on capital gains and dividends. This is generally taxed at a rate lower than the income tax rate, even though income from capital gains and dividends often surpasses salaried income reported for income tax purposes ("Capital Gains", 2016). There are two ways to increase revenue from capital gains and dividends: increase the rate at which they are taxed so that it is equal to the income tax rate and enforce a cap on tax deductions for Americans in the highest tax brackets. Capital gains are profits from the sale of capital assets and dividends are income from companies paid to shareholders. For many individuals, these two sources of income are more important and more

significant than their actual salary. In these cases, capital gains and dividends should be taxed like income, meaning the capital gains tax rate should be progressively increased to match income tax rates. By capping tax deductions for high-income tax brackets, tax revenues will increase. Both of these methods will provide increased revenues and make the tax system more progressive.

By increasing tax revenues, the federal and state governments and local districts will be able to increase the quality of public education students receive. Achievement of this long-term goal will lead to reductions in extraneous expenses such as law enforcement and emergency medical expenses, two externalities related to poor educational attainment. In the short-term, it will be important for physicians and healthcare facilities to have an understanding of the education level their patients. By communicating education level to health care providers, patients that have lower levels of education can be flagged in the system and afforded extra monitoring and attention, especially when it comes to larger medical procedures such as childbirth.

As demonstrated above, one way deficiencies in education manifest are through poor public health outcomes. Educational attainment is a crucial social determinant of personal outcomes and this makes education equity and higher educational attainment a moral imperative for a society. Inadequate education affects not only the poorly educated individuals in society, but also affects the society as a whole through loss of productivity, lower tax returns, and higher costs of public services felt by the population (Levin, 2017). The United States is experiencing growth in a way that necessitates investment in education to maintain that growth over the next few decades. Through increased local and state revenues and implementation of evidence-based

reform policies, the United States has the opportunity to improve educational attainment across the nation and therefore positively affect health outcomes.

## Insurance Policy

There are three major categories of health insurance coverage in the United States: private coverage, public coverage, and uninsured. Private insurance includes employment-based and direct purchase insurance plans, which cover approximately 72% of Americans. Public insurance includes Medicare, Medicaid, and Military insurance plans, which cover approximately 21% of Americans. In 2017, approximately 12% of the United States population did not have health insurance coverage (Berchick, Hood, & Barnett, 2018). It is important to note that these values do not sum to 100% because some people are covered on more than one plan. The United States health insurance market is an outlier when compared to other developed nations where universal health care dominates. In the United States, health care and insurance are businesses whereas they are entitlements in economically and socially comparable OECD nations. During WWII, wages and prices were frozen in the United States. At the same time, the federal government allowed employers to provide health insurance to employees rather than wage increases as a form of compensation. Health insurance premiums paid by employers are not taxed and this favorable tax treatment creates incentives for employees to take more compensation in the form of health insurance and other fringe benefits. This phenomenon caused employment-based health care to control the health insurance market and continues to account for the majority of American health insurance coverage.

As discussed in this research, published data and analysis overwhelmingly conclude that there is a strong positive relationship between lack of health insurance coverage and poor health outcomes (Quesnel-Vallée, 2004). The uninsured are more likely to go without needed care, such as diagnostic screenings and chronic condition management, than those covered by insurance. These individuals are more likely to visit the emergency department of hospitals for

"ambulatory care sensitive conditions," suggesting preventable illnesses are also a consequence of lack of health insurance (Wilper et al., 2009). In statistical models adjusted for age and gender, lack of health insurance coverage is significantly associated with mortality and disproportionately affects the young, minorities, unemployed, and less-educated populations (Wilper et al., 2009). These conclusions make health insurance coverage and the lack thereof a public health issue and something that warrants policy change.

The Patient Protection and Affordable Care Act (ACA) is a piece of federal legislation passed in 2010 under the Obama Administration. It was an attempt by Congress to blend entitlement and business models of health insurance systems in an effort to extend health insurance coverage to more people and services ("Obamacare Basics", n.d.). The act contains several important provisions that were to be phased in over time through 2022. These provisions include the end of experience rating for group insurance, meaning over half of the population covered by employment-based private insurance companies became community-rated, the expansion of Medicaid to people and households with income up to 138% of the poverty level versus the previous metric of 100% of the poverty level, the elimination of lifetime caps on expenses, and the provision that individuals up to age 26 can remain on their parents' insurance policies. To maintain health insurance affordability, the act mandated the purchase of insurance and provided a subsidy for insurance purchase to individuals at certain low-income thresholds (Gruber, 2018).

The mandate is one provision of the ACA that attracted political and legal attention post-2010. It is difficult for insurance companies to operate and maintain a profit margin without the entire population being enrolled in some sort of health insurance program. Administrative costs of private insurance companies are high in comparison to those of the government due to the

need for actuaries to compile data, analyze statistics, and calculate insurance risks for their enrollees. When the entirety of the population purchases health insurance, premiums are lower because low-risk enrollees, who are less expensive to cover, help the insurance company redistribute resources to cover the costs of high-risk enrollees. In 2012, the Supreme Court of the United States upheld the individual mandate provision as an exercise of Congress' taxing power (Mervosh, 2018). However, in 2017 under the tax overhaul passed by Congress and signed into law by President Trump, the individual mandate was reduced to a tax penalty of zero dollars starting in 2019, effectively eliminating this provision of the original ACA.

Prior to the passage of the ACA, private insurance companies were able to deny an individual or charge a very high premium for health insurance coverage due to a pre-existing health condition. These types of health conditions can cost insurance companies significant amounts of money over a person's lifetime and is not financially beneficial for the insurance company. This type of discrimination impacts the job market in the United States. For individuals with employment-based health insurance, there is job lock in the labor market when they are unable to change places of employment due to the possibility that they will lose their health insurance coverage. This leads to inefficiency in output and stunts economic growth. There is continued debate over the constitutionality of the law as in 2018, a federal judge in Texas ruled that the entire ACA was invalid finding the requirement that people purchase health insurance was unconstitutional (Mervosh, 2018). This debate leans toward the more political discussions surrounding the ACA and is less relevant to an economic understanding.

While the individual mandate was upheld in 2012, the Supreme Court ruled that states can reject the law's requirement of Medicaid expansion (Haberkorn, 2012). As of March 2019, there are 35 states that have chosen to expand Medicaid up to 138% of the federal poverty level.

