Female Suicide and Labor Markets: A Disaggregated Panel Analysis of the Link between Labor Market Conditions and Female Suicides in the United States (1979- 2004)

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Abstract: Suicide is a well-known public health problem in the United States. Macroeconomic conditions, among many other factors, because of their impacts on psychological well-being of individuals, are thought to be linked to suicide attempts. However, previous research onthe relationship between suicide rates and macroeconomic conditions, especially that of labor market conditions, has resulted into ambiguous and often contradictory results. This paper attempts to provide a detailed disaggregated econometric analysis on the link between labor market conditions and female suicide rates in the United States. Using a state-level panel data of 50 U.S. states and the District of Columbia between 1979 and 2004, this paper finds that labor market deteriorations (i.e. higher rates of unemployment, larger deviations of unemployment rate from its trend, and greater volatilities in the overall rate of unemployment), are correlated with only the suicide rates of the prime working-age women (i.e. 35-64 years old). Moreover, the results provide some evidence that female suicide rates in the United States are also positively correlated with higher female labor force participation rates.

Keywords: Female Suicide, Macroeconomics, Labor Market.

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Introduction

Suicide is considered as an important public health problem in the United States. In 2007 alone, suicide was responsible for more than 34,598 deaths, making it the eleventh leading cause of death in America (Crosby et al, 2011). Also, as seen in Figure 1, the declining trend ofsuicide rates in the United States between 1986 and 2000 has been reversed since 2001. More specifically, while America's suicide rates declined by an average annual rate of 1.5 percent during the period 1986 to 2000, it experienced a positive average growth rate of 1.4 percent per year between 2001 and 2007. Given that psychiatric disorders, alcohol and drug abuse, incarceration, family suicide history, history of violence and physical or sexual abuse, family disruption (such as divorce or loss of loved ones), major injury or illness, abrupt social or economic changes, feelings of insecurity, excessive stress, and hopelessness are among suicide risk factors (Moscicki, 2001; National Institute of Mental Health, 2009;and United States Department of Health and Human Services, 2001) the recent sudden and rapid hike in America's suicide rates may point to significant declines in human and social well-being in the American society.

Considering that several risk factors of suicide can be influenced by macroeconomic conditions, economists have attempted to examine the link between macroeconomics and suicide for over three decades. The overall finding of this body of literature is that alongside other social and geographic factors, real macroeconomic variables such as output levelsand unemployment ratescould explain the patterns of suicide in a given society (Brainerd,2001; Chung, 2009; Hamermesh and Soss, 1974; Koo and Cox, 2008; Minoiu and Andres, 2008; Noh, 2009; Andres, 2005; Yang, 1992; Yang and Stack, 1992).

Despite the importance of suicide as a proxy for human and social well-being, and the growing volume of international evidence on the relationship between macroeconomic conditions and suicide, the economic literature on suicide in the United States is rather thin[2] and its findings on the links between labor market conditionsand suicide are largely inconclusive. This paper sets out to reinvestigate the link between labor market conditions and female suicide for the case of United

2. One can point to Yang (1992), Yang and Stack (1992), Yang and Lester (1990, 1994, 1995), Kunce and Aderson (2002), and Minoiu and Andres (2008) as constituting the main works in the economic literature on the macroeconomic determinants of suicide in the United States.

States, while also heeding to two main shortcomings in the literature. The first shortcoming pertains to the pooling of data across different gender and age groups. As one would expect for the driving factors of suicide to vary across different gender and age groups, conclusions derived from analyses based on pooled data along one or both of these dimensions may not be trusted. One can point to Yang (1992) and Minoiu and Andres (2008) as the only two recent studies in this line of research that have heeded to gender differences in their works.[3]Furthermore,Minoiu and Andres (2008) also focus their analysis on population aged 26-69 years old, but they do not take into account the difference between those who are more established and less flexible in their careers (e.g. age group 35-64) and those who are either at the beginning (e.g. age group 20-34) or at the end of their working years (e.g. age group 65 and above). Furthermore, the authors ignore the fact that the macroeconomics of suicide may widely differ across the working population (i.e. 26-64 years old) and the population who are eligible for full retirement benefits (65 years old and above).In short, the previous work has not adequately differentiated between the determinants of suicide across different genders and age groups.

The second weakness is that other than overall unemployment rates and female labor force participation rates, no other relevant labor market conditions are included in the set of explanatory variables of suicide. While there is no debate that overall unemployment rate is an important indicator in assessing the conditions in the labor market, and therefore that of anxiety and frustration among the working population, the inclusion of other labor market indicators such as labor market volatility may yield important information on the link between labor market conditions and suicide in America.

This paper makes use of a panel data of America's 50 states and the District of Columbia between 1979 and 2004, and analyzes the determinants of female suicide in the United States for three different age groups: 20-34 years, 35-64 years, and 65 years and above. Furthermore, in addition to unemployment rate, the present work also examines the relevance of other labor market indicators in explaining the

3. Yang (1992) also incorporated race (white and non-white) differences, thereby analyzing suicide rates across four gender-by-race population groups. Also, Hamermesh and Soss (1974) is an older study which provides a detailed cross-country as well as U.S. time-series analysis for rates of suicide at different age groups.

behavior of female suicides in the United States. These indicators are labor force participation rates for each age group, the deviation of unemployment rate from its trend for each age group, the volatility in the overall unemployment rate,[4] andaverage earnings per job.

In brief, the results suggest that across different models and estimation methods, deteriorations for female labor market in the United States (i.e. higher rates of unemployment, larger deviations of unemployment rate from its trend, and greater volatilities in the overall rate of unemployment) are associated with higher rates of suicide for only theprime working-age women (e.g. 35-64 years old). Moreover, the results show that female suicide ratesin the United States are sensitive to higher female labor force participation rates.

The remainder of this paper is organized as follows. Section II provides a brief discussion on the determinants of suicide and the variables examined in this study. Section III establishes the importance of a disaggregated approach to the study of suicide. Section IV outlines the estimation methodology and presents some relevant descriptive statistics. Section V presents and discusses the findings. Section VI concludes the paper.

Determinants of Suicide

Evidence from Previous Empirical Works

Table A.1 in the appendix lists the main determinants of suicide that have been analyzedby previous works. A description for each variable and its sourceare also included in the Table. The main findings of the literature on the relevance of these variables forthe study of suicide are summarized below.

Geographic and Seasonal Factors.Climate conditions are known to be correlated with suicide rates as they may affect the incidenceand the severity of depression (Robbins, DeWalt, and Pelto 1972; Thorson and Kasworm 1984); however, there are some nuances.On the onehand,suicide rates are relatively higher in Nordic countries, which have relatively shorter hours of daylight during winters (Goodwin and Jamison, 1990;Meares, Mendelsohn, and Milgrom-Friedman, 1981; Lambert et al., 2003; Lester and Frank, 1988; and Parker and Walter, 1982).

4. In Minoiu and Andres (2008), the authors use the share of migrant population as a measure of uncertainty in economic conditions.

On the other hand, several studies (Ibid)on the seasonal patternsof suicides find that suicide rates peak during summer, when hours of daylight are relatively longer.[5] Recent literature also points to "a dose-response relationship, with the seasonal peak being greatest for countries farthest from the equator and absent from countries close to the equator" (Helliwell, 2007, p. 458).[6] While explanations for these findings remain under investigation by psychologists, the link between geographical factors and the suicide rates is irrefutable. Such a pattern has also been observed in the United States. For example, Minoiu and Andres (2008) find that regardless of regression specification, states located in the mountain region of the United States (i.e. states which are associated with severer climate conditions) have significantly higher suicide rates compared to other states.[7]

Alcohol Consumption.The World Health Organization (WHO), Centers for Disease Control (CDC), and the American Association of Suicidology (AAS) identify alcohol abuse as one of the major suicide risk factors. Theoretically, alcohol dependence is thought to increase the probability of suicide because of its negative effects on family and social ties, self-esteem, depression, and self-restraint against harmful behavior (Kendall 1983). Quantitative research also confirms that, controlling for other factors, higher alcohol consumption is indeed positively correlated with higher suicide rates (Brainerd, 2001; Koo and Cox, 2008; Lester, 1995; Markowitz, Chatterji, and Kaestner, 2003; and Andres, 2005).

Divorce Rate.The divorce rate is often controlled for in studies of suicide, as it is thought to reduce social integration and family ties while increasing the probability of depression, and economic, sexual, and emotional hardships, all of which are considered to be important suicide risk factors.[8] The overall conclusion of previous works is that divorce and suicide rates are positively correlated (Brainerd, 2004;Minoiu and Andres, 2008;Neumayer, 2003; and Stack, 1989),[9]especially

5. Both of these phenomena, namely the higher suicide rates in Nordic countries and the summer peak of suicide, were reported in Durkheim's 1897 Suicide.

6. Also see Parker, Gao and Machin (2001).

7. Tables A.4 and A.5 in the appendix also support their findings.

8. See Stack (1987) and Stack (1989) for a detailed review of literature on the direct and indirect links between divorce and suicide.

9. However, Chuang and Huang's (1997) panel analysis of 23 Taiwanese cities and counties during the period 1983-1993 finds no statistically significant evidence for the link between suicide and divorce.

amongmen (Anders, 2005).

Income Inequality.Conceivably, income inequality may be associated with suicide owing to its negative effects on social cohesion and solidarity, as well as on individual happiness and satisfaction from life in general (Alesina, et al., 2004;Kawachi et al., 1997;Sen, 1999,pp. 92-93, and Wilkinson, 2005). Most studies on suicide have not incorporated this variable in their analyses, and those that have, present mixed findings on the link between inequality and suicide. For example, while Minoiu and Andres (2008)[10] and Andres (2005) find a statistically significant and positive relationship between income inequality and suicide, Neumayer (2004), Lester (1987), and Kowalski, Faupel, and Starr (1987) do not.

