



2019

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Recommended Citation

Filbert, Rowland (2019) "The Effect of the Economy on Suicide Rates," *The Park Place Economist*: Vol. 27

Available at: <https://digitalcommons.iwu.edu/parkplace/vol27/iss1/14>

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The Effect of the Economy on Suicide Rates

Abstract

Using a panel dataset covering all 50 states and the District of Columbia during the period of 1999-2014, the present study will analyze the relationship between economic factors, such as business closures and job destruction, and suicide rates. The goal of this study is to explain how suicide rates have changed over time in relation to changes in the economy. Additionally, the study will show which states were most or least affected in terms of suicide by these economic changes.

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I. INTRODUCTION

Mental health is a topic that can oftentimes be overlooked by society in the United States. It can be hard to determine how an individual feels on the inside without direct knowledge of that person's lifestyle or personal and professional circumstances. The most fatal determination that someone may be having trouble with his or her mental health is suicide, or the act of taking one's own life voluntarily and intentionally. Suicide is an issue that resonates among many households throughout the United States, with 44,965 occurrences of suicide in 2016 alone (National Institute of Mental Health). There is a multitude of factors that can play into why an individual commits suicide and one of these potential factors is losing one's job. Having an income taken away can be devastating for an individual and may lead to desperate thoughts of suicide.

In 2016, suicide was the tenth-leading cause of death among all age groups in the U.S. with 44,965 deaths. Heart disease was the leading cause with 635,260 deaths while malignant neoplasms was second with 598,038 deaths (National Center for Injury Prevention and Control). While this accounts for all age groups in the United States, suicide was also found to be more prevalent during earlier stages of one's lifetime. During the ages of 10 to 34, suicide was second (13,525 deaths) only to unintentional injury (38,726 deaths) as the leading cause of death in the United States (National Center for Injury Prevention and Control). This can have a significant impact on a society as this is the age group predominantly asso-

ciated with acquiring and sustaining human capital. If there is a rise in fatalities among this age group, then the country is losing out on the resources that those individuals would have brought to society. The other side of this argument is that these individuals who are committing suicide are trying to use their knowledge and skill set yet have still been laid off or forced to quit due to the economy.

Economic factors that can lead to the destruction of jobs include large factory closures, small businesses being forced to shut down because they have too much debt, or companies relocating their offices. In addition, troughs in the business cycle of the United States economy as a whole could account for suddenly leaving many individuals without a job. However, even as the economy is regaining strength after the financial crisis of 2008, the suicide rate in the U.S. has steadily increased. The suicide rate in the U.S. per 100,000 individuals was 12.96 in 2014, rose to 13.26 in 2015, and then stepped up to 13.42 in 2016 (American Foundation for Suicide Prevention). As the economy gets increasingly stronger, the expectation is that job destruction will fall as businesses that were once struggling will regain their footing. In addition, new job openings may become available for individuals that had once been laid off or fired. Both of these factors should influence a decrease in the suicide rate, but this is not the case.

Using a panel dataset covering all 50 states and the District of Columbia during the period of 1999-2014, the present study will analyze the relationship between economic factors, such as business closures

and job destruction, and suicide rates. The goal of this study is to explain how suicide rates have changed over time in relation to changes in the economy. Additionally, the study will show which states were most or least affected in terms of suicide by these economic changes.

The rest of the paper proceeds in the following manner: Section 2 summarizes previous findings related to economic outcomes affecting the health of individuals. Section 3 details the data and empirical model. Section 4 presents the results, and finally, Section 5 establishes the conclusion.

II. LITERATURE REVIEW

In the pursuit to gain more knowledge of the impact of economic hardships on health outcomes, several previously published pieces of literature at the intersection of job loss and suicide were analyzed. The seminal work of Hamermesh (1974) examines the economic theory of suicide while discussing the relationship between sociology and economics. It postulates that suicide results from individuals' frustration in their attempts to achieve their social goals and the ensuing aggressive feelings, directed either at themselves (suicide) or at others (homicide) (Hamermesh 1974). In addition, Hamermesh states that economic improvement leads to a decrease in frustration and thus aggression (1974). An important social goal in America's capitalist society is getting and retaining a job, so not obtaining this goal may induce these aggressive feelings whereas keeping a job could help prevent aggression.

