The Journal of Socio-Economics 45 (2013) 175–186

Contents lists available at SciVerse ScienceDirect

The Journal of Socio-Economics

journal homepage: www.elsevier.com/locate/soceco

Labor markets and mental wellbeing: Labor market conditions and suicides in the United States (1979–2004)

Amin Mohseni-Cheraghlou*

American University, 4400 Massachusetts Avenue, NW, Washington, DC 20016, United States

ARTICLE INFO

Article history:
Received 6 December 2012
Received in revised form 9 April 2013
Accepted 4 May 2013

Keywords:
Suicide
Mental wellbeing
Labor markets
Unemployment
Fixed-effects
Panel data

ABSTRACT

Applying a fixed-effects panel analysis to a 1979–2004 panel data of the U.S. states, this essay re-examines the link between labor markets and suicides in the United States. By disaggregating the analysis across genders and three different age groups (20–34, 35–64, and 65+) and analyzing several other labor market indicators besides overall unemployment rates, the essay finds that deteriorations in labor markets is associated with hikes in suicide rates of only men and women between 35 and 64 years of age. In other words, higher group-specific unemployment rates, larger deviations of unemployment rates from their group-specific trends, and larger variance in the overall unemployment rates are all associated with higher suicide rates of adults aged 35–64, or prime working-age adults. These findings suggest that the mental wellbeing of prime working-age adults is more dependent on labor market conditions than people in other age groups. Therefore, during period when prime working-age adults are facing unfavorable labor market conditions, U.S. suicide prevention programs must especially target this group of population.

1. Introduction

Suicide is considered a public health problem in the United States. In 2009 alone, suicide was responsible for more than 36,909 deaths, making it the 10th leading cause of death in the U.S. In the same year, 2.2 times more people died as a result of suicide than as a result of assault. Suicide was also the only cause of death showing a significant increase between 2008 and 2009 (Kochanek et al., 2011). What is more worrisome is that the declining trend of adult (aged 20+) suicide rates in the United States between 1986 and 2000 has been reversed since 2001: while America's adult suicide rates declined by an average annual rate of 1.5% during 1986–2000, it experienced an annual average of 1.4% growth between 2001 and 2007 (Fig. 1).

Among the known risk factors of suicide are 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, excessive stress, and feelings of insecurity and hopelessness.[1] Therefore, the recent hike in U.S. suicide rates may point to declining mental wellbeing of Americans.

Several risk factors of suicide, such as excessive stress, divorce, and feelings of financial insecurity can be influenced by macroeconomic conditions. As a result, over the past three decades, research has attempted to examine the link between macroeconomic conditions and suicide rates. The overall finding of this body of literature shows that alongside other social and geographic factors, macroeconomic variables such as income levels and unemployment rates could explain the patterns of suicide in a society.[2] From amongst these indicators, researchers have especially focused on the link between unemployment and suicide as unemployment rates are included in literally all macroeconomic analysis of suicides. While there is unanimity among researchers in including unemployment rates in empirical studies as an important explanatory variable of suicide, there is hardly any agreement on the link between suicide and unemployment rates. For example, in their time-series analyses of aggregate suicide data for the U.S. between 1940 and 1984, Yang et al. (1992), Yang and Lester (1995), and Yang and Stack (1992) show that increasing unemployment rates can raise suicide rates. Also, in his 1972–1991 state-level panel study of the U.S., Ruhm (2000) also finds unemployment and suicide to be positively correlated. However, more recent panel data analyses have cast doubt on these earlier findings. In particular, in their panel analyses of 50 U.S. states and the District of Columbia, Kunce and Anderson

* Correspondence address: American University, 440 Massachusets Avenue, NW, Washington, DC, 20016, United States.
E-mail address: am8369a@american.edu

[1] See Moscicki (2001).

[2] See Brainerd (2001), Chung (2009), Hamermesh and Soss (1974), Koo and Cox (2008), Minoiu and Andres (2008), Noh (2009), Andres (2005), Yang (1992), and Yang and Stack (1992).