Fertility Rate.Durkheim hypothesized that increased fertility, because of its positive influence on "family feeling", could in fact reduce suicide rates (Durkheim 1988). Again, on the empirical side, depending on the region and population under analysis, there is mixed evidence for and against this hypothesis. While Chuang and Hunag (1997) do not find a statistically significant relationship between fertility and suicide rates, most studies such as Koo and Cox (2008), Neumayer (2003), Noh (2009), and Andres (2005) support Durkheim's hypothesis.

Elderly Population.In their theoretical exercise, Hamermesh and Soss (1974) suggest that because of lower future expected utility, the elderly are more prone to suicidal attempts. They furthermore argue that this would be trueramong those elderly for whom the cost of maintaining life is more than the benefits they receive from it. The authors provide empirical evidence by examining the suicide rates between 1965 and1967 in 21 developed countries and find that countries with a higher percentage of elderly population (age 65 and above) report statistically significant higher suicide rates. Although, Hamermesh and Soss's (1974) conclusion is supported by Noh's (2009) analysis of suicide rates of OECD countries, Chuang and Huang's (1997) 1983-1993 panel study of suicide in 23 Taiwanese cities and counties introduces a qualification to this theory. In particular, the authors find that the percentage of elderly population in a society is adversely linked to only suicide rates among the male population.

Taxes.Presumably taxes are related to suicide rates because higher tax

10. Minoiu and Andres (2008) find that inequality is adversely linked to suicide rates (especially that of female suicide rates) for some and not all of their specifications.

revenues could potentially translate into larger quantity and better quality of social and welfare programs that could reduce the negative effects of macroeconomic deteriorations on mental health of individuals. The only economic study of suicide that has analyzed the influence of public programs on suicide rates is Minoiu and Andres (2008), wherein the authors find that the share of health and welfare expenditures in public spending is negatively correlated with the suicide rates of the United States during the period 1982-1997.

Female Labor Force Participation Rate (FLFPR). Previous works that have analyzed the link between female labor force participation rate(FLFPR) and suicide have resulted intomixed findings. Theoretical and empirical research suggests that FLFPR, independent of its positive correlation with divorce rates (Bentzen and Smith, 2002; Stevenson and Wolfers, 2006), can positively or negatively affect suicide rates and differently so along gender lines.[11] Furthermore, some studies do not find any statistically significant relationship between FLFPR and suicide rates (Chuang and Huang, 1997, Neumayer, 2003). The present study expands the analysis on the link between FLFPR and suicide rates by examining the link between FLFPR and suicide rates for women in different age groups.

Income and Unemployment.The literature on quality of life and happiness considersunemployment rates and income levels as two of the most important macroeconomic factors that could influence one's overall well-beingand mental health. Di Tella, MacCulloch, and Oswald's (2003) cross-country panel analysis finds that self-reported happiness is strongly related to macroeconomic conditions. Specifically, people generally feel happier and less stressed when macroeconomic conditions are more favorable. Conversely, the authors find that the levels of anxiety, hopelessness, and stress increase as macroeconomic conditions deteriorate (Di Tella, MacCulloch, and Oswald 2003,p. 823).[12] Considering the

11. For Example Davis (1981) supports Gibbs and Martin>s (1964) "status integration hypothesis" by findings that FLFPR is positively correlated with only female suicide rates. But Cumming, Lazar, and Chisolm (1975) provide an opposite hypothesis known as "role accumulation or role expansion theory" put forward by Marks (1977) and Sieber (1974). The authors find that FLFPR is negatively correlated to suicide rates of working mother in British Columbia around 1961 and 1971. Also see Newman, Whittemore and Newman (1973), Fernquist(2009) and Stack (1987). The latter study provides a detailed review of the sociological literature on the links between FLFPR and suicide.

12. Also see Wisman (2008) for a detailed review of the literature on the link between unemployment

significant effects of macroeconomic conditions on the mental health of individuals and also the important link between mental health and suicide,[13]all previous economic studies of suicide have controlled for output levels per capita and unemployment rates (Chuang and Huang, 1997;Hamermesh and Soss, 1974;Jungeilges and Kirchgassner, 2002;Kunce and Anderson, 2002;Minoiu and Andres, 2008; Noh, 2009; Andres, 2005;Ruhm, 2000; Yang, 1992, and Yang and Stack, 1992). However, despite the consensus among researchers on the importance of these factors in explaining suicide rates, there is little consensus on the magnitude and direction of their effects. For example, time-series analyses for United States'aggregate suicide data between 1940 and 1984 in Yang, Stack, and Lester (1992), Yang and Lester (1995), and Yang and Stack (1992) show that increasing unemployment rates can adversely affect suicide rates in the United States. Additionally, in his 1972-1991 panel study of the United States, Ruhm (2000) suggests that unemployment and suicide rates are positively correlated. However, more recent panel data analyses of suicide rates in the United State have introduced doubts into these earlier findings. In particular, in their 1985-1995 and 1982-1997 panel analyses of 50 U.S. states and the District of Columbia, Kunce and Aderson (2002) and Minoiu and Andres (2008) did not find any statistical evidence pointing to the link between unemployment rates and suicide rates in America.[14]

Facing these inconsistencies, in a recent attempt Noh's (2009) cross-country analysis sets out to determine whether the link between unemployment rates and suicide rates vary across countries at different income levels. To accomplish this objective, he includes an interaction term between unemployment ratesand real per capita gross domestic product and finds that "the unemployment rate does significantly affect suicide rates, but in a way that varies with income: in a positive

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and quality of life.

13. Mental illness is considered as a necessary (but not a sufficient) condition for suicide (Moscicki 2001). In other words, all those who commit suicide suffer from at least one form of mental illness.

14. The international evidence on the link between unemployment and suicide rates is also inconclusive. Yang and Lester's (1995) study of 12 countries between 1950 and 1985 finds no evidence of such a link. Brainerd (2001), Chuang and Huang (1997), Hamermesh and Soss (1974), and Neumayer (2003) suggest that unemployment and suicide rates are positively correlated. Finally and contrary to the intuition, Neumayer's (2004) 1980-2000 analysis of German states discovers a statistically significant and negative correlation between unemployment and suicide rates.

manner for high-income countries, but in a negative manner for low-income countries" (Noh 2009,p. 582).In other words, higher unemployment ratesare associated with higher suicide rates in richer countries and lower suicide rates in low-income economies.

As seen from the brief review of literature presented above, the economic literature on the determinants of suicide is abundant with inconsistent and conflicting results. There may be two main reasons for these inconsistencies in the findings. First, it is possible that they are because ofthe differences in data availability, accuracy of model specification, and the econometric methodologies employed,all of which could be improved over time. Second and more probably, theseinconsistent results may actually be a reflection of inherent differences insuicide patterns across different regions, cultures, and periods of time. In this case, the findings of each study, no matter the degree of its accuracy, may only be applicable to the specific region and the period of time the study is focused on, makingit unwise to generalize the findings of one analysisto other regions, societies, and time periods.

Additional Labor Market Indicators

In an effort to examine the link between American labor market conditions and female suicide rates in more detail, the present paper controls for three novel labor market variables not accounted for in previous works: deviation of unemployment rate from its trend, volatility in the overall unemployment rate, and average earnings per job. Table A.2 in the appendix provides descriptions and sources of these variables whiletheir potential relevance to this study is outlined below:

Deviation of Unemployment Rate from its Trend.In an analysis of 1991 wave of British Household Panel Study, Clark and Oswald (1994) show that although unemployed people are in general less happy than employed ones, "high[er] unemployment levels across regions and age-groups are correlated with relatively low disutility from joblessness" (p. 658). Specifically, the authors find that distress from unemployment is less in some groups than in others: the younger population and also workers in high-unemployment regions. Furthermore, the study finds that "people who have been unemployed for a long time show less distress than those who have recently lost their jobs" (p. 658). Therefore,in addition to unemployment rates for each female population group, annual changes in unemployment rates

may also play an important role in the mental well-being of individuals. Consequently, this study also controls for thedeviation of annual unemployment rate from its trend, which is measured as a three-year moving average of annual unemployment rates.

Volatility in the Overall Unemployment Rate.Volatility and uncertainty in the labor market can be a significant source of anxiety and stress, especially among the working-age population. As illustrated by the "vulnerability approach"inCalvo (2008) and Calvo and Dercon (2005), not only the level of deprivation affects the well-being of an individual or society, but also the fear of facing hardships in the future is harmful to one's psychological and physical well-being.[15]Graham (2010) also provides evidence that "while people can adapt to be happy at low levels of income, they are far less happy when there is uncertainty over their future wealth" (p.1). Therefore, in order to examine the link between the uncertainty in the labor market and suicide rates in the United States, the regression models in this study also include the variance of the seasonally adjusted monthly unemployment rates for all panels.

Average Earnings per Job.In addition tohigherunemployment rates, labor market downturns may also be psychologically stressful if they result in lower real earnings per job or reduced quality of jobs. This often takes placewhen the workers are forced into involuntary underemployment by either working fewer hours or working in jobs they are overqualified for or both (Dooley 2003; Friedland and Price 2003). As a result, the regressions in this study include average earnings per job which serve as proxies for both the quality of available employment and the income level.