Thirteen states are currently not expanding Medicaid and two are only expanding to 100% of the federal poverty level ("A 50 State Look", 2019). Of the states represented in this research, all but Alabama and Texas elected to expand Medicaid. The states that chose to expand passed their own legislation between 2012 and 2014 ("Where the states stand", 2019). Analysis completed in 2015 of Medicaid expansion states showed that as a result of the expansion, the states reported financial benefits through savings and revenue gains (Bachrach, Boozang, Herring, & Reyneri, 2016). This was a promising prospect going into 2017 when the federal government stopped funding 100% of expansion costs. Due to the expansion of Medicaid for households with income up to 138% of the federal poverty level, there was reduced state spending in hospitals and other health care facilities on the uninsured and additional revenue from insurer and provider taxes. States who expanded Medicaid along with the other provisions of the ACA also saw previously eligible Medicaid beneficiaries become eligible for other, generally more comprehensive health insurance plans, which reduced the Medicaid burden on the state. There were also broader economic benefits that these states experienced. Significant decreases in the rates of uninsurance meant uncompensated hospital costs were reduced and a job growth was seen across the labor market (Bachrach, Boozang, Herring, & Reyneri, 2016).

Medicaid expansion is funded through a matching funds system. The Federal Medical Assistance Percentages (FMAPs) dictate the federal financial participation in state Medicaid expenditures. These matching funds are for assistance payments for social services and state medical insurance. When the ACA was rolled out, the federal government matched 100% of state expenses, but this was to be phased out over the next few years. Currently, the FMAPs are calculated by state and determined by per capital income and other wealth criteria ("Federal Medical Assistance Percentages", 2017). In order to continue financing Medicare, the ACA

implemented a tax on all income earners. The 2.9% tax is split between wage earners and employers who pay their employees W-2 income. Beginning in 2013, an additional tax of 0.9% was imposed on all income above a certain level for high-income tax payers. There is also a 3.8% tax on all taxable interest, dividends, capital gains, annuities, royalties, and rented properties (Cussen, 2018).

Data and analysis show that increasing the number of people covered by health insurance improves health outcomes and contributes to labor market growth, overall economic stability, and growth through increased revenues and decreased spending. Further, there is a clear association between insurance coverage and maternal health outcomes, specifically that lack of health insurance raises a woman's risk of maternal mortality. While insurance coverage is in some ways the business of each individual state, the passage of the ACA cemented the federal government's position and regulatory authority in the insurance markets. Even if the ACA is 'repealed and replaced' by the current administration, there will still be federal involvement in national health insurance.

To continue, from an economic perspective, the health insurance reform that the ACA began, cost-benefit analysis needs to be used to create a more efficient and beneficial system. The United States spends substantially more money on health care and health services than OECD nations and this is one reason individuals are less inclined to purchase insurance. High health care costs translates to high premiums for health insurance consumers. There is a tendency in the United States to adopt the newest technology as it is made available when the social value of that technology is not enough to compensate for the monetary cost (Gruber & Owings, 1996). For example, during the 1970's, the fertility rate in the United States was decreasing and caesarean section births were increasing. Gruber was able to use the theory of

induced demand to characterize the relationship between physicians and their patients as physicians elected to utilize the caesarean section technology more frequently. Through analysis of birth record data, there was a strong correlation found between within-state declines in fertility and within-state increases in caesarean utilization. Following the theory of induced demand, when faced with the negative shock of decreased fertility and, therefore, decreased number of births, physicians elected to exploit the agency relationship they had with their patients and provide excessive care in the form of a caesarean birth in order to maintain income (Gruber & Owings, 1996). The up-front payment or insurance reimbursement for a caesarean section was greater than that for a natural birth and physicians were responsive to this change in financial environment. This is not to imply that all physicians are greedy and deliver care based solely on financial incentive, but it does highlight an important interplay between health insurance coverage, health care costs, and the physical and monetary burdens rising health care costs have on individuals.

Before increasing tax revenues through more progressive tax policy, there is a need to investigate redundancies, fraud, and inefficiencies in the United States health care system to better understand the true costs of the care being provided and its benefit to society. In conjunction with understanding the costs and benefits of the health insurance system, it is equally important to recognize the improvements in public health since the passage of the ACA. These benefits are possible through continued state and federal funding, which depend on tax revenue. There is evidence that cutting taxes for lower-income earners may boost spending activity at the margin more than cutting taxes for the wealthy (Kurtzleben, 2015). However, tax cuts lead to lower revenues, which in turn lead to spending cuts. Long-term continuation of tax cuts slow long-term economic growth and increase budget deficits, which already weigh

immensely on local, state, and federal government ("Federal Budget and Economy", 2016). As a first step, the United States must limit the duration of tax cuts in order to prioritize health insurance coverage as a means to achieve better public health outcomes.

With regard to maternal health specifically, increased coverage is a critical piece of reform that needs to be a continued concern and priority. The passage of the ACA required all insurance plans to provide coverage for maternal and prenatal expenses. There are still plans that were grandfathered into the system and do not currently have to cover maternal health expenses. A standard for maternal health coverage must be established by the federal government to ensure that no populations of women in the United States are being medically underserved.

The philosophy of the ACA is health insurance is a social or merit good that everyone should have. Whether the United States decides that health insurance is a human right, there is still a pressing need to reform the health insurance system to better serve Americans and increase positive health outcomes for all individuals. A mandate on insurance purchasing is still considered constitutional, but it comes with the requirement that health insurance be affordable (or made affordable through a subsidy) and that there is a standard of coverage being provided nationally. With a mandate and subsidy, the first thought is generally to increase taxes and increase tax revenue in order to fund these measures. The United States is already spending high amounts on health care and needs to evaluate the efficiency of the health care system to justify these tax increases. On the physician and health care facility side of this issue, there needs to be a change in the workflow to flag patients with lower education levels or decreased insurance coverage as needing increased attention throughout pregnancy and postpartum.

A crucial fact for understanding the United States health insurance system is that, as a society, the U.S. has elected capitalism as the way to allocate resources, including health

resources. Markets determine resource allocation with generally minimal government intervention. Health insurance becomes a delicate issue because of the belief by some individuals that access to quality health care is a human right and health insurance coverage provides the means to this right. However, it is more difficult to assign a monetary amount to health outcomes than it is with other public goods. This is where variations in the cost-benefit analysis of health insurance system reforms becomes relevant. Economists who place high monetary value on positive health outcomes will argue that the benefits of increased health insurance coverage and access will greatly outweigh the costs of health insurance reform. There is a need for many different economists and policy makers to work together to create a better financial outline of the costs and benefits of health insurance reform in order to move forward with fiscal and other social policies.

# Chapter 4: Conclusion

The regression analysis supports the rejection of the null hypothesis, that there is no association between the identified social variables and maternal mortality in the United States. The model specifically showed that maternal education level and health insurance coverage have significant effects on maternal mortality. The alternate hypothesis supports this conclusion, that there is an association between the identified social variables and maternal mortality. This provides a clear path for economic policy to address the social variables that can help decrease maternal mortality rates in the United States.

Social variables are becoming increasingly recognized as powerful determinants of health. In an analysis of 24 countries across the world, the higher mortality of women with lower levels of education, as one example of a social variable, cannot be explained by the level of medical services available at the facilities where they give birth (Karlsen et al., 2011). The impacts of wider social determinants of health are surpassing the quality of health care facilities and should garner public focus and prioritization in order to improve the health outcomes of mothers.