1053-5357/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.socec.2013.05.003

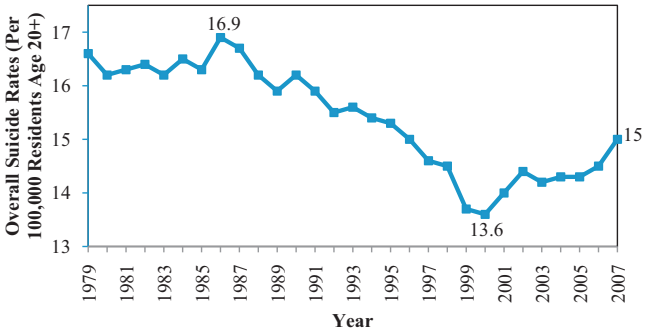

Fig. 1. U.S. suicide rates for adults 20 years old and above (1979–2007).

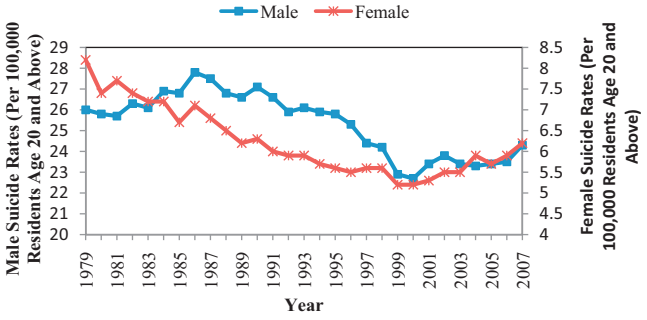

Fig. 2. U.S. suicide rates for adults 20 years old and above.

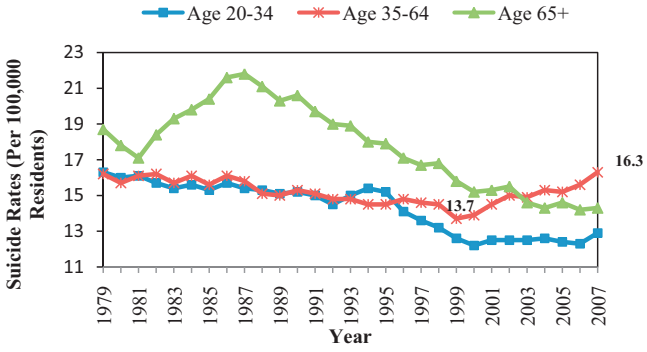

Fig. 3. U.S. suicide rates disaggregated by age (1979–2007).

(2002) and Minoiu and Andres (2008) did not find any evidence of a significant link between unemployment and suicide rates.[3]

This work sets out to reinvestigate the link between labor market conditions and suicide in the case of the United States, while taking into account two main gaps in the literature. The first issue pertains to the pooling of data across different gender and age groups. As factors precipitating suicide may vary across different gender and age groups, conclusions derived from aggregated data may mask dynamics specific to particular age and/or gender subpopulation. Yang (1992) and Minoiu and Andres (2008) are the main recent studies that have included suicide rates for different genders as their dependent variable.[4] However, both studies include overall unemployment rates as part of the matrix of explanatory variables. Also, both studies fail to distinguish between different age groups. While Minoiu and Andres (2008) are more careful in their treatment of age factor, they aggregate together population between 26 and 69 years of age. This does not allow for possible differences between those who are at the beginning of their careers (20–34 years old), those who are more established in their careers (35–64 years old), and those who are eligible for retirement benefits (65 years old and above).

The second weakness in the literature stems from the fact that besides overall unemployment rates and female labor force participation rates, other relevant labor market conditions are not included as part of labor market explanatory variables of suicide. While the overall unemployment rate is an important indicator in assessing the general conditions in the labor market, 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.