DisaggregationacrossGender and Age

As noted earlier, although a number of previous studies have analyzed United States'suicide rates across either genders or age categories (Minoiu and Andres 2008; Noh 2009; Yang 1992), there is no study that has analyzed the determinant of female suicide in the United States across different age categories. In order to present the necessity of such a disaggregation, Figures 2 through 4alongsideTable 1 show the pattern of suicide rates in the United States between 1979 and 2007for

15. Also see Basu and Nolen (2004)

different demographic groups. Several important observations could be made from these Figures. First, male suicide rates have been 3.1 to 4.6 times higher than female suicide rates (Figure2), pointing to differences in dynamicsof suicide across genders. Second and as mentioned earlier, the 1986-1999 declining trends for both male and female suicide rates have been reversed since 2000 (Figure2). One plausible explanation for this phenomenon could be the higher sense of economic, physical, and psychological insecurity that has dominated the American society since the beginning of the millennium, which was marked with an economic recession, as well as the 911terrorist attacks and the start of the United States' military operationsin Afghanistan. Table A.3 in the appendix provides some evidence in support of the sudden mental health deterioration of the American public at the start of the 21st century, which is consistent with the observed growing rates of suicides in the United Statesover the past decade. Third, for the most part, during 1979-2007, male and female suicide rates followed similar trends with a stronger correlation visible in the recent decade (Figure2). This could be caused by the converging social and economic roles of males and females in the American society over the past three decades. For example, the ratio of male to female labor force participation rates has fallen from 1.5 in 1980 to 1.2 in 2007 (United States Bureau of Labor Statistics: Labor Force Statistics 2010).

Fourth, starting in the late-1990s, the suicide rates for the prime working-age group (i.e. 35-64 years old) has been steadily increasing, while the suicide rates for the other two age groups who are at the beginning or end of their career lives (i.e. 20-34 years old and 65 years and above) have more or less continued to decline or remained unchanged (Figures3, 4 and 5). This may be linked to the declining job creation and increasing job destruction rates in the United States that started in the mid-1990s and have increased momentum since 1999 (Lee and Rudick, 2006). Furthermore, the rapid rise of information technology and the "dot.com" industry in the second half of the 1990s led to significant structural shifts in the United States' productive capacity and therefore labor market. One such shift has been the declining employee tenureship since the mid-1990s, which can be translated into reduced stability of employment and increasing movements between jobs,[16] which could be

16. Employee tenureship dropped significantly in mid-1990s in comparison to early 1980s and this drop was more pronounced for men aged 45 to 64 (United States Bureau of Labor Statistics, 1997).

sources of anxiety and stress. The above observations may point to the fact that suicide rates for the prime working-age population are more sensitive to the conditions in the labor market than suicide rates of other age groups.

Lastly, the suicide rate among the population 65 years old and above (i.e. the elderly), peaked in the mid-1980s and has been declining rapidly since then (Figure 3). This pattern, which was mainly driven by the suicide rates of the elderly men (Figure 4), has been the main cause of the overall decline in the United States' suicide rates between 1986 and 2000 and it points to the major differences in the determinants of suicide for the elderly in comparison to other age groups.

Table 1 depicts a summary of some of the above observations. It is important to note that the gap between male to female suicide rates is smallest for the prime working-age population and largest for the elderly. This suggests that the social and economic risk factors of suicide among the prime working-age men and women are more similar than they are for men and women in other age groups.

Based on the above observations, the regressions in this study controlfor different age groups among females. This is accomplished by estimating the regression models outlined in the next section for fourdifferent demographic groups: all peopleaged 20 and over, femalesaged 20-34, femalesaged 35-64, and femalesaged 65 and above. The logic behind this specific age categorization stems from the following facts:

During the period 1979-2004 the normal retirement age (NRA), the age by which American retirees were eligible to receive full social security benefits, was 65 years old.[17]It is therefore assumed here that the macroeconomic determinants of suicide would be different for those who are eligible for full retirement benefits in comparison to those who are not (i.e. it is expected for suicide rates of the elderly to be less sensitive to changes in macroeconomic conditions).

Females aged 20-34 are either in school or are at the early stages of their career lives. Also, they have fewer or no dependents, making them more risk tolerant. Furthermore, they have a higher capacityfor learning the new skills that are demanded in the labor market. All of these would make them geographically and occupationally more flexible and less vulnerable to the changing condition of

17. More accurately, the NRA was increased by two and four months in 2003 and 2004 respectively. See Social Security Administration at http://www.ssa.gov/OACT/ProgData/nra.html.

the labor market.

The majority of females aged 35-64 typically have children and/or elderly dependents, are more settled in their career paths, and have little to no retraining capacity. As a result,they are geographically and occupationallyless mobile and are therefore more vulnerable to the local as well as national changesin the labor market conditions.

Empirical Methodologies, Descriptive Statistics, and Preliminary Evidence

The underlying panel-data used in this study covers 50 states and the District of Columbia over the period of 1979-2004, and the analysis makes use of four different panel-data estimation techniques: fixed-effects ordinary least squares (OLS) regression, fixed-effects ordinary least squares (OLS) regression with panel-corrected standard errors, fixed-effects OLS regression with a correction for the bias due to a first-order autoregressive term, and system generalized method of moments estimation procedure (system-GMM). The reasoning behind employing different econometric procedures is based on the different assumptionsregarding the underlying relationship between suicide rates and other explanatory variables, which results in four different econometric specifications as presented below.

Static Econometric Specification

The baseline econometric model is of the following structure:

$$suicide_{i,t} = \mu_i + x_{i,t}\beta + D_t\eta + \varepsilon_{i,t}; i=1,\ldots,51;\ t=1979,\ldots,2004 \quad (1)$$

where $\mu_i$reflects time-invariant heterogeneity for statei, xit is the vector of explanatory variables for country i at time t, Dt is a vector of year dummies capturing shifts common to all states in year t, and $\varepsilon_i$tis idiosyncratic error presenting the random variation that is not captured by the variables included in the model. Similar to the majority of previous economic works on suicides, the baseline model in (1) is a static specification, whereby the suicide rate at any given year is assumed to be determined by social, demographic, and economic factors in the same year.

The standard errors obtained from estimating (1) through fixed-effects OLS techniques, could potentially be biased because the error process may not be

independent and identically distributed; therefore, violating the classical OLS assumption. First is the issue of autocorrelation in any given panel unit (i.e. state). Only when E(εitεis)=0 for all t ≠ s (i.e. serial independence), are the estimates for βand the standard errors to be trusted. To test for the validity of this assumption, Wooldridge's (2002) test for auto-correlation in panel data is utilized.[18]In the presence of such autocorrelations, Prais&Winsten (1954) regression is used to estimate parameter β.

A second potential issue is groupwiseheteroskedasticity, wherein variance-covariance matrices of different panel units are not the same, which is commonly the case in panel data. In such cases, the OLS estimates for parameter β are consistent but inefficient. Two procedures could be applied to the residuals obtained from a fixed-effects OLS estimation to test for groupwiseheteroskedasticity. The first one is based on Levene's (1960) robustness test statistic and its two extensions proposed by Brown and Forsythe (1974).[19] The second of these procedures is based on Greene (2003) which uses residuals of a fixed effect model to calculate a modified Wald statistic.[20]

A third potential problem concerns contemporaneous correlation of errors terms across cross-sectional units. This often happens from the cross-sectional units sharing common characteristics, for example when the cross-section units are a subset of a larger group (similar to this study). Again, in such cases, the OLS estimates of parameter β are consistent but inefficient. As shown in Greene (2003), if the number of cross-section units exceeds the number of time periods (N>T), then the procedures proposed by Frees (1995) or Pesaran (2004) could be used to analyze the residuals obtained from the fixed-effects OLS procedure for the presence of cross-sectional correlation across the panels.

In the presence of one or more of the above deviations from classical OLS assumptions, the bias in the standard errors could be corrected using the "Panel-

18. This test uses residuals from regressing the first-differenced model to test the hypothesis of existence of autocorrelation in any given panel unit. See Drukker (2003).

19. The two extensions replace the mean in Levene's procedure with the median and the 10% trimmed mean, respectively.

20. Specifically, this procedure tests the null hypothesis of whether residual variance in each panel equals the homoskedastic variance assumed by the fixed effect model. See Baum (2001, 2006).

Corrected Standard Errors"(PCSE) procedure suggested by Beck and Katz (1995).[21]

Dynamic Econometric Specifications

Considering the existence of some evidence in support of the contagious and therefore persistent nature of suicide (Agerbo, 2005, Gould et al., 1990, Hedström, Ka-Yuet, and Nordvik, 2008, Phillips, 1979, Qin, Agerbo and Mortensen, 2002, and Runeson and Åsberg, 2003), the coefficient estimates of parameter β in (1) is re-estimated, this time by including a first-order autoregressive term in the right hand side (RHS):

$$suicide_{i,t} = \gamma\, suicide_{i,t-1} + \mu_i + x_{i,t}\beta + D_t\eta + \varepsilon_{i,t}; i=1,\ldots,51;\ t=1979,\ldots,2004 \quad (2)$$

In this formulation, the static coefficient estimates of parameter β obtained from (2)would be biased. One can use the fixed-effects panel-data procedure suggested by Bruno (2005) to correct for the biases in parameter β that are associated with the presence of lagged suicide rates in the RHS.

Additionally, this paper entertains the possibility that the behavior of suicide in the current period may in fact be correlated with the lags of some of the explanatory variables. Two relatively recent works, Minoiu and Andres (2008) and Neumayer (2004) have proposed such a possibility. Specifically, Minoiu and Andres's (2008) estimations include lags of (and not current) income levels, divorce rates, and share of welfare and health expenditures in public spending, while Neumayer (2004) employs a model that includes lagged unemployment rates.