Relating this idea of job loss affecting certain aspects of health to a more current United States labor market, Strully (2009) observed the effect of rising rates in job loss in white-collar occupations on individual health. Expanding on the seminal study, Strully states that job loss is a major social stressor

that may simultaneously disrupt many dimensions of socioeconomic status (e.g., income, occupational standing, wealth, family life, and social connections) (2009). The article concludes by saying that increased churning, i.e. high rates of job loss, but relatively low unemployment, in the United States may lead to an increase in the number of health conditions endured by American workers (Strully 2009).

Another relevant study questions if job loss leads to a shortened life expectancy and also describes mechanisms through which job loss can affect health. The article states that these mechanisms include stress associated to financial strain and the loss of psychosocial assets such as time structure, personal status, and work relationships; triggering of, or increased vulnerability to subsequent adverse life events; and destructive coping strategies or risky behaviors (Eliason 2007). Additionally, Eliason directly mentions suicide and says that a large part of the immediate mortality following job loss was due to an increase in the number of fatal suicides (2009).

There have been a number of empirical works directly looking at this cross section between job loss and suicide. One of these works, performed by Browning, uses Danish administrative data to identify plant closures primarily in the private sector during the years 1986-2002 (2012). Then, connecting individuals to these plants and certain data for the plants themselves such as the number of employees and the future status of the plant, Browning searched for overlaps in health diagnoses and mortality (2012). It was found that job loss due to these plant closures increased the risk of overall mortality, specifically mortality caused by suicide, suicide attempts, and mental illness (Browning 2012). The study also concluded that the effect of job loss on suicide is very strong immediately after losing a job with an increase of 62 percent in risk within 1 - 4

years after the base year (Browning 2012).

A similar study used administrative data covering over fifteen years of quarterly earnings and employer records matched to information on dates of death to study the effects of job displacement on the mortality of high-seniority male workers losing their jobs in Pennsylvania in the early to mid-1980s (Sullivan 2009). This examination of the relationship between job displacement and mortality again suggests that there is a particularly pronounced increase in mortality during the period immediately following a job loss (Sullivan 2009). However, Sullivan also found that there is a long-run increase of 10-15 percent in the annual probability of dying and this persists for twenty after displacement (2009).

Huikari and Korhonen utilizing national and regional data for suicide mortality rates in Finland during 1991-2011 looked at the impact of unemployment on these rates (2016). They found that fear of future unemployment leads people to commit suicide more often than would be expected in good economic times (2016). In addition, it was found that an increasing shock in regional unemployment rates relative to the national level affects regional suicides (Huikari and Korhonen 2016).

This provides an opportunity to expand the literature by analyzing the effects of job loss on suicide rates in the United States and determine if some states have been affected differently by economic changes. This analysis will help determine if the US shows similar characteristics to other countries such as Finland in regard to economic shocks having an effect on suicide. In addition, examining business exit and job destruction as variables in addition to unemployment rate will help gain more specific knowledge on this topic.

III. DATA AND EMPIRICAL MODEL

The panel dataset is composed of data collected from 1999-2014 over all 50 states and the District of Columbia. State-level business exit data is from the US Census Bureau's Business Dynamic Database. State-level macroeconomic data, such as real GDP and real personal income, is from the US Bureau of Economic Analysis and unemployment data is sourced from the US Bureau of Labor Statistics. Utilizing this data, the study analyzes one key outcome variable (suicide rate) and how economic changes such as establishment exits and job destruction affect this rate in different states.