This essay makes use of panel data on America's 50 states and the District of Columbia between 1979 and 2004 and analyses the determinants of suicide in the United States for six gender-by-age demographic groups. The three age groups are: 20–34 years, 35–64 years, and 65 years and above. Furthermore, in addition to the unemployment rate, we also examine the relevance of other labor market indicators. These indicators are labor force participation rates of each population subgroup, deviations of unemployment rates of each population subgroup from their trends, and the volatility of state-level overall unemployment rates.[5]

In brief, the results suggest that deteriorations in labor market conditions in the United States – higher unemployment rates, larger deviations of unemployment rates from their trends, and greater volatility in the overall state-level unemployment rates – are associated with higher rates of suicide for only those men and women between 35 and 64 years of age, that is, in the prime working-age range.

The remainder of the paper is organized as follows: Section 2 discusses the merit of a disaggregated approach to the study of suicide. Section 3 discusses the variables that are included in our econometric specifications. Section 4 outlines the estimation methodology. Section 5 presents and discusses the findings, while Section 6 concludes the paper.

2. Disaggregation across gender and age

In order to establish the merits of a disaggregated analysis of suicide in the U.S., Figs. 2–5 show patterns of suicide rates between 1979 and 2007 for different demographic groups in the U.S. Several important observations can be made from these figures. First, male suicide rates have been 3.1–4.6 times higher than female suicide rates (Fig. 2).[6] Second, as mentioned earlier, declining trends in suicide rate from 1986 to 1999 for both men and women have been reversed since 2000 (Fig. 2). One explanation for this

[3] 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 rate and suicide rate.

[4] 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.

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

[6] It must be noted that female suicide attempts are about three times higher than male suicide attempts. However, since men usually choose more violent methods of suicide, such as firearms and hanging as opposed to poisoning (the most common method among women), male suicide attempts are about 12 times more successful than that of women, making male suicide rates about four time higher than female suicide rates (see http://www.afsp.org/files/College_Film//factsheets.pdf, http://www.cdc.gov/violenceprevention/pdf/suicide-datasheet-a.PDF).

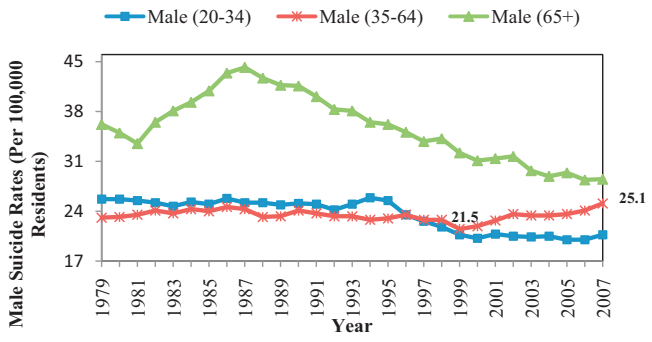

Fig. 4. U.S. male suicide rates disaggregated by age (1979–2007).

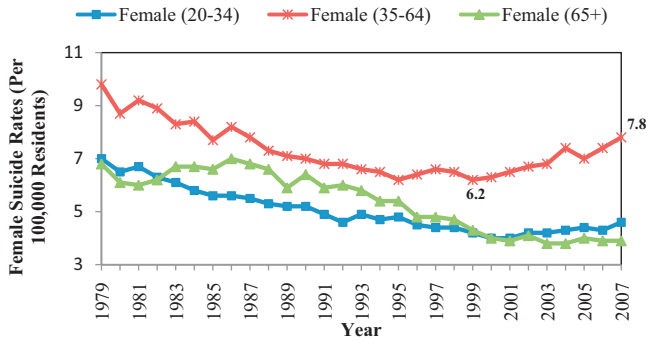

Fig. 5. U.S. female suicide rates disaggregated by age (1979–2007).