Based on the evidence provided by these two recent works, this paper also estimates the following model:

$$suicide_{i,t} = \mu_i + x_{i,t}\beta_1 + z_{i,t-1}\beta_2 + D_t\eta + \varepsilon_{i,t};\ i=1,\ldots,51;\ t=1979,\ldots,2004 \quad (3)$$

where$x_{i,t}$ is the vector of explanatory variables in the current period and $z_{i,t-1}$ is the vector of lagged explanatory variables. Particularly, $z_{i,t-1}$ in (3) includes one-period lags of the following variables: either unemployment rate or deviation of unemployment rate from its trend, average earnings per job, and taxes per capita. All other explanatory variables enter (3) in their current period form,which are represented by$x_{i,t}$. The motivation behind this particular specification stems

21. Note that PCSE can be estimated only after the serial correlations in the error terms are accounted for.

from the assumption that individuals may tolerate worsening unemployment rates or job security and quality for some time before they consider suicide as an option. Moreover, it is assumed here that suicide rates in any period are related to the quality and quantity of public health, education, and welfare programs available in the same period, which in turn, is based on the tax revenues from the previous period. Therefore, taxes per capita also enters (3) in its lagged form.

The final econometric specification considered in this work, combines the ideas in (2) and (3) by including the lags of suicide rate and that of some explanatory variables in the RHS:

$$suicide_{i,t} = \gamma\, suicide_{i,t-1} + \mu_i + x_{i,t}\beta_1 + z_{i,t-1}\beta_2 + D_t\eta + \varepsilon_{i,t};\ i=1,\ldots,51;\ t=1979,\ldots,2004 \quad (4)$$

where $x_{i,t}$ and $z_{i,t-1}$ are similar to $x_{i,t}$ and $z_{i,t-1}$ in (3).

In estimating (3) and (4) one has to be wary about the correlation between $z_{i,t-1}$ and $\varepsilon_{i,t}$ because the error terms may be serially correlated. Additionally, in both models μ_i maybe correlated with $x_{i,t}$ and/or $z_{i,t-1}$. Moreover, $suicide_{i,t-1}$ and within transformation of $\varepsilon_{i,t}$ in (4) are correlated by construction. In the presence of these endogeneity issues, the use of system-GMM is suitable. Although system-GMM was originally developed by Arellano and Bover (1995) and Blundell and Bond (1998) for estimating dynamic panel models of the autoregressive form in (4), this econometric procedure is still applicable to (3) because of the endogeneity issues existing between μ_i, $x_{i,t}$, $z_{i,t-1}$, and $\varepsilon_{i,t}$.[22]

Descriptive Statistics, Correlation Coefficients, and Panel Unit Root Tests

Tables A.4 to A.7in the appendix provide some relevant descriptive statistic and preliminary evidence on the link between the variables highlighted above and female suicide rates in the United States. Table A.4 depicts the average suicide rates for the 50 U.S. states and the District of Columbia between 1979 and 2004.[23] As seen from Table A.4 and A.5, on average, Alaska and the states located in the

22. See Bond (2002) and Bond, Hoeffler, and Temple (2001) for more details on system generalized method of moments procedure.

23. The annual suicide count is extracted from the Multiple Cause of Death Data Database which is available through Centers for Disease Control and Prevention's Wide-ranging Online Data for Epidemiologic Research (CDC WONDER).

mountain region of the United States have higher female suicide rates in comparison to other states, which is consistent with the theories and empirical evidence outlined earlier.

Table A.6 provides the descriptive statistics for all the control variables. The most important piece of information conveyed by this table is that different age groups experience widely different labor market conditions, which furthermore supports the age disaggregation strategy pointed out earlier.

Table A.7 shows the bi-variate correlation coefficient between the female suicide rates of each different population group and the variables controlled for in the regressions. This table provides preliminary evidence that in comparison to other age groups, the suicide rates among prime working-age females (i.e. women aged 35-64 years old) are more sensitive to the fluctuations in the labor market.

Before embarking on estimating the models outlined above, it is crucial to ensure that all of the variables included in these models are free of any unit root processes. For this purpose, panel unit root tests developed in Harris and Tzavalis (1999) and Im, Pesaran, and Shin (2003) are used. In order to reduce the effect of cross-sectional dependence on the results of the panel unit root tests, the panel-specific mean of each series is subtracted from the series before these tests are performed (Levin, Lu, and Chu, 2002).The results confirm that there is no sufficientevidence pointing to a unit root process in any of the variables, making the results of the regressions immune to spurious relationships.

Results and Discussion

Tables 2.2 through 2.5 present the results for different agegroups examined in this study. Each table depicts the findings for two slightly different models: MODEL 1 includes the unemployment rates in the econometric specifications whereas MODEL 2 includes the deviation of unemployment rate from its trendbut is otherwise similar to MODEL 1. As a reminder, the columns labeled Pooled OLS and Fixed Effects (PCSE) include the estimation results for the econometric specification (1) while the column labeled Fixed Effects Bias-Corrected LSDV presents the estimation results for model (2). Finally, the last two columns of each tablepresent the findings for models (3) and (4), respectively. More details on regression specifications and relevant diagnostic tests are available in Tables A.8 and A.9in

the appendix,respectively.In the following pages, the findings on the determinants of female suicide are discussed in some detail, with a special focus granted to the labor market determinants of female suicides in the United States.It is important to remember that the findings from the Pooled OLS estimation are not to be trusted because the OLS technique assumes that classical OLS assumptionsare valid (i.e. disturbances of each panel are identically and independently distributed), which is not the case here (see Table A.8). Therefore, the coefficient and standard error estimates obtained from the PooledOLS are biased, which are corrected through the fixed-effect PCSE technique. Nevertheless, these results are presented here because OLS constructs the baseline analysis upon which all other estimating techniques rely on.

Labor Markets and Female Suicide

The results depicted in Tables 2 through 5reveal the fact that only the suicide rates of females aged 35-64 years old (i.e. prime working-age) are positively correlated with the variance of overall unemployment rates, age-specific unemployment rates and its deviation from trend. Second, average earnings per job are not correlated with the suicide rate of females in any age group. Third, there is some evidence from MODEL 1 results in Tables 3 and 5 that higher labor force participation rates (LFPR)among younger and especially elder females are associated with higher suicide rates for these groups.

Four important conclusions could be derived from these findings. First and as hypothesized earlier, in comparison to younger and elder populations, thesuicide ratesof American females aged 35-64 years old is more sensitive to unemployment and uncertainties in the female labor market. This, as mentioned earlier, could be traced back to the lower levels of occupational and geographic mobility of this demographic group.

Second, considering the above and given that average earnings per job is not a determining factor in the suicide rates of females aged 35-64 years old, one could conclude that the mental well-beingof prime working-age women is more dependent on the availability of jobs and job stability than on the level of income generated from available jobs.

Third, in Table 2.2, while unemployment rate does not seem to have any statistical

significance in explaining suicide rates, its deviation from the trend does. This is consistent with the idea that in addition to the level of unemployment rates,the psychological well-being of an individualcould also be significantly influenced by the size of achange in the rates of unemployment (Clark and Oswald, 1994). For example, an increase in the unemployment rates from 5 percent to10 percent will have a graver consequence on the mental well-being(and therefore suicide rates) of the prime working-age population than an increase from 8 percent to 10 percent.

Lastly, the evidence onthe link between LFPR and suicide rates among younger and elder female populations is in support of Gibbs and Martin's (1964) "status integration theory", which is also supported by the empirical works of Davis (1981) and Fernquist(2009). This theory argues that higher female LFPR leads to higher levels of stress, and therefore higher levels of conflict between married couples which may eventually be manifested in forms of higher suicide rates, especially among females. Although this explanation may be plausible for women aged 20-34 years old, who are at the beginning of their marriage as well as their career lives, and therefore less experienced in maneuvering through the challenges associated with these sometimes conflicting roles, it loses ground for women aged 65 years old and above. There is, however, another plausible explanation for this group which is based on the assumption that the elderly women may decide to remain in or join the labor force against their preferences and because of unfavorable economic conditions. This may in turn increase the level of stress, anxiety, and insecurity for the elderly women who are in the labor market,and therefore put an upward pressure on the suicide rates of this demographic group.

Other Determinantsof Suicide

Alcohol Consumption.Higher alcohol consumption in a given year and state seems to be associated with higher suicide rates among elderly women.This is consistent with some evidence in the literature suggesting that elderly women are among the growing consumers of alcoholic beverages. "As a whole, more older men have substance abuse problems than do older women, but women are more likely than men to start drinking heavily later in life…[and] because of their physical make-up, older women are more vulnerable to the negative effects of alcohol [such as suicide]"(Hazelden 2010). Based on the above, it is therefore likely that spatial or

temporal variations of per capita alcohol consumption be partially driven by alcohol consumption of elderly women, which could in turn explain the robust and positive correlation between the levels of alcohol consumption and the suicide rates of this group (Markowitz, Chatterji, and Kaestner, 2003).

Divorce.The findings hereprovide weak evidence on the link between divorce and female suicide rates.

Income Inequality.The link between income inequality and suicide rates varies widely across different population groups. As seen from Tables 3 and 4, the suicide rates for females aged 20-34 and 35-64have strong negative correlations with income inequality rates. This link seems to be stronger and more robust for prime working-agewomen. This may point to the fact that for the majority of younger women who have most of their career lives ahead of them and are more optimistic about the future of the economy, increasing income inequalities may actually be a driving factor to hope and work harder for a financially affluent future.[24]The findings of a recent poll provide some support for this line of reasoning:according to The Hill 2010 Midterm Election Poll conducted by Penn Schoen Berland, "thirty percent of voters under age 55 said the [American] dream was there for all, while just 23 percent of older voters agreed" (The Hill, 2010). As Paul Taylor, executive vice president of the Pew Research Centerputs it "for years, younger Americans have shown more optimism about their future than their elders…The trend has persisted through the recession, which in some cases has hit young adults the hardest" (The Hill, 2010).

At the end, because of the inconsistencies of these findingswith the conclusions of previous studies, additionalfocused research is needed to more effectively assess the link between income inequality and suicides in the United States.