In the United States, a developed nation with high levels of health care, researchers assert that investment in education and health insurance may prove the most cost-effective and efficient means of achieving better community health and, specifically, better maternal health. Educational disparities are strongly correlated with major risk factors and health issues complicating pregnancies today, such as smoking, obesity, and high blood pressure (Ma et al., 2018). Additionally, the increased risk of death attributable to lack of health insurance coverage suggests that alternative measures of access to medical care such as community health centers do

not provide enough health protection and expanding health insurance to cover more or all of the population will have a greater effect on reducing mortality (Wilper et al., 2009).

There are limitations to this study that require further, more specific and more comprehensive research in order to more completely understand the health issue of maternal mortality. In this study, there was no differentiation between maternal deaths in urban centers and in rural areas. Access to health facilities remains a barrier to positive health outcomes for rural communities. By distinguishing between maternal deaths in rural and urban areas, more specific policy can be formulated to better fit different social communities. Another important social variable missing from this analysis is race. There are copious amount of literature evidence correlating race with health outcomes. Non-White Americans, on average, have significantly poorer health outcomes than their White (non-Hispanic) counterparts. To properly address the health issues experienced by these communities, policy must be changed to specifically target different racial groups.

The presence of high maternal mortality rates in United States society is an indicator of an opportunity to improve social determinants of health in an effort to achieve positive health outcomes for all Americans. The findings in this research, while based in maternal mortality and maternal health, can be applied more broadly to other public health issues to better understand action that can be taken through policy to facilitate a healthier society.

# Reference List

[2016 Public Elementary-Secondary Education Finance Data]. (2016). Data retrieved from United States Census Bureau. www.census.gov/data/tables/2016/econ/school-finances/secondary-education-finance.html.

A 50 State Look at Medicaid Expansion. (2019, March). Retrieved from https://familiesusa.org/product/50-state-look-medicaid-expansion.

Agrawal, P. (2015). Maternal mortality and morbidity in the united states of america. *Bulletin of the World Health Organization*, *93*(3), 135. https://doi.org/10.2471/BLT.14.148627

*Annual Survey of School System Finances.* (2016). Retrieved from www.census.gov/programs-surveys/school-finances.html.

Bachrach, D., Boozang, P., Herring, A., & Reyneri, D. (2016, March 1) *States Expanding Medicaid See Significant Budget Savings and Revenue Gains* (Rep.). Retrieved from www.rwjf.org/en/library/research/2015/04/states-expanding-medicaid-see-significant-budget-savings-and-rev.html.

Backlund, E., Sorlie, P. D., & Johnson, N. J. (1999). A comparison of the relationships of education and income with mortality: The national longitudinal mortality study. *Social Science and Medicine*. https://doi.org/10.1016/S0277-9536(99)00209-9

Berchick, E. R., Hood, E., & Barnett, J. C. (2018, September). *Health Insurance Coverage in the United States: 2017 Current Population Reports.* (Rep.). Retrieved from www.census.gov/content/dam/Census/library/publications/2018/demo/p60-264.pdf.

Capital Gains and Dividends: How are capital gains taxed? (2016). In *Tax Policy Center Briefing Book: Key Elements of the U.S. Tax System.* Retrieved from www.taxpolicycenter.org/briefing-book/how-are-capital-gains-taxed.

Centers for Disease Control and Prevention. (2018). WONDER. Retrieved from https://wonder.cdc.gov/

*CDC WONDER* [Pamphlet]. (2018, June 19). Atlanta, GA: Centers for Disease Control. Retrieved from https://wonder.cdc.gov/wonder/help/about-cdc-wonder-508.pdf.

Collins, C., & Propheter, G. (2013). The Property Tax Base and The Great Recession. *Ta, Tax Analys*(fiscal 2012), 445–448. Retrieved from https://gwipp.gwu.edu/sites/g/files/zaxdzs2181/f/downloads/Property Tax Base and the Great Recession August 2013.pdf

Completion Rates, 2013-2017 (Completing college, adults 25 and older) [Map]. (2019, February 28). In *United States Department of Agriculture and Economic Research Service*. Washington, D.C. Retrieved from https://data.ers.usda.gov/reports.aspx?ID=17829.

Creanga, A. A., Berg, C. J., Ko, J. Y., Farr, S. L., Tong, V. T., Bruce, F. C., & Callaghan, W. M. (2014). Maternal Mortality and Morbidity in the United States: Where Are We Now? *Journal of Women's Health*, *23*(1), 3–9. https://doi.org/10.1089/jwh.2013.4617

Creanga, A. A., Berg, C. J., Syverson, C., Bruce, F. C., Callaghan, W. M., & Seed, K. (2015). Pregnancy-Related Mortality in the United, *125*(1), 2006–2010. https://doi.org/10.1097/AOG.0000000000000564

Cussen, M.P. (2018, October 18). How Much Medicaid and Medicare Cost Americans. Retrieved from www.investopedia.com/articles/personal-finance/082015/how-much-medicaid-and-medicare-cost-americans.asp.

Data Access and Dissemination Systems (DADS). (2010, October). American FactFinder. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

DeSilver, D. (2017, February 15). U.S. students' academic achievement still lags that of their peers in many other countries. Retrieved from www.pewresearch.org/fact-tank/2017/02/15/u-s-students-internationally-math-science/.

Dyrda, L. (2017, February 2). How many hospitals does each state have? Retrieved from www.beckershospitalreview.com/hospital-transactions-and-valuation/how-many-hospitals-does-each-state-have.html.

Federal Budget and Economy: How do taxes affect the economy in the long run? (2016). In *Tax Policy Center Briefing Book: Key Elements of the U.S. Tax System.* Retrieved from www.taxpolicycenter.org/briefing-book/how-do-taxes-affect-economy-long-run.

Federal Medical Assistance Percentages or Federal Financial Participation in State Assistance Expenditures. (2017, April 4). Retrieved from https://aspe.hhs.gov/federal-medical-assistance-percentages-or-federal-financial-participation-state-assistance-expenditures.

Geng, T. (2018). The Complementarity of Incentive Policies in Education : Evidence from New York City.

Goldstein, S. M., Ward, P. T., Leong, G. K., & Butler, T. W. (2002). The effect of location, strategy, and operations technology on hospital performance. *Journal of Operations Management*, *20*(1), 63–75. https://doi.org/10.1016/S0272-6963(01)00081-X

Gruber, J. (2018). *Public Finance and Public Policy.* (5th ed.). New York: Worth.

Gruber, J., & Owings, M. (1996). Physician Financial Incentives and Cesarean Section Delivery. *The RAND Journal of Economics*, *27*(1), 99–123.

Guzman, G. C. (2017, September). *Household Income: 2016, American Community Service Briefs*. (pp. 1-7, Issue brief No. ACSBR 16-02). U.S. Census Bureau. Retrieved from www.census.gov/content/dam/Census/library/publications/2017/acs/acsbr16-02.pdf.