phenomenon could be an increased sense of economic, physical, and psychological insecurity from 2000 onwards, reflecting the 2001 recession, 9/11 terrorist attacks, and the start of military campaigns in Afghanistan and then Iraq. Third, for the most part, during 1979–2007, male and female suicide rates followed similar trends, with the correlation perhaps strengthening most in the recent decade (Fig. 2). Conceivably, this may be due to the converging social and economic roles of males and females in 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.[7]

Fourth, starting in the late-1990s, suicide rates for the prime working-age group (35–64 years old) has been increasing while suicide rates for people at the beginning years of their careers (20–34 years old) or in the retirement age have more or less held steady or continued to decline (Figs. 3–5). Conceivably, this may be linked to changing patterns of job creation and job destruction that started in the mid-1990s and have gained momentum since 1999. For example, a 2006 report authored by Yoonsoo Lee and Brian Rudick, two economists from Federal Reserve Bank of Cleveland, shows that since the mid-1990s job creation rates in the U.S. have been declining while job destruction rates has been on steady rise. Furthermore, the rise of information technology and the "dot.com" industry in the second half of the 1990s contributed to notable structural shifts in the labor market. One consequence of such shifts has been declining employee tenure, which can be translated into reduced stability of employment and increasing movements between jobs[8] that could be 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 peaked in the mid-1980s and has been declining steadily since then (Fig. 3). This pattern, which was mainly driven by the suicide rates of the men aged 65+ (Fig. 4), has played a central role in the decline of the overall suicide rate between 1986 and 2000. It also points to possible differences in the determinants of suicide for the 65+ people in comparison to others.

As a result, our econometric specifications are estimated for seven different population subgroups: adults aged 20 and over, males aged 20–34, males aged 35–64, males aged 65 and above, females aged 20–34, females aged 35–64, and females aged 65 and above. The logic behind this specific age categorization stems from the following facts. First, people aged 20–34 are either in school or are at early stages of their work lives. Particularly before they marry and/or have children they tend to be more geographically mobile. William Frey, a senior fellow and demographer at Brookings Institution, shows in a recent report that interstate migration rates among U.S. young adults are more than twice larger than the rest of the population as they are not bugged down by mortgages and can easily move to different cities in search of better and higher paying jobs.[9] Furthermore, they have a higher capacity and motivation to learn the changing skills that are demanded in today's more fluid labor markets. These factors would make them more geographically and occupationally mobile and thus less vulnerable to changing conditions of the local labor market. On the other hand, people aged 35–64 are more likely to have children and/or elderly dependents, be more settled in their career paths, and have lower retraining capacity or motivation to learn new skills compared to younger workers. As a result, they tend to be geographically and occupationally less mobile and therefore more vulnerable to local as well as national fluctuations in the labor market conditions. These differences between younger and older workers have been documented by several studies including Dixon (2003), Davis et al. (2006, 14), Topel and Ward (1992).

Second, during the period 1979–2004 the Normal Retirement Age (NRA), the age by which retirees were eligible to receive full social security benefits, was 65 years old.[10] 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. This is because upon retirement labor income plays a much less important role in the total income of the retired population, and as a result, aggregate fluctuations in the labor market are likely to play a smaller role in their wellbeing. Finally, this study avoids analyzing teen suicide rates as they may be less dependent on state-wide socio-economic conditions, at least in a direct manner, and may be affected by other complicated and more localized factors.

3. Variables

3.1. Variable included in previous studies

Similar to previous studies of suicide, we include alcohol consumption per capita, divorce rates, fertility rates, share of population above 65 years of age, unemployment rates, and

[7] See United States Bureau of Labor Statistics: Labor Force Statistics 2010.

[8] Munnell and Sass (2008) report a considerable decline in job tenure among older workers (55–64 age range) between 1991 and 1996. Moreover, Neumark (2000) find that, during 1990s, higher tenure male workers had a lower probability of remaining in their jobs than previous decade. Finally, Bernhardt et al. (1999) reports an increasing separation rate for younger workers between MID-1970s and mid-1990s.

[9] See Frey (2012).