The suicide rate is calculated by dividing the number of deaths caused by suicide and intentional self-harm by the number of people, and then multiplying the result by 100,000. Establishment exits are the number of establishments that closed during a certain period of time. Job destruction is defined as the employment decline resulting from establishments that contracted or closed. Table 1 in the Appendix shows the states with the highest and lowest values of suicide in the first (1999) and last (2014) years of the dataset. In 1999, the states with the highest suicide rates include Nevada, Wyoming, New Mexico, Alaska, and Arizona, whereas the states with the lowest were the District of Columbia, New York, New Jersey, Massachusetts, and Connecticut. Many of the states that had the lowest suicide rates in 1999 also had the lowest in 2014 as the District of Columbia, New York, New Jersey, and Massachusetts were again at the bottom. Maryland replaced Connecticut as one of the states with the lowest rates. As for the states with the highest suicide rates in 2014, Alaska, New Mexico, and Wyoming were again at the top with Nevada and Arizona being replaced by Montana and Colorado.

Table 2 in the Appendix shows the summary statistics for the variables included in the model. Sui-

cide rate is determined by the following variables: job destruction, establishment exits, population, unemployment rates, and real GDP per capita. Job destruction and real GDP per capita have the greatest standard deviations while job destruction has the largest range.

Graphs 1 and 2 in the Appendix display how the suicide rate is correlated with both job destruction and business exit, respectively. In both cases, there was negative correlation with job destruction at -0.3609 and business exit at -0.3341. Additionally, Graph 3 in the Appendix shows the correlation between suicide rate and unemployment rate. There was positive correlation at 0.0778.

Each variable was first transformed into logarithmic values in order to induce linearity in the series. In addition, all variables are run with one-year lagged values to account for the fact that there is a time-lag in the loss of a job being reflected on suicide rates. Before proceeding with the results, panel unit roots on the aforementioned variables were tested. All variables reject the null hypothesis of presence of a unit root indicating that they are stationary. Differences in population and production create unobserved variation across states. This variation promotes heterogeneity, or unique differences. Unobserved heterogeneity across states are captured by state fixed-effects (state dummies), and unobserved events over time like changes in the entrepreneurial environment or improvements in technology are captured by time fixed-effects (year dummies). With these parameters, the following fixed-effect estimation models are used:

$$\begin{aligned}
 (1) \text{ Suicide Rate} &= a_0 + a_1(\text{Establishment Exit}) \\
 &+ a_2(\text{Unemployment rates}) \\
 &+ a_3(\text{Real GDP per capita}) \\
 &+ a_4(\text{Population}) \\
 &+ a_5(\text{Year dummies})
 \end{aligned}$$

$$+ a_6(\text{State dummies})$$

$$\begin{aligned}
 (2) \text{ Suicide Rate} &= a_0 + a_1(\text{Job Destruction}) \\
 &+ a_2(\text{Unemployment rates}) \\
 &+ a_3(\text{Real GDP per capita}) \\
 &+ a_4(\text{Population}) \\
 &+ a_5(\text{Year dummies}) \\
 &+ a_6(\text{State dummies})
 \end{aligned}$$

IV. RESULTS

As the key outcome variable, the suicide rate was analyzed using both establishment exit and job destruction. The unemployment rate, population growth, and real GDP per capita in a state were also analyzed. To test the hypothesis that losing one's job plays a role in a subsequent suicide, fixed-effects regression using these variables was run. Regression 1 in Table 3 in the Appendix shows that a 1 percent rise in business exit significantly increases suicide rate by 0.174 percent, indicating that business exit has an impact on the suicide rate. Population growth is shown to have a negative impact on the suicide rate as a 1 percent increase in population leads to a 0.617 percent decrease in suicide rate. Additionally, real GDP per capita is shown to be positively significant in Regression 1 with regard to suicide rate, as a 1 percent increase in real GDP per capita leads to a 0.133 percent increase in suicide rate. Unemployment rates were not statistically significant as a factor toward suicide rate.