Fertility Rates.The results suggest that fertility rates are negatively correlated to suicide rates of females 20-34 and 35-64 years old. Considering that spatial and temporal variations in total fertility rate is mainly driven by the fertility rates of women aged 20-34,[25]one could argue that higher fertility rate among this group is

24. Wisman and Capehart (2010: 959) argue that people respond in three ways to higher inequality rates, one of which is working harder.

25. American women aged 20-34 have much higher fertility rates in comparison to women in other age categories. In 2009 females aged 20-34 had a fertility rate of 102 births per 1,000 women, while this rate stood at 20 and 18 births per 1,000 women for females aged 10-19 and 35-54 respectively (Ham-

associated with lower suicide ratesof non-elderly females, which is consistent with Durkheim's (1988) "family feelings" hypothesis.

Elderly Population.The findings here suggest that higher percentageof the elderly population is positively correlated with suicide rates of non-elderly women and negatively correlated with suicide rates of women aged 65+. This finding may point to a dynamic that washidden in previous aggregate studies of suicide. Specifically, previous studies suggest that higher percentage of the elderly people in society leads to higher aggregate suicide rate because older people are more likely to commit suicide than their younger counterparts (Hamermesh and Soss 1974). Figure 5, however, suggests that historically, the elderly women have had lower suicide rates than prime working-age women. Also, it can be argued here that higher concentration of elderly people in a state may increase the level of social support available for the elderly; therefore, improving their mental health and, ceteris paribus,reducing their suicide rates. On the other hand, higher percentage of elderly in a state increases the level of dependency ratio (the ratio of dependents to working-age population), which may increase the level of stress and economic insecurity among the working women aged 20 to 64; therefore, increasing the risk of suicide among this group of women in the society.[26]

Taxes.This study does not find any conclusive evidence on the link between the level of taxation and the suicide ratesin the United States.

Geography.Tables 2through5 provide conclusive evidence that, ceteris paribus, residing in Alaska and the states located in the mountain region of the United States can increase the incidence of suicide among all females, except that of the elderly.

Is Suicide Contagious?

To answer this question, we refer to the last column in Tables 2 through 5 (i.e. the estimation results for the auto-regressive model (4) estimated using the System-GMM technique) which suggests that lagged suicide rateshave explanatory power for current suicide rates for the Americans aged 20 and up (Table 2) and to a much lesser degree for American females aged 20-34 years old (Table 3). These findings

ilton, Martin, Ventura 2010).

26. Noh (2009) finds that dependency ratio is positively correlated with suicide rates on aggregate levels.

are consistent with the literature on the contagious nature of suicide as suggested by Hedström, Ka-Yuet, and Nordvik (2008).

Conclusion

Suicide is the eleventh leading cause of death in the United States. The recent upsurge of suicide among Americanfemales (Figures2 and 5) suggests that one or more of the suicide risk factors have become more prevalentamong females in the United States,[27] which may in turn point to the deterioration of overall levels of happiness and well-beingof women in America. As seen from Figures 3 through 5, the post-2000 increase in the United States' suicide rates is mainly driven by the suicide ratesof the population 35 to 64 years old, especially that of the females.[28] Therefore, any successful suicide prevention policyshould take into consideration the different behavior of suicide across different gender and agegroups.It was based on this logic that this study attempted to provide ananalysis of femalesuicidesin the United States between 1979 and 2004 across three age categories.

Furthermore, given that the recent increase in the suicide ratesof the prime working-age femalehas coincided with increasing macroeconomic volatility in the American economy, this study also attempted to analyze the link between female suicide and American labor marketconditions in more details. This was accomplished by introducing three novel labor market indicators not found in previous studies: deviation of unemployment rate from its trend, volatility in overall unemployment rates, and average earnings per job.

The main findings of this study suggest the fact that deteriorations of labor market conditions may in fact be linked to higher incidencesof suicidesamong prime working-age (i.e. 35-64 years old) women in the United States. The results of different econometric specifications and techniques show that, the positive correlations between suicide rates and unemployment ratesas well as its volatility and its deviation from trend only existfor women 35 to 64 years old. The main policy implication of thisfinding is that during periods of increasing unemployment and uncertainties in the labor market, suicide prevention efforts must actively targetthe female population aged 35 to 64 years old.

27. For a list of suicide risk factors see footnote 2.

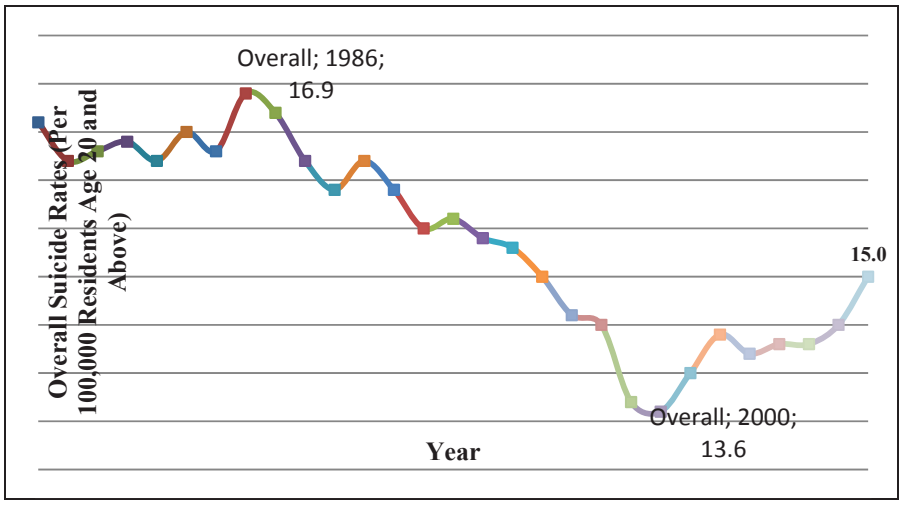
28. Between 1999 and 2007, the suicide rates of American women and men aged 35-64 years old grew by 25.8 and 16.7 percent, respectively.

These findings point to the fact that aggregate national studies of suicide, while important in providing a general understanding of the determinants of suicide in a country, often fail to capture the differentialdynamics of suicide across different gender and age groups. Without a detailed understanding of such dynamics, suicide prevention programs may not be as effective and efficient as they could potentially be.

Considering that there are tremendous degrees of variations across different localities in a given state, future studies of female suicide in the United States need to exploit the available county and city level suicide data which is widely available. The most challenging part of such research, however, would be the availability of disaggregated annual demographic and macroeconomic dataat countyand city levels, which is not readily available for all counties and cities in the United States. Furthermore, a more detailed analysis of male suicide rates in the United States would be a welcomed addition to this study as it could reveal useful facts into the difference of the determinant of suicide across different genders as well as age groups. Additionally, studies that are disaggregated across different races and ethnicities would be helpful in devising effective and targeted suicide prevention programs in the United States.

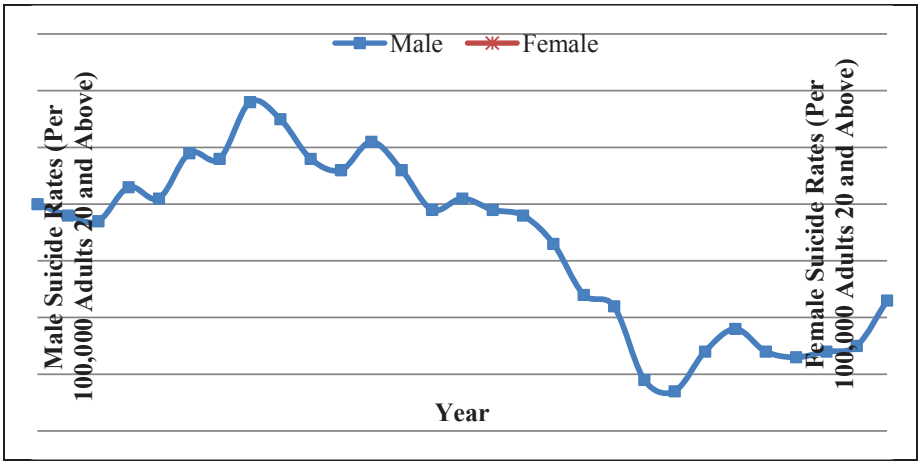
At the end and as mentioned earlier, it is important to remember that although the findings of this study are fairly robust over different econometric specifications and estimation techniques, given the complex nature of suicide, caution should be used in generalizing the resultsof the this study to other regions and time periods.

Figure 1. Overall Suicide Rates for Adults 20 Years Old and AboveUnited States (1979-2007)



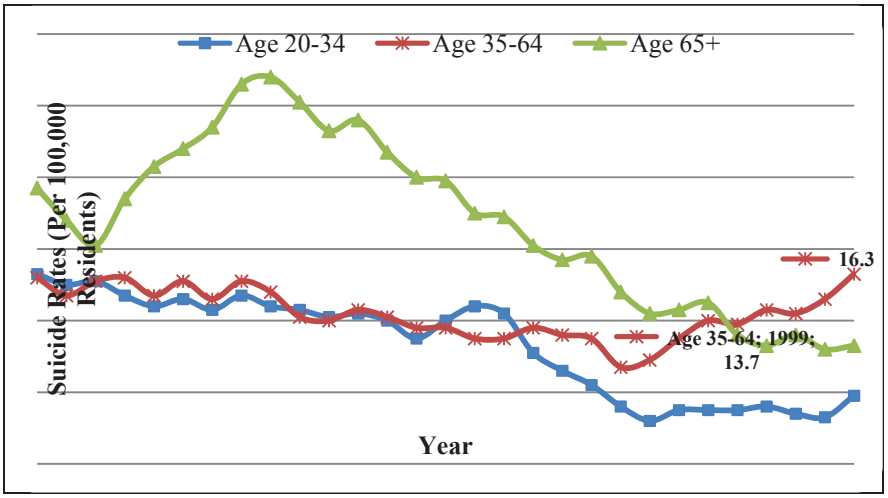
Source: Centers for Disease Control Compressed Mortality File Underlying Causes-of-Death Database.