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

geographic factors in our matrix of explanatory variables. As found by the World Health Organization (WHO), Centers for Disease Control (CDC), and the American Association of Suicidology (AAS), alcohol abuse is an important correlate of suicide risk.[11] 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, even after controlling for other factors associated with suicide risk, higher alcohol consumption remains significantly associated with higher suicide rates.[12]

Studies of suicide often control for the divorce rate, as it is thought to reduce social integration and family ties, while increasing the probability of depression and economic, sexual, and emotional hardships.[13] In regards to fertility rates, Durkheim (1988) hypothesized that increased fertility, due to its positive influence on "family feeling", could reduce suicide rates. Empirically, with results depending on the region and population under analysis, there is mixed evidence for and against this hypothesis. While Chuang and Huang (1997) do not find a statistically significant relationship between fertility and suicide rates, other studies such as Koo and Cox (2008), Neumayer (2003), Noh (2009), and Andres (2005) support Durkheim's hypothesis.

Some studies have included share of elderly population in their empirical analysis. The pioneers of this approach were Hamermesh and Soss (1974) who suggested that the elderly may be more prone to suicide as they may find the costs of maintaining life to exceed the benefits they receive from it. Their analysis of 1965–1967 suicide rates of 21 developed countries indicated that countries with a higher percentage of elderly population (age 65 and above) have statistically significant higher overall suicide rates. Hamermesh and Soss's (1974) conclusion is supported by Noh's (2009) analysis of suicide rates of OECD countries.

In regard to labor force participation rates, previous work has only analyzed the link between female labor force participation rates (FLFPR) and suicide and has had mixed results. 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 et al. (1975) provide an opposite hypothesis known as "role accumulation or role expansion theory". Marks (1977) and Sieber (1974) provide some support for this hypothesis as they find that FLFPR is negatively correlated to suicide rates of working mothers in British Columbia around 1961 and 1971.[14] At the same time, some studies do not find any statistically significant relationship between FLFPR and suicide rates.[15]

The literature on quality of life and happiness considers unemployment rates as the most important macroeconomic factors that could influence overall wellbeing and mental health. Di Tella et al.'s (2003) cross-country panel analysis finds that self-reported happiness is strongly related to macroeconomic conditions.[16] Therefore, not surprisingly, it is standard in quantitative studies of suicide to control for unemployment rates.[17] However, as we saw earlier there is little agreement on the size and direction of its effects on the suicide rates. Aiming to revisit these mixed findings, Noh (2009) analyses the link between unemployment rates and suicide across countries at different income levels. Hypothesizing that the effects of changes in unemployment may depend on income level, he includes an interaction term between unemployment rates and real per capita gross domestic product. He finds that "the unemployment rate does significantly affect suicide rates, but in a way that varies with income: in a positive manner for high-income countries, but in a negative manner for low-income countries" (Noh, 2009, 582).

Finally, climate conditions are known to be correlated with suicide rates because of its potential effects on the incidence and the severity of depression (Robbins et al., 1972; Thorson and Kasworm, 1984). In particular, suicide rates are relatively high in Nordic countries in comparison to all other regions in the world. An important factor that may explain this is the relatively short hours of daylight during winters in Northern regions of the globe exacerbating feelings of sadness and depression.[18] However, several studies have found some nuances in this regard.[19] In particular, some analyses of seasonal patterns of suicides find that suicide rates peak during summer, when hours of daylight are relatively long.[20] While the causal explanations for these findings remain under investigation, the correlation between geographical factors and suicide rates is supported by many studies. In the United States, for example, Minoiu and Andres (2008) find that across many regression specifications, states located in the mountain region have significantly higher suicide rates than other states.[21] Some studies have also pointed to the indirect effect of harsh climate (too cold or too hot) on suicide through its effects on population density. These studies argue that lower population density (as a result of harsh climate or other factors) may reduce social integration, therefore increasing feelings of loneliness and depression and thus risk of suicide.[22]

3.2. Three novel variables

While overall unemployment rate is certainly an important variable in assessing the general