Haberkorn, J. (2012, June 28). Supreme Court upholds individual mandate. *Politico.* Retrieved from www.politico.com/story/2012/06/supreme-court-health-care-ruling-077935.

Hadley, J. (2003). Sicker and Poorer—The Consequences of Being Uninsured: A Review of the Research on the Relationship between Health Insurance, Medical Care Use, Health, Work, and Income. *Medical Care Research and Review*. https://doi.org/10.1177/1077558703254101

Hilmer, Christiana E., and Michael J. Hilmer. *Practical Econometrics: Data Collection, Analysis, and Application.* New York, NY: McGraw-Hill Education, 2014.

How are the Local, State and Federal Governments Involved in Education? Is this Involvement Just? (n.d.). Retrieved from www.cpjustice.org/public/page/content/cie_faq_levels_of_government.

Kaplan, G. A., Pamuk, E. R., Lynch, J. W., Cohen, R. D., & Balfour, J. L. (1996). Inequality in income and mortality in the United States: analysis of mortality and potential pathways. *Bmj*, *312*(7037), 999–1003. https://doi.org/10.1136/bmj.312.7037.999

Karlsen, S., Say, L., Souza, J. P., Hogue, C. J., Calles, D. L., Gülmezoglu, A. M., & Raine, R. (2011). The relationship between maternal education and mortality among women giving birth in health care institutions: Analysis of the cross sectional WHO Global Survey on Maternal and Perinatal Health. *BMC Public Health*, *11*. https://doi.org/10.1186/1471-2458-11-606

Knight, D. S., & DeMatthews, D. (2018, October 9). Texas Needs to Fund Its Public Schools Differently. *UT News*. Retrieved from https://news.utexas.edu/2018/10/09/texas-needs-to-fund-its-public-schools-differently/.

Kurtzleben, D. (Writer). (2015, October 30). Fact Check: Do Tax Cuts Grow the Economy? [Transcript, Radio]. In *It's All Politics*. National Public Radio. Retrieved from www.npr.org/sections/itsallpolitics/2015/10/30/452905475/fact-check-do-tax-cuts-grow-the-economy.

Leachman, M., Albares, N., Masterson, K., & Wallace, M. (2016). Most States Have Cut School Funding, and Some Continue Cutting | Center on Budget and Policy Priorities, 1–16. Retrieved from http://www.cbpp.org/research/state-budget-and-tax/most-states-have-cut-school-funding-and-some-continue-cutting

Levin, H. M. (2017). The Economic Payoff to Investing in Educational Justice. In P. Siljander, K. Kontio, & E. Pikkarainen (Eds.), *Schools in Transition: Linking Past, Present, and Future Educational Practice* (pp. 161–188). Finland: Sense Publishers.

Lleras-Muney, A. (2001). The relationship between education and adult mortality in the US. *Mimeograph, Princeton University*, *72*(1), 189–221. https://doi.org/10.1111/0034-6527.00329

Ma, J., Siegel, R. L., Ward, E. M., & Jemal, A. (2018). State-level educational disparities in mortality in the United States, 2010–2014. *Preventive Medicine*, *106*(October 2017), 53–59. https://doi.org/10.1016/j.ypmed.2017.10.004

Main Page. (2019). Retrieved from https://ballotpedia.org/Main_Page.

Mervosh, S. (2018, December 30). Obamacare, Ruled Invalid by Federal Judge, Will Remain in Effect During Appeal. *The New York Times.* Retrieved from www.nytimes.com/2018/12/30/us/politics/obamacare-appeal-judge.html.

Miron, G., Mathis, W., & Welner, K. (2015). Review of Separating Fact & Fiction, *174*, 168–174. Retrieved from http://nepc.colorado.edu/thinktank/review-separating-fact-and-fiction

Obamacare Basics: What is the Affordable Care Act? (n.d.). Retrieved from https://healthcare.findlaw.com/patient-rights/obamacare-basics-understanding-the-affordable-care-act.html.

Peterson, P. E. (2016). The End of the Bush-Obama Regulatory Approach to School Reform: Choice and competition remain the country's best hope. *Education Next*.

Policy Basics: Where Do Our State Tax Dollars Go? (2018, July 25). Retrieved from www.cbpp.org/research/state-budget-and-tax/policy-basics-where-do-our-state-tax-dollars-go.

Property Taxes by State. (2019). Retrieved from www.tax-rates.org/taxtables/property-tax-by-state.

Quesnel-Vallée, A. (2004). Is it really worse to have public health insurance than to have no insurance at all? Health insurance and adult health in the united states. *Journal of Health and Social Behavior*. https://doi.org/10.1177/002214650404500402

Ravitch, D. (2018, June 22). Charter schools damage public education. *Washington Post*. Retrieved from www.washingtonpost.com/opinions/charter-schools-are-leading-to-an-unhealthy-divide-in-american-education/2018/06/22/73430df8-7016-11e8-afd5-778aca903bbe_story.html?noredirect=on&utm_term=.5c7e9d34ef43.

*SOI Tax Stats – Individual Statistical Tables by Tax Rate and Income Percentile.* (2016). Retrieved from Internal Revenue Service.

Sorlie, P. D., Johnson, N. J., Backlund, E., & Bradham, D. D. (1994). Mortality in the uninsured compared with that in persons with public and private health insurance. *Archives of Internal Medicine*. https://doi.org/10.1001/archinte.154.21.2409

Swaby, A. (2019, February 15). Texas' school finance system is unpopular and complex. Here's how it works. *The Texas Tribune*. Retrieved from www.texastribune.org/2019/02/15/texas-school-funding-how-it-works/.

Tax Cuts: Myths and Realities. (2017, October 11). Retrieved from www.cbpp.org/research/tax-cuts-myths-and-realities.

Tilsley, A., Blagg, K., & Chingos, M. (2017, November 29). How do school funding formulas work? (E. Forney, Ed.) Retrieved from https://apps.urban.org/features/funding-formulas/.

The Henry J. Kaiser Family Foundation. (2019). Retrieved from www.kff.org.

The Henry J. Kaiser Family Foundation. (2016). Health Insurance Coverage of the Total Population. Retrieved from www.kff.org/other/state-indicator/distribution-by-gender/?dataView=1&currentTimeframe=1&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D

Title I, Part A Program. (2018, November 7). Retrieved from www.ed.gov/programs/titleiparta/index.html.

Trends, M. M. (2016). HHS Public Access, *128*(3), 447–455. https://doi.org/10.1097/AOG.0000000000001556.Is

Turner, C. (Writer). (2016, April 18). *Why American Schools Have a Money Problem* [Transcript, Radio broadcast]. In *Morning Edition*. National Public Radio. Retrieved from www.npr.org/2016/04/18/474256366/why-americas-schools-have-a-money-problem.