This study also focuses on job destruction as a measure of the effect job loss has on instances of suicide. Regression 2 in Table 4 in the Appendix shows that a 1 percent increase in job destruction leads to 0.139 percent increase in suicide rate. Again, population growth has a negatively significant impact as a 1 percent increase in population leads to a 0.583 percent decrease in suicide rate. In this regression, neither real GDP per capita nor unemployment rates

were statistically significant. In both regressions, the R-squared value was 0.635, indicating that the variables selected account for 63.5 percent of the variance in these regressions.

V. CONCLUSIONS

The present study provides a deeper dissection of the relationship between job loss and suicide rate. Utilizing data collected from 1999-2014 over all 50 states and the District of Columbia, the study analyzes how economic changes, such as business exit and job destruction, affect rates of self-harm. After performing two separate fixed-effects regressions, it was shown that both business exits and job destruction had a positively significant impact on suicide rate. In addition, population growth was negatively associated with suicide rate in both regressions as increases in population led to decreases in suicide rate. Real GDP growth was positively significant in the first regression, but insignificant in the second.

Interestingly, unemployment rates were insignificant in both regressions. This is consistent with previous literature on this topic. The study published by Huikari and Korhonen in Finland also found that unemployment rates with one-year lags were insignificant as a factor in suicide rate. They, however, go on to study the effect of expected future unemployment on suicide rates, whereas this study focuses more on job loss itself, not necessarily unemployment rates. This study is unique in that it shows the effect of job loss through two different variables across all states and the District of Columbia. A majority of the previous literature on this topic focuses on specific closures of large factories or is contained to certain regions within the nation, whereas this study presents analysis of job loss and suicide across a larger area. Due to this, it shows how some areas may be more prone to factors leading to suicide.

Knowing that population growth is inversely related to suicide rate might lead individuals to move to more populous urban centers or more populous states. This could be especially prevalent if an individual is searching for a new occupation. It is often-times harder to learn new skills as opposed to moving to a location where your acquired skills can be utilized, and this move could also prove to be better for one's mental health. Concerning the improvement of mental health in individuals recently laid off, local governments or organizations could offer counseling sessions for free or at a reduced price for people that may need help coping with this loss of an important social function. These sessions could be beneficial after mass layoffs by large companies or even if a small business was forced to lay someone off.

This study only analyzes 15 years of data, so it would be interesting to see how economic changes affected suicide rates before 1999 as well as after 2014 and how they might change going into the future. In addition, using an analysis similar to the Huikari and Korhonen study, in which future expected unemployment was a variable on data from the U.S., could prove to be interesting. However, the most intriguing expansion could be analyzing the time gap from an individual being laid off to that same individual committing suicide. This would determine if there actually is a time-lag in job loss reflected on suicide rates.

APPENDIX

Table 1: Highest and Lowest Suicide Rates by State in 1999 and 2014

1999	
Highest	Lowest
Nevada (20.9)	District of Columbia (5.3)
Wyoming (19.9)	New York (6.3)
New Mexico (17.6)	New Jersey (6.7)
Alaska (15.4)	Massachusetts (6.8)
Arizona (15.2)	Connecticut (8.1)
2014	
Highest	Lowest
Montana (24.4)	District of Columbia (7.9)
Alaska (22.7)	New York (8.6)
New Mexico (21.5)	New Jersey (8.8)
Wyoming (20.5)	Massachusetts (8.8)
Colorado (20.2)	Maryland (10.1)

Table 4: Job Destruction Fixed-Effect Regression

N= 816, Year: 2000-2014	Suicide Rate
log(Job Destruction) _(t-1)	0.139*** (3.55)
log(Unemployment Rate) _(t-1)	0.063 (1.67)
log(Population) _(t-1)	-0.583*** (-3.41)
log(Real GDP Per Capita) _(t-1)	0.094 (1.38)
Control	8.403*** (3.18)
Number of Observations	765
R-squared	0.635
Number of States	51

t-statistics in parentheses
= " * p < 0.10 ** p < 0.05 *** p < 0.01"