Figure 2. Suicide Rates for Adults 20 Years Old and Above in the United States(1979-2007): By Gender



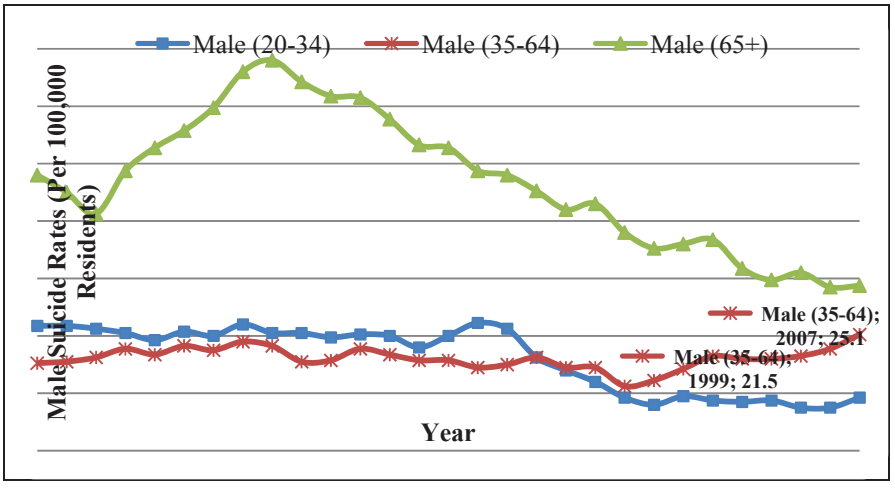
Source: Centers for Disease Control Compressed Mortality File Underlying Causes-of-Death Database.

Figure 3. Suicide Rates in the United States(1979-2007): By Age



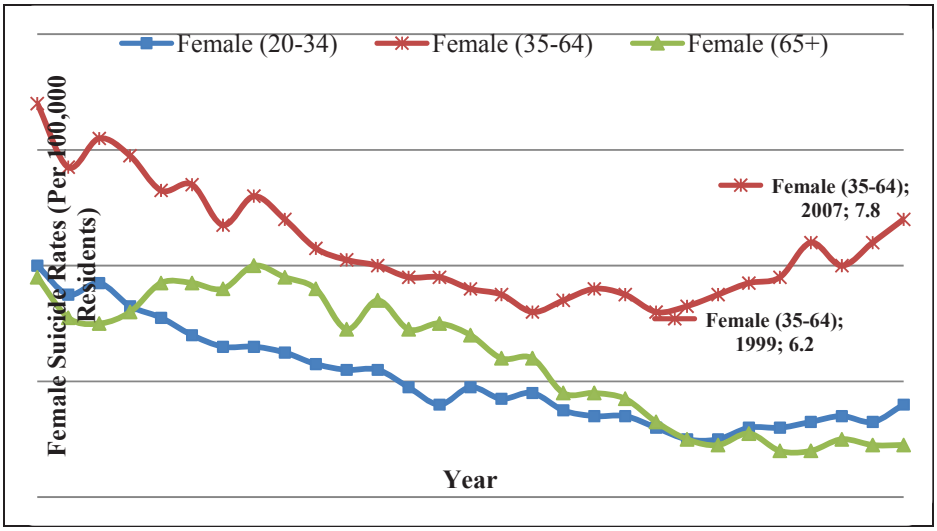
Source: Centers for Disease Control Compressed Mortality File Underlying Causes-of-Death Database.

Figure 4. Male Suicide Rates in the United States(1979-2007): By Age



Source: Centers for Disease Control Compressed Mortality File Underlying Causes-of-Death Database.

Figure 5. Female Suicide Rates in the United States(1979- 2007): By Age



Source: Centers for Disease Control Compressed Mortality File Underlying Causes-of-Death Database.

Table 1. Mean of Suicide Rates in the United States (1979-2004): by Gender and Age

	All Ages	Age: 20-34	Age: 35-64	Age: 65+
Overall (Male and Female)	17.0	16.9	16.4	20.3
Male	28.3	28.7	25.6	40.0
Female	6.5	5.7	7.7	6.0
Ratio of Male to Female	4.4	5.0	3.3	6.7

Table 2. Adults Aged 20 Years Old and Over
(Independent Variable: Suicide Rates): 1979-2004

	Pooled OLS	Fixed Effects (PCSE)	Fixed Effects Bias-corrected LSDV	System-GMM (without Lagged Suicide Rate)	System-GMM (with Lagged Suicide Rate)
MODEL 1					
Unemployment Rate[1]	0.278	0.0808	0.0506	0.0118	0.00994
Volatility in Overall Unemployment Rates	0.491	0.132	0.0501	0.61	0.577
Average Earnings Per Job[1]	-18.20**	-4.413*	-3.328	-6.296	-4.799
Labor Force Participation Rate	-0.197	0.122*	0.0912	0.0897	0.0743
Alcohol Consumption	1.642	2.009**	1.258**	0.935	1.129
Divorce Rate	1.365**	-0.0611	0.01	0.0341	0.0475
Income Inequality	-15.19	-11.98	-10.74	-21.46	-10.83
Fertility Rate	0.15	-0.0680	-0.041	-0.0857	-0.0192
Percentage of Elderly Population	-0.772**	0.160*	0.139	0.0938	0.0395
Taxes[1]	3.028	-1.406	-0.835	-0.424	-0.52
Mountain Dummy	..	..	..	7.082**	5.381**
Suicide[1]	..	..	..	..	0.228**
N	1326	1326	1275	1275	1275
MODEL 2					
Deviation of Unemployment Rate from its Trend[1]	0.281**	0.164*	0.139*	0.122*	0.295
Volatility in Overall Unemployment Rates	0.527	0.166	0.0788	0.677	0.506
Average Earnings Per Job[1]	-17.05**	-6.290**	-4.995**	-8.443	-11.14
Labor Force	-0.247*	0.0816	0.055	0.0176	-0.0467

Participation Rate					
Alcohol Consumption	1.958*	1.846**	1.374**	1.098	2.339
Divorce Rate	1.418**	-0.0408	-0.0155	-0.0111	0.113
Income Inequality	-14.48	-7.555	-7.099	-14.31	25.24
Fertility Rate	0.115	-0.0395	-0.0306	-0.0501	0.106
Percentage of Elderly Population	-0.824**	0.109	0.0878	0.00962	-0.0964
Taxes[1]	2.216	-1.471	-1.037	0.0849	-2.68
Mountain Dummy	..	..	..	7.500**	7.117**
Suicide[1]	..	..	..	..	0.173**
N	1173	1173	1173	1112	1122

1: One-Period Lagged term is used for System-GMM Models
:** significant at 5% level. *:** significant at 1% level.

Table 3. Females 20-34 Years Old (Independent Variable: Suicide Rates): 1979-2004

	Pooled OLS	Fixed Effects (PCSE)	Fixed Effects Bias-corrected LSDV	System-GMM (without Lagged Suicide Rate)	System-GMM (with Lagged Suicide Rate)
MODEL 1					
Unemployment Rate[1]	-0.0253	0.06	0.0665	0.025	0.0216
Volatility in Overall Unemployment Rates	0.176	0.148	0.125	-0.0278	0.261
Average Earnings Per Job[1]	-2.526	-0.628	-0.7	-1.781	-1.387
Labor Force Participation Rate	-0.0560	0.0512	0.0508*	0.0494	0.0745*
Alcohol Consumption	0.944*	0.707	0.38	0.273	0.438
Divorce Rate	0.466**	0.12	0.0924	0.0198	-0.0368
Income Inequality	-4.624	-17.23*	-14.89*	-19.75	-17.54
Fertility Rate	-0.0371	-0.153**	-0.107**	-0.175	-0.151
Percentage of Elderly Population	-0.217*	0.146*	0.139*	0.0952	0.111
Taxes[1]	-0.565	0.579	0.386	0.34	0.658
Mountain Dummy	..	..	..	2.243**	2.024**

Suicide[1]	..	..	..	..	0.0989*
N	1326	1326	1275	1275	1275
MODEL 2					
Deviation of Unemployment Rate from its Trend[1]	0.0335	0.0212	0.0227	-0.0531	-0.0486
Volatility in Overall Unemployment Rates	0.152	0.146	0.132	0.543	0.5
Average Earnings Per Job[1]	-3.143	-1.945	-1.765	-2.332	-2.386
Labor Force Participation Rate	-0.0552	0.0499	0.0455	0.0305	0.0443
Alcohol Consumption	1.011**	0.115	0.187	-0.16	-0.168
Divorce Rate	0.358**	-0.0373	-0.0412	-0.0266	-0.0655
Income Inequality	-5.631	-16.77*	-14.34*	-23.85	-18.62
Fertility Rate	-0.0163	-0.0985*	-0.0881*	-0.167	-0.0902
Percentage of Elderly Population	-0.223*	0.145*	0.129	0.121	0.137*
Taxes[1]	-0.502	-0.28	-0.338	0.699	0.554
Mountain Dummy	..	..	..	2.322**	2.434**
Suicide[1]	..	..	..	..	0.0533
N	1173	1173	1173	1112	1122

1: One-Period Lagged term is used for System-GMM Models. ***:** significant at 5% level. ****:** significant at 1% level.