"United Nations Millennium Development Goal #5: Improve Maternal Health." (n.d.). Retrieved from www.un.org/millenniumgoals/maternal.shtml.

United States Census Bureau. (2017). *American FactFinder*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Weingarten, R. (2016, December 19). Education Policies Worthy of the Name 'Reform'. Retrieved from www.huffingtonpost.com/randi-weingarten/education-policies-worthy_b_8847068.html.

Whellan, A. (2017, May 10). *Income Effects on Maternal Mortality Rates in Texas Counties* [Scholarly project].

Where the states stand on Medicaid expansion. (2019, April 1). Retrieved from www.advisory.com/daily-briefing/resources/primers/medicaidmap.

Wilper, A. P., Woolhandler, S., Lasser, K. E., McCormick, D., Bor, D. H., & Himmelstein, D. U. (2009). Health insurance and mortality in US adults. *American Journal of Public Health*. https://doi.org/10.2105/AJPH.2008.157685

Women's and men's earnings by age in 2016. (2017, August 27). Retrieved from www.bls.gov/opub/ted/2017/womens-and-mens-earnings-by-age-in-2016.htm.

"World Health Organization: Maternal mortality ratio (per 100,000 live births". (2014, March 11). Retrieved from www.who.int/healthinfo/statistics/indmaternalmortality/en/.

Yang, N., Chen, S., Hu, W., Wu, Z., & Chao, Y. (2016). Spatial distribution balance analysis of hospitals in Wuhan. *International Journal of Environmental Research and Public Health*, *13*(10). https://doi.org/10.3390/ijerph13100971

Zhao, Y. (2009). Chapter 1: Recent Education Reform in the United States. In *Catching Up or Leading the Way*.

# Appendices

**Figure 1:** Summary Statistics Table of All Variables

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| State ID | 5.5 | 3.02765 | 1 | 10 |
| Electoral College | .4 | 5163978 | 0 | 1 |
| Population | 1.43e+07 | 1.15e+07 | 3134693 | 3.93e+07 |
| Male Population | 7044795 | 5711095 | 1559119 | 1.95e+07 |
| Female Population | 7250645 | 5781421 | 1575574 | 1.98e+07 |
| Male/Female Ratio | .967008 | .0200763 | .938384 | .9895562 |
| Mortality Rate | 864.74 | 137.4015 | 668.1 | 1078 |
| Birth Rate | 12.136 | .9643558 | 10.47 | 14.29 |
| Maternal Mortality Rate | 16.72 | 8.014681 | 5.8 | 31.5 |
| Education Level: Less than High School | 998628.1 | 1097009 | 110042 | 3530335 |
| Education Level: High School Graduate (GED) | 1806775 | 1249970 | 441298 | 4170491 |
| Education Level: Bachelor Degree or Higher | 2396913 | 1957359 | 462862 | 6707111 |
| Percent Uninsured | 7.4 | 3.977716 | 3 | 17 |
| Median Income | 58435.8 | 8499.662 | 46257 | 75297 |
| Gini Coefficient | .4782 | .017428 | .445 | .513 |
| Unemployment Rate | 7.41 | 1.270564 | 4.5 | 8.7 |
| Average Age of Mother | 28.726 | 1.067658 | 27.18 | 30.64 |
| Fertility Rate | 61.604 | 4.561655 | 51.94 | 68.55 |
| Population Below Poverty Level | 1175076 | 960724.8 | 210303 | 3303242 |

Observations: 10

Variables in the table listed from top to bottom: State ID, Electoral College ID, State Population in 2016, Male Population, Female Population, Male/Female Ratio, Mortality Rate (per 100,000 population), Birth Rate (per 1,000 population), Maternal Mortality Rate, Education Level: Less than High School, Education Level: High School Graduate or GED, Education Level: Bachelor Degree or Higher, Percent of Population Uninsured, Median Annual Income, Gini Coefficient, Unemployment Rate, Average Age of Mother at Childbirth, Fertility Rate, Population Below the Poverty Level.

**Figure 2:** Summary Statistics Table of Education Level Variables

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Education Level: Less than High School | 998628.1 | 1097009 | 110042 | 3530335 |
| Education Level: High School Graduate (GED) | 1806775 | 1249970 | 441298 | 4170491 |
| Education Level: Bachelor Degree or Higher | 2396913 | 1957359 | 462862 | 6707111 |

**Figure 3:** Scatter Plot Showing Fertility Rate vs. Electoral College

States are given the designation of either Red State (0) or Blue State (1) based on the Electoral College votes from the 2016 presidential election. This is a general variable to determine the overall political leaning of the states in an effort to analyze policy within the terms of Conservative and Liberal states. This scatter plot shows that Red States have, on average, have higher fertility rates than Blue States.