Table 2: Summary Statistics of Variables

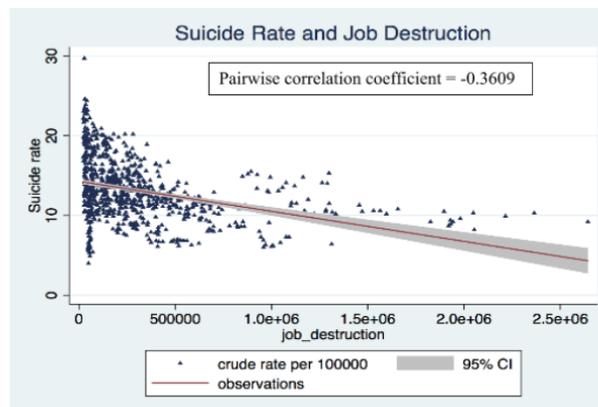
Variable	Obs	Mean	Std. Dev.	Min	Max
Suicide rate	816	13.116	3.756	4	29.7
Job destruction	816	310,005.9	359,295.1	22,385	2,642,714
Establishment exits	816	12,653.12	14,524.4	1,308	91,260
log(population)	816	15.084	1.033501	13.106	17.474
Unemployment rates	816	5.802	2.054	2.3	13.8
Real GDP per capita	816	47,904.56	18,163.15	28,801.65	17,4428.4

Table 3: Business Exit Fixed-Effect Regression

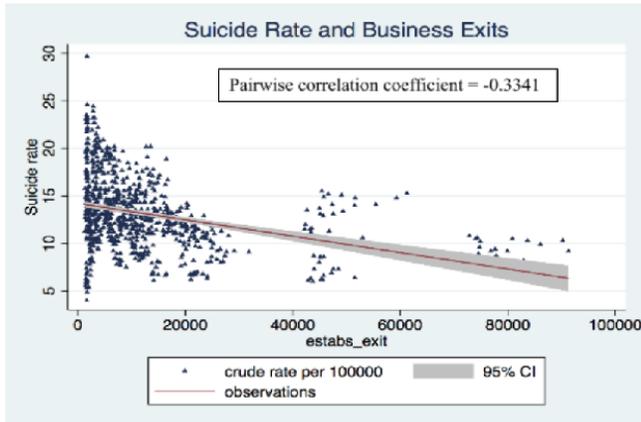
N= 816, Year: 2000-2014	Suicide Rate
log(Business Exit) _(t-1)	0.174*** (2.74)
log(Unemployment Rate) _(t-1)	0.050 (1.31)
log(Population) _(t-1)	-0.617*** (-3.78)
log(Real GDP Per Capita) _(t-1)	0.133* (1.96)
Control	8.642*** (3.52)
Number of Observations	765
R-squared	0.635
Number of States	51

t-statistics in parentheses
= " * p < 0.10 ** p < 0.05 *** p < 0.01"

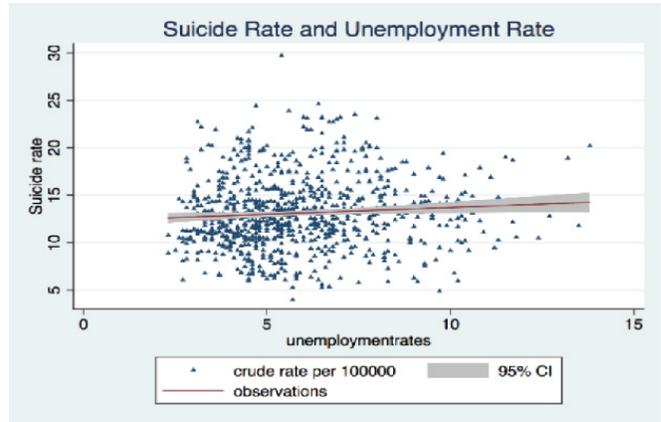
Graph 1: Correlation between Suicide Rate and Job Destruction



Graph 2: Correlation between Suicide Rate and Business Exits



Graph 3: Correlation between Suicide Rate and Unemployment Rate



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