Table 4. Females 35-64 Years Old (Independent Variable: Suicide Rates): 1979-2004

	Pooled OLS	Fixed Effects (PCSE)	Fixed Effects Bias-corrected LSDV	System-GMM (without Lagged Suicide Rate)	System-GMM (with Lagged Suicide Rate)
MODEL 1					
Unemployment Rate[1]	0.324**	0.173**	0.184**	-0.00325	0.0000128
Volatility in Overall Unemployment Rates	0.670*	0.452*	0.480*	0.615	0.535
Average Earnings Per	-9.313**	-0.603	-1.351	2.1	1.591

Job[1]					
Labor Force Participation Rate	-0.096**	-0.0056	-0.0199	-0.0217	-0.0113
Alcohol Consumption	0.876*	1.357**	1.320	0.433	0.738
Divorce Rate	0.669**	-0.0302	0.00818	-0.0812	0.0279
Income Inequality	-6.24	-19.68**	-18.85**	-29.87**	-24.98**
Fertility Rate	0.123	-0.086**	-0.0700*	-0.105	-0.0983*
Percentage of Elderly Population	-0.233	0.129*	0.123*	0.088	0.146*
Taxes[1]	3.057**	-0.476	0.209	-1.549	-1.332
Mountain Dummy	..	..	..	2.296*	1.708*
Suicide[1]	..	..	..	..	0.0238
N	1326	1326	1275	1275	1275
MODEL 2					
Deviation of Unemployment Rate from its Trend[1]	0.183**	0.104*	0.106*	0.0256	0.0418
Volatility in Overall Unemployment Rates	0.782**	0.633**	0.624**	0.525	0.342
Average Earnings Per Job[1]	-7.776**	-2.808	-2.674	-1.022	-1.476
Labor Force Participation Rate	-0.109**	-0.011	-0.0105	-0.0328	-0.0212
Alcohol Consumption	0.964*	0.753	0.774	0.332	0.667
Divorce Rate	0.674**	-0.0154	-0.0173	-0.101	-0.0145
Income Inequality	-4.772	-17.43*	-17.01**	-24.35**	-18.70*
Fertility Rate	0.0914	-0.090**	-0.0912*	-0.0722	-0.0545
Percentage of Elderly Population	-0.258	0.0924	0.0868	0.0704	0.114
Taxes[1]	2.196*	-0.137	-0.071	-1.059	-0.627
Mountain Dummy	..	..	..	2.330**	1.567**
Suicide[1]	..	..	..	..	-0.00265
N	1173	1173	1173	1112	1122

1: One-Period Lagged term is used for System-GMM Models. ***:** significant at 5% level. ****:** significant at 1% level.

Table 5. Females 65 Years Old and Over
(Independent Variable: Suicide Rates): 1979-2004

	Pooled OLS	Fixed Effects (PCSE)	Fixed Effects Bias-corrected LSDV	System-GMM (without Lagged Suicide Rate)	System-GMM (with Lagged Suicide Rate)
MODEL 1					
Unemployment Rate[1]	0.0605	-0.0003	-0.00345	0.0085	0.00413
Volatility in Overall Unemployment Rates	-0.257	-0.448	-0.495	-0.239	-0.334
Average Earnings Per Job[1]	-1.068	2.212	3.078	3.954	2.808
Labor Force Participation Rate	-0.0269	0.0986*	0.0932*	0.104*	0.0787
Alcohol Consumption	0.857	2.007**	1.733**	2.669**	2.427**
Divorce Rate	0.582**	-0.0023	0.0237	-0.129	-0.127
Income Inequality	-0.906	7.549	3.002	3.136	7.044
Fertility Rate	-0.0146	-0.0741	-0.0719	-0.0822	-0.0192
Percentage of Elderly Population	-0.392*	-0.305**	-0.263**	-0.397**	-0.360**
Taxes[1]	0.729	-1.065	-0.63	-1.173	-1.016
Mountain Dummy	..	..	..	0.157	-0.0652
Suicide[1]	..	..	..	..	0.0279
N	1326	1326	1275	1275	1275
MODEL 2					
Deviation of Unemployment	-0.0047	-0.015	-0.0151	-0.0246	-0.0262

Rate from its Trend[1]					
Volatility in Overall Unemployment Rates	-0.346	-0.675	-0.666	-0.116	-0.491
Average Earnings Per Job[1]	-2.092	4.098	3.791	2.047	1.518
Labor Force Participation Rate	-0.0784	0.0317	0.0292	0.0990*	0.061
Alcohol Consumption	0.906*	2.019**	1.848**	2.722**	2.446**
Divorce Rate	0.594**	-0.0829	-0.0871	-0.0683	-0.096
Income Inequality	-0.91	5.974	6.003	14.99	15.73
Fertility Rate	0.00736	-0.0513	-0.0513	-0.00517	0.033
Percentage of Elderly Population	-0.388*	-0.391**	-0.369**	-0.410**	-0.455**
Taxes[1]	1.181	-0.667	-0.568	-1.689	-0.873
Mountain Dummy	..	..	..	0.646	0.49
Suicide[1]	..	..	..	..	-0.00805
N	1173	1173	1173	1122	1122

1: One-Period Lagged term is used for System-GMM Models
:** significant at 5% level. *:** significant at 1% level.

APPENDIX

Table A.1. Source and Description of ExplanatoryVariables

Indicator	Description	Source
Geographic Factor	Dummy variable for Alaska and the States in the Mountain Region	National Climate Data Center
Alcohol Consumption	Annual Average per Capita alcohol Consumption (Gallons)	Alcohol Epidemiologic Data System. National Institute on Alcohol Abuse and\Alcoholism, Division of Epidemiology and Prevention Research
Divorce Rate	Annual Divorce Rate (per 1,000 Residents)	Center for Disease Control, National Vital Statistics Report (CDC NVSR).
Income Inequality	Estimated Family Income Inequality (GINI Coefficient)	University of Texas Inequality Program
Fertility Rate	Annual Birth Rate (per 1,000 Residents)	Center for Disease Control, National Center for Health Statistics (CDC NCHS)
Percentage of Elderly Population	Percent of Residents 65 and Above in Total State Population	United States Bureau of Labor Statistics (BLS) (Calculation by Author)
Taxes	Natural Log of Total Taxes per Capita(Constant 2005 $)[29]	U.S. Department of Commerce, Bureau of Economic Analysis (BEA)
Labor Force Participation Rate*	Percentage of Population in Labor Force (%)	BLS (Calculation by Author)
Income	See the Description for *Average Earnings per Job* in Table A.2.	See the Source for Average Earnings per Job in Table A.2.
Unemployment Rate*	Annual Average Unemployment Rate (%)	United States Bureau of Labor Statistics (BLS)

*: Available For each of the Three Age Groups

[29]Constant dollar values are calculated using BEA's implicit price deflator for personal consumption expenditures (2005=100).

Table A.2. Other Labor Market Explanatory Variables: Source and Description

Indicator	Description	Source
Deviation of Unemployment Rate from its Trend*	Deviation of Annual Unemployment Rate from its Three-Year Moving Average	BLS (Calculation by Author)
Volatility in Overall Unemployment Rate	Variance of Seasonally Adjusted Monthly Unemployment Rates	BLS (Calculation by Author)
Average Earnings Per Job	Natural Log of Annual Average Earnings per Job (Constant 2005 $)	U.S. Department of Commerce, Bureau of Economic Analysis (BEA)

*: Available For each of the ThreeAge Groups

Table A.3. Mean of Mentally Unhealthy Days per Year: Overall United States

Year	Statistic	Estimate
1993	Mean	2.9
	95 % Confidence Interval	(2.8–3.0)
	n	98,619
1996	Mean	2.9
	95 % Confidence Interval	(2.8–3.0)
	n	118,309
1999	Mean	3
	95 % Confidence Interval	(2.9–3.1)
	n	150,957
2000	Mean	3.2
	95 % Confidence Interval	(3.1–3.3)
	n	172,960
2001	Mean	3.4
	95 % Confidence Interval	(3.3–3.5)
	n	194,471
2003	Mean	3.4
	95 % Confidence Interval	(3.3–3.5)
	n	246,134
2005	Mean	3.3
	95 % Confidence Interval	(3.2–3.4)
	n	331,517
2008	Mean	3.4
	95 % Confidence Interval	(3.3–3.5)
	n	386,066
2009	Mean	3.5
	95 % Confidence Interval	(3.4–3.6)
	n	402,735

n:The number of adult (18 years old and above) respondents who answered both the physically and mentally unhealthy days (i.e., overall unhealthy days) questions.
Source: 1993–2009 Behavioral Risk Factor Surveillance System.