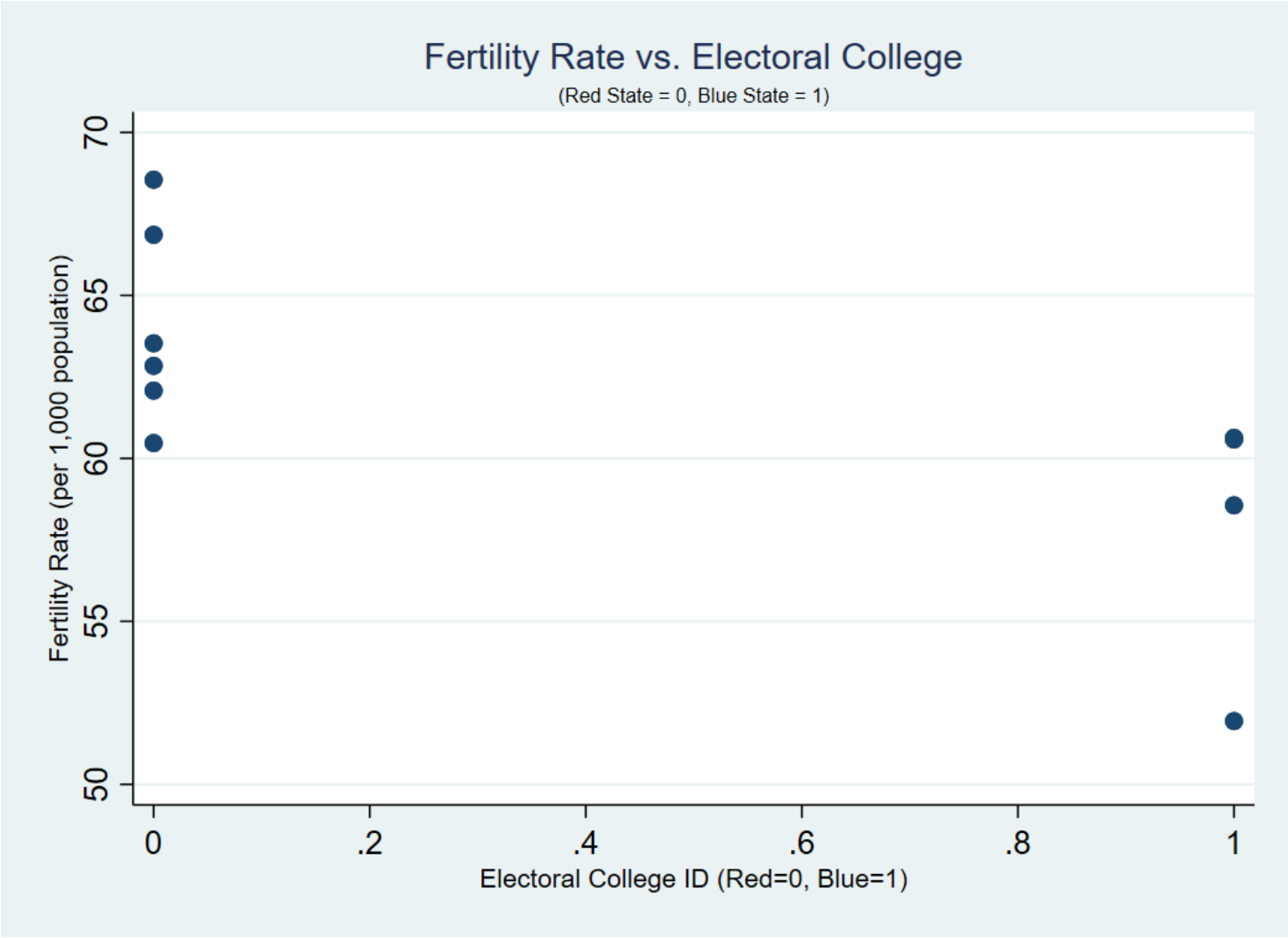

**Figure 4:** Scatter Plot Showing Educational Attainment vs. Mortality Rate

The scatter plot shows negative association between then number of people whose education level is labeled as 'High School Graduate or GED' and mortality. This means that as more members of the population attain a high school diploma or equivalent, the state mortality rate decreases.

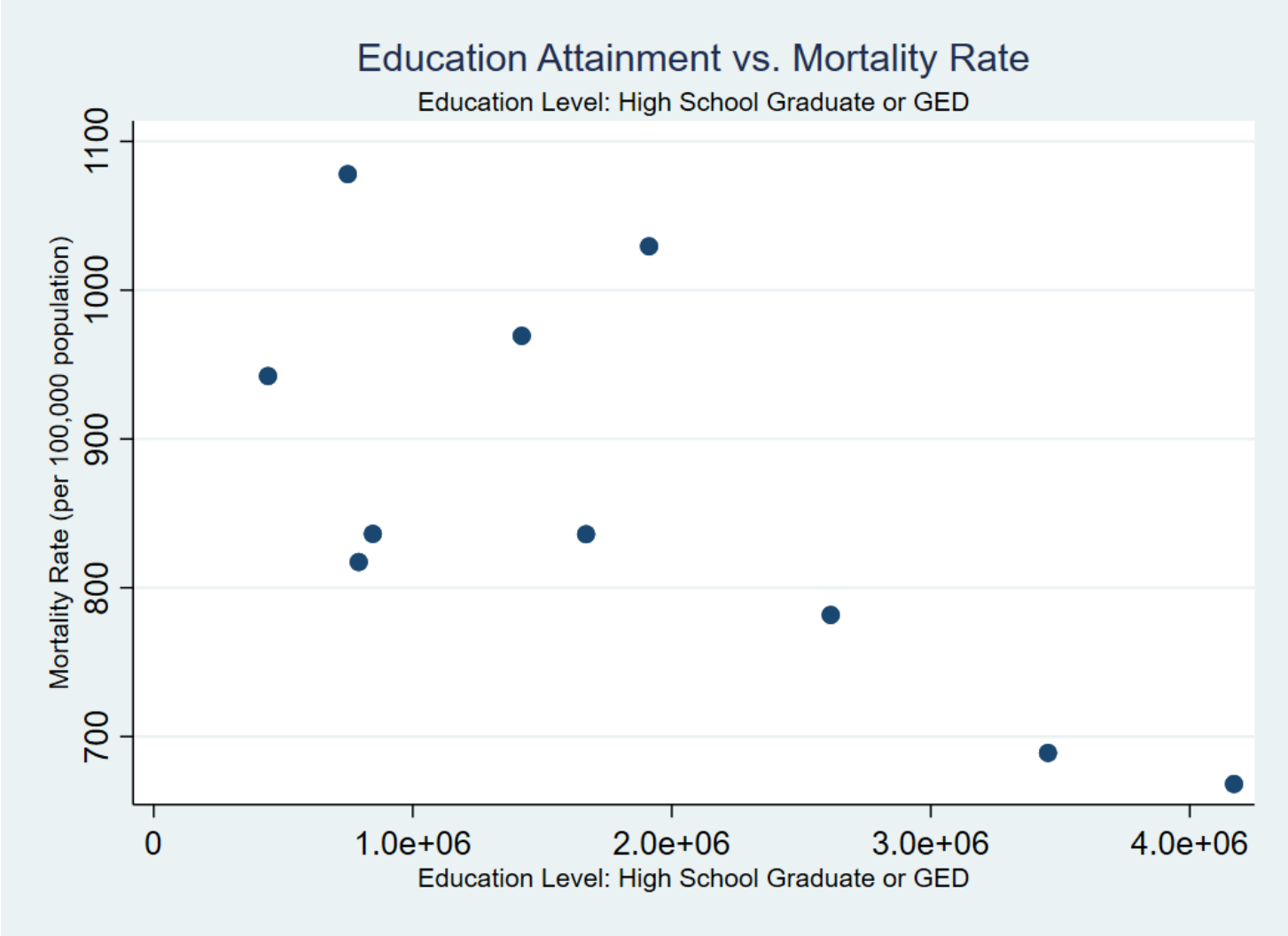

**Figure 5:** Scatter Plot Showing Mortality Rate vs. Median Annual Income

The scatter plot shows a negative association between the median annual income of a state and that state's mortality rate. This means that as median income increases, the mortality rate of a state decreases.

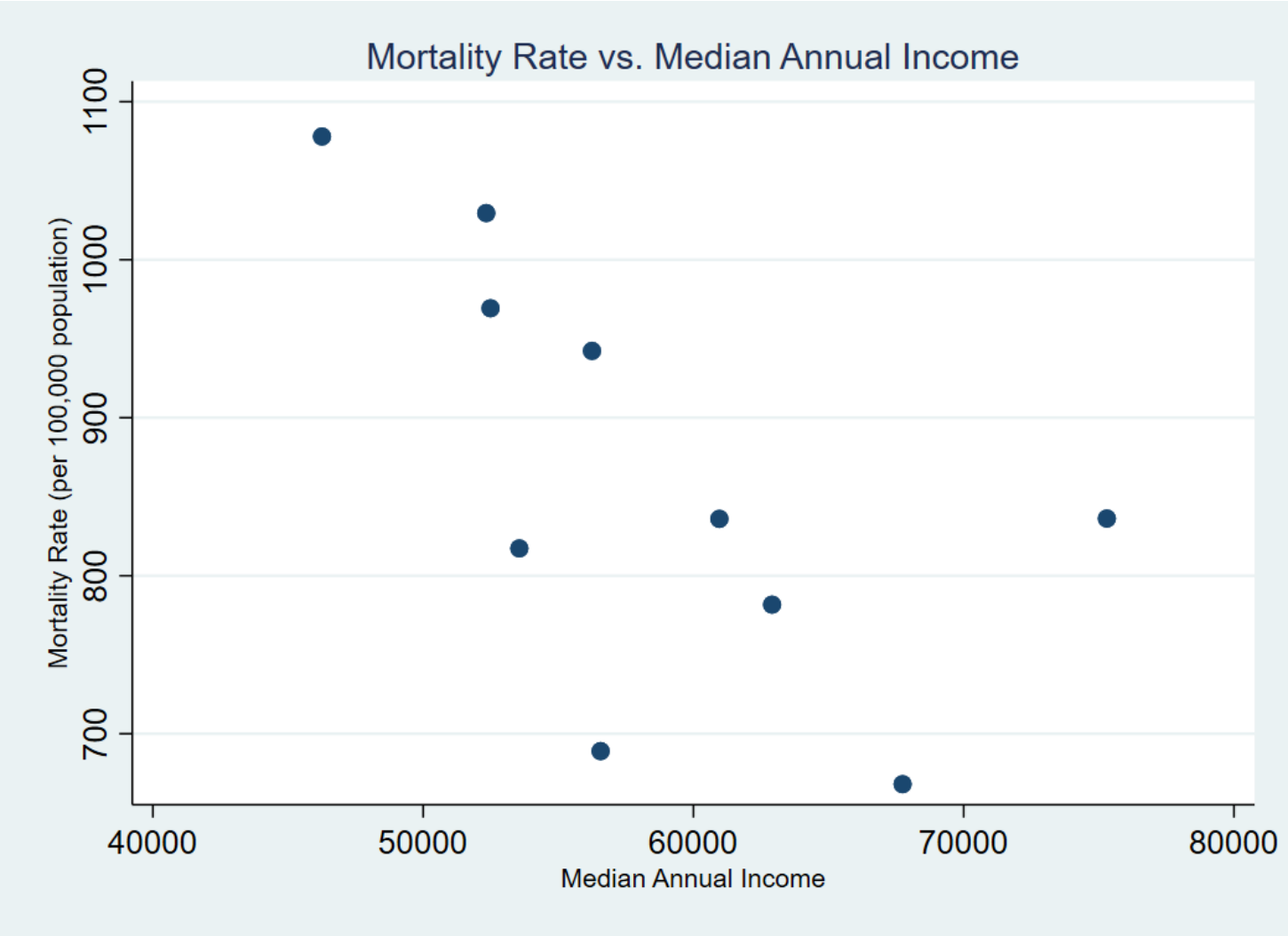

**Figure 6:** Scatter Plot Showing Percent of Population Uninsured vs. Average Age of Mother at Childbirth

The scatter plot shows a negative association between the percent of the population of a state that is uninsured and the average age of the mother at childbirth. It appears that women who have children when they are slightly older are more likely to have health insurance.

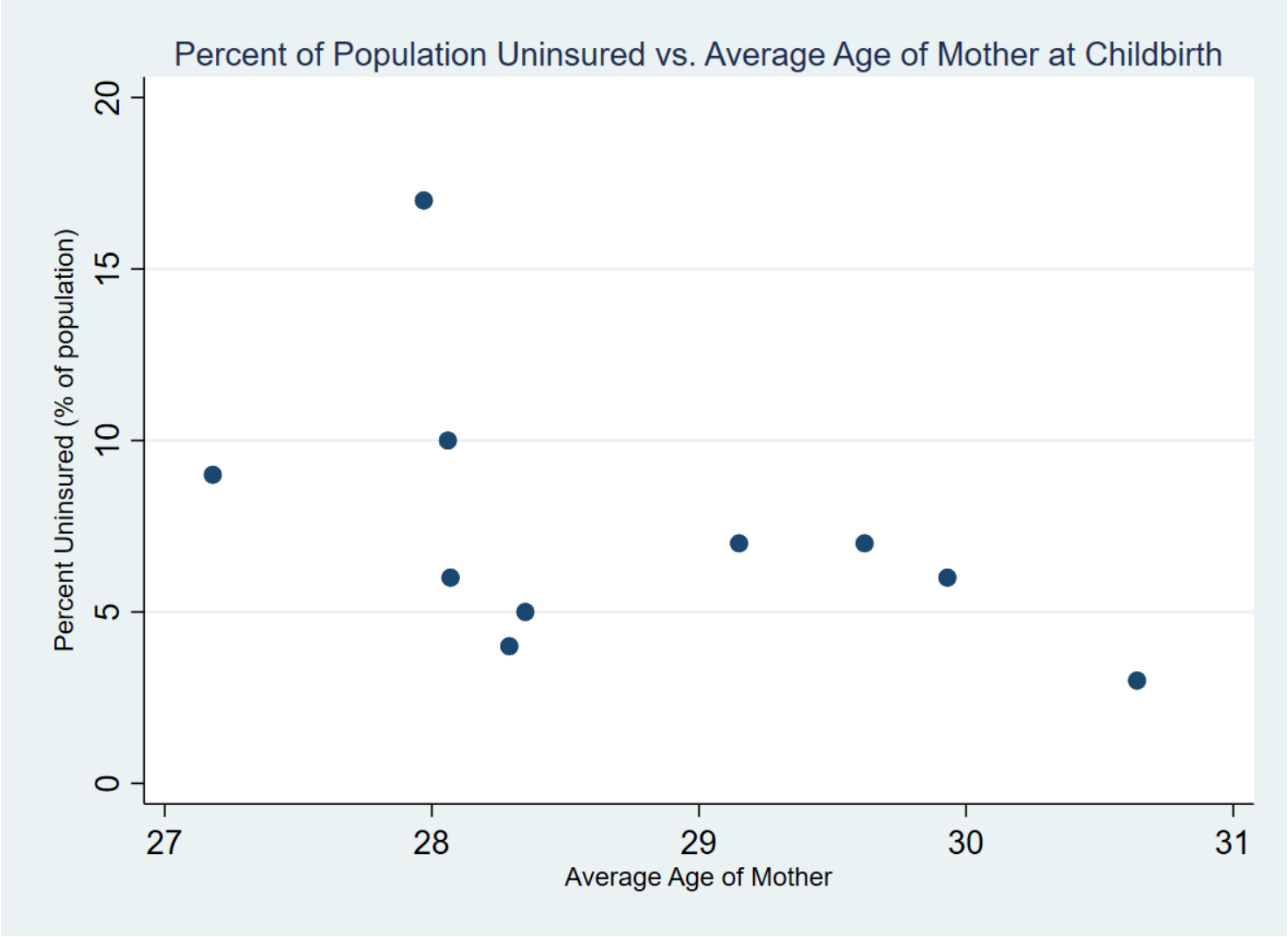

**Figure 7:** Scatter Plot Showing Maternal Mortality Rate vs. the Number of Hospitals in the State

The scatter plot shows a positive association between the maternal mortality rate and the number of hospitals present in the state. There is one outlier in this scatterplot. The state of California has a high number of hospitals and a low maternal mortality rate.