Table A.4. Mean of Suicide Rates for 50 U.S. States and the District of Columbia (1979–2004):Suicides per 100,000 Residents

State	Rank	Overall	Female	Male	Age: 20-34	Age: 35-64	Age: 65+
Nevada*	1	30.9	13	48.9	27.9	31.7	41.2
Wyoming*	2	25.5	8.6	42.7	25.9	22.6	36.3
New Mexico*	3	25.3	9.7	42.1	28.3	23.1	26.4
Montana*	4	24.5	8.3	41.4	23.5	23.2	31.1
Alaska*	5	23.8	9	38.8	29.5	18.6	19.2
Arizona*	6	23.4	9.3	38.5	22.8	22.5	29.1
Colorado*	7	22.3	9.2	36	20.6	22.7	27.6
Idaho*	8	21.5	7.3	36.1	19.9	20.3	29.7
Utah*	9	20.6	7.6	34.1	19.6	21.5	21.3
Oregon	10	20.2	8.2	32.6	17.9	19.3	30.1
Florida	11	19.6	8.6	31.9	17	20.1	25.1
Oklahoma	12	18.8	7.4	31.4	20.2	17.8	20.4
Vermont	13	18.6	6.5	31.6	18.2	17.9	23.4
Washington	14	18.2	7.5	29.5	17.5	17.3	24.7
South Dakota	15	18.1	5.3	31.7	19.7	16	18.5
Kentucky	16	17.3	6.1	29.8	16.6	17.2	22.1
Maine	17	17.2	6.5	28.7	18.5	15.8	20.1
West Virginia	18	17.2	5.6	30.2	16.5	17.5	19.9
Arkansas	19	17.1	6	29.4	17.1	16.6	20.2
Missouri	20	17.1	6.4	28.9	16	16.9	20.6
Tennessee	21	17	6.6	28.7	16.3	17.2	20.9
Louisiana	22	16.7	6.7	28	17.5	15.8	19.7
Virginia	23	16.7	6.7	27.8	16	16.4	21.5
Georgia	24	16.4	6.2	27.9	15.5	16.5	20.6

North Carolina	25	16.4	6.6	27.2	15.3	16.7	19.8
Texas	26	16.4	6.7	26.7	15.6	16.1	21
Kansas	27	16.3	6	27.4	16.7	15.7	17.9
California	28	16.2	7.5	25.5	14.2	16.3	24.5
Wisconsin	29	15.9	6.2	26.1	16	15	18.7
New Hampshire	30	15.8	6.2	26	15.9	15.7	17.1
Alabama	31	15.7	5.7	27	14.5	15.8	21.1
Indiana	32	15.7	5.6	26.9	15.9	15.3	18.6
North Dakota	33	15.6	4.8	26.9	16.7	14.6	15.2
Delaware	34	15.5	6.4	25.6	15.3	15.5	18.4

Table A.4 (Continued)

State	Rank	Overall	Female	Male	Age: 20-34	Age: 35-64	Age: 65+
South Carolina	35	15.5	5.9	26.4	15.5	15.9	17.3
Mississippi	36	15.2	5.8	26	14.9	14.9	18.5
Iowa	37	14.9	5.1	25.4	14	14.4	18.3
Michigan	38	14.9	5.8	24.6	14.7	14.6	17.6
Nebraska	39	14.8	5.1	25.5	14.3	14.4	17.3
Pennsylvania	40	14.8	5.5	25.3	15.6	14.6	15.5
Hawaii	41	14.5	6.2	23.8	16.8	12.8	16
Minnesota	42	14.3	5.5	23.4	14.1	13.9	15.4
Ohio	43	14.3	5.7	23.7	13.8	14	18.1
Maryland	44	13.2	5	22.3	13.9	12.3	16.3
Illinois	45	12.5	5	20.7	12.2	12.1	15.8
Rhode Island	46	12.3	5.1	20.5	14.3	12.2	10.3
Connecticut	47	11.4	4.5	19.1	12.1	11.1	12.4
Massachusetts	48	10.5	4.5	17.1	11.1	10.8	9.7
New York	49	9.8	4	16.4	10	9.5	11.5
District of Columbia	50	9.3	3.5	16.3	10.3	8.8	9.4
New Jersey	51	9.3	3.7	15.6	9.2	9.1	11.5

*: Mountain States and Alaska

Table A.5. Mean of Suicide Rates in Mountain States and Non-Mountain States (1979–2004): Suicides per 100,000 Residents

		Mean	Standard Error	99.99% Confidence Interval	N
Overall	Mountain States and Alaska	24.5	0.27	(23.5, 25.6)	208
	Non-Mountain States	15.9	0.10	(15.5,16.3)	1118
Male	Mountain States and Alaska	40.4	0.43	(38.7, 42.0)	208
	Non-Mountain States	26.6	0.16	(26.0, 27.2)	1118
Female	Mountain States and Alaska	9.4	0.18	(8.7, 10.1)	208
	Non-Mountain States	6.2	0.05	(6.0, 6.4)	1118

Table A.6. Descriptive Statistics

	Variable	N	Mean	Standard Deviation	Minimum	Maximum
Overall	Alcohol Consumption (Gallons Per Capita)	1326	2.48	0.67	1.20	6.44
	Divorce Rate (per 1,000 Residents)	1326	4.84	1.64	0.26	17.60
	Income Inequality (GINI Coefficient)	1326	0.40	0.03	0.33	0.59
	Fertility Rate (Births per 1,000 Residents)	1326	15.21	2.75	10.4	37.3
	Percentage of Elderly Population (Percentage of Total Population)	1326	11.45	1.98	2.63	16.81
	Taxes (Natural Log $)	1326	1.11	0.31	0.33	2.21
	Volatility in Overall Unemployment Rate (Variance of Unemployment Rate)	1326	0.13	0.29	0.00	5.13

	Average Earnings per Job (Natural Log $)	1326	10.49	0.18	10.05	11.31
Overall	Labor Force Participation Rate	1326	67.72	3.92	52.15	77.20
	Unemployment Rate	1326	5.22	1.93	1.49	16.53
	Deviation of Unemployment Rate from its Trend	1173	-0.09	1.33	-3.69	6.72
Female (20-34)	Labor Force Participation Rate	1326	73.46	5.46	50.64	88.06
	Unemployment Rate	1326	7.08	2.52	2.25	17.59
	Deviation of Unemployment Rate from its Trend	1173	-0.17	1.60	-5.14	6.29
Female (35-64)	Labor Force Participation Rate	1326	67.28	7.50	41.20	85.11
	Unemployment Rate	1326	3.91	1.44	0.00	10.47
	Deviation of Unemployment Rate from its Trend	1173	-0.05	1.13	-4.20	4.92
Female (65+)	Labor Force Participation Rate	1326	9.10	2.31	3.14	20.00
	Unemployment Rate	1326	2.18	2.86	0.00	16.67
	Deviation of Unemployment Rate from its Trend	1173	0.01	2.78	-11.10	16.65

Table A.7. Bivariate Correlation between Suicide Rates and Control Variables (Observation=1326)

	Overall	Female (20-34)	Female (35-64)	Female (65+)
Mountain	0.7184*	0.4517*	0.5244*	0.3628*
Alcohol Consumption	0.2136*	0.3049*	0.2741*	0.3428*
Divorce Rate	0.6641*	0.5015*	0.5651*	0.4328*
Income Inequality	-0.2400*	-0.2123*	-0.2013*	-0.1627*
Fertility Rate	0.1983*	0.2017*	0.2282*	0.2736*
Percentage of Elderly Population	-0.3169*	-0.3085*	-0.3096*	-0.3616*
Taxes	-0.4060*	-0.2574*	-0.2848*	-0.1061*
Labor Force Participation Rate	0.0696*	-0.1989*	-0.2688*	-0.0351
Unemployment Rate	0.0769*	0.1262*	0.1693*	-0.0129
Deviation of Unemployment Rate from its Trend	0.0018	0.027	0.0728*	-0.0023
Volatility in Overall Unemployment Rate	0.0512	0.1033*	0.1434*	0.0505*
Average Earnings Per Job	-0.3870*	-0.2317*	-0.2456*	-0.0838*

***:** Indicates Statistical Significance at the 10 Percent Level.

Table A.8. Details on Regression Specifications

Econometric Method	Estimation Details
Pooled OLS	• Huber-White standard errors are reported. These standard errors are robust to correlation of errors within but not across panels (i.e. States).
Fixed-Effects (PCSE)	• Prais-Winsten models with panel-corrected standard errors. • For all demographic groups, disturbances are found to be heteroskedastic and contemporaneously correlated across panels (i.e. States). • First order autocorrelation is detected for only the disturbances of one demographic group: Males aged 35-64 years old. • The effects of the above violations of classical OLS assumptions are corrected using *Panel-Corrected Standard Errors"(PCSE)* procedure suggested by Beck and Katz (1995).
Fixed Effects Bias-corrected LSDV	• Estimated using Giovanni Bruno's (2005) XTLSDVC .ado routine in Stata 11. • Bootstrap standard errors are reported (100 repetitions).
System-GMM	• Estimated using David Roodman's XTABOND2 .ado routine in Stata 11. • Robust standard errors are reported. • The Hansen test indicates whether the over-identifying restrictions can be rejected by the data. • Only when the null of 2nd order autocorrelation (AR) test can be rejected, the results are considered to be inconsistent.

Note: All Regressions Include Year Dummies

Table A.9. Relevant Diagnostic Tests

		Pooled OLS	Fixed Effects OLS	System-GMM without Lagged Suicide Rate	System-GMM with Lagged Suicide Rate
Overall	MODEL 1	RMSE= 2.77 Ad.R^2= 0.64	RMSE= 1.54 R^2= 0.89	Hansen Test= 1 1st Order AR: 0.0001 2nd Order AR: 0.387	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.0794
	MODEL 2	RMSE= 2.75 Ad.R^2= 0.64	RMSE= 1.52 R^2= 0.90	Hansen Test= 1 1st Order AR: 0.0005 2nd Order AR: 0.816	Hansen Test= 1 1st Order AR: 0.117 2nd Order AR: 0.392
Females 20-34 Years Old	MODEL 1	RMSE= 1.94 Ad. R^2= 0.34	RMSE= 1.74 R^2= 0.50	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.951	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.553
	MODEL 2	RMSE= 1.86 Ad. R^2= 0.29	RMSE= 1.65 R^2= 0.48	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.879	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.875
Females 35-64 Years Old	MODEL 1	RMSE= 1.98 Ad. R^2= 0.46	RMSE= 1.63 R^2= 0.66	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.368	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.417
	MODEL 2	RMSE= 1.93 Ad. R^2= 0.43	RMSE= 1.57 R^2= 0.65	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.217	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.170
Females 65 Years Old and Over	MODEL 1	RMSE= 2.64 Ad. R^2= 0.32	RMSE= 2.33 R^2= 0.50	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.632	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.822
	MODEL 2	RMSE= 2.56 Ad. R^2= 0.32	RMSE= 2.24 R^2= 0.51	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.463	Hansen Test= 1 1st Order AR: 0.0000 2nd Order AR: 0.398

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