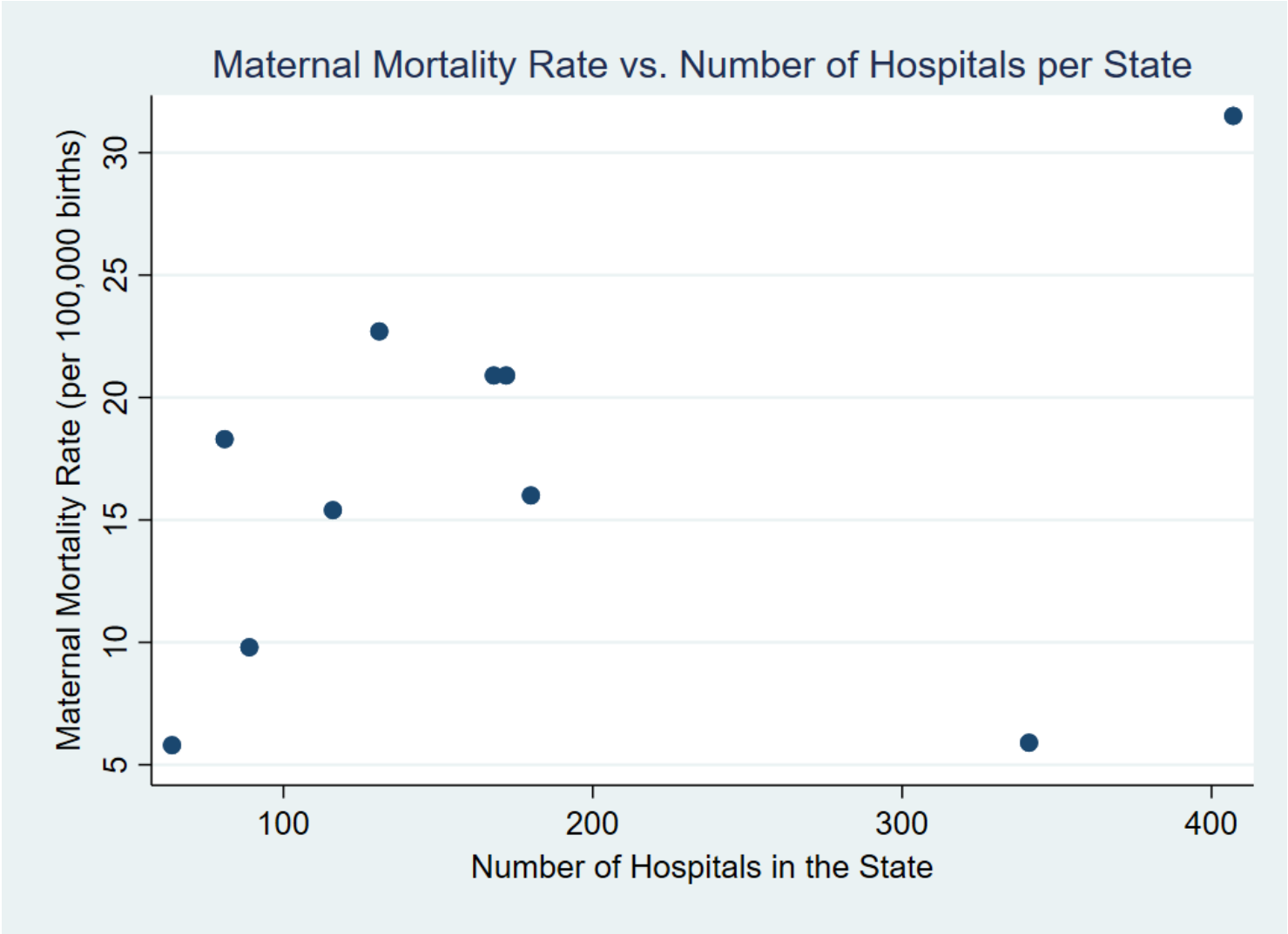

**Figure 8:** Coefficients and Robust Standard Errors from ML-Random Effects and OLS Models for the Effect of Social Variables on Maternal Mortality Rates in 10 States (Panel Variable: StateID)

| | ML-Random Effects Coefficients | OLS Coefficients |
|---|---|---|
| Male/Female Ratio | 176.3735* | 176.3735 |
| Education Level: Less than High School | -.0000135* | -.0000135 |
| Education Level: High School Graduate (GED) | .0000106* | .0000106 |
| Percent of Population Uninsured | 1.453501* | 1.453501 |
| Unemployment Rate | -1.376964 | -.0011779 |
| Median Income | -.0011779 | -1.376964 |
| Average Age of Mother | 9.523855 | 9.523855 |
| Observations | 10 | 10 |

*p < 0.05 Prob > $chi^2$ = 0.0026 LR $chi^2$ = 21.90

None of the P>|t| values are less than .05 which means that none of these variables are significant when they are all run together. Further, the R-squared value is .9502 which means 95.02% of the variation in the dependent variable can be explained by the independent variables, which is a very high and strong correlation. This is an indication that the OLS model is not the right fit for the data.

**Figure 9:** Paired T-Test Comparing Maternal Mortality and State ID

| | Standard Deviation | 95% Confidence Interval | |
|---|---|---|---|
| Maternal Mortality | 8.014681 | 10.98664 | 22.45336 |
| State ID | 3.02765 | 3.334149 | 7.665851 |

$|T| > |t| = 0.0003$

**Figure 10:** Coefficients and Robust Standard Errors from ML-Random Effects for the Effect of Social Variables on Maternal Mortality Rates in 10 States (Education variables include Female-only data, Panel Variable: StateID)

| | ML-Random Effects Coefficients |
|---|---|
| Male/Female Ratio | 96.28722 |
| Education Level: Less than High School<br>*Female-only education* | -.0000804* |
| Education Level: High School Graduate (GED)<br>*Female-only education* | .0000308* |
| Percent of Population Uninsured | 1.488714* |
| Unemployment Rate | -1.25057 |
| Median Income | -.0002016 |
| Observations | 10 |

*$p < 0.05$ Prob > $chi^2$ = 0.0194 LR $chi^2$ = 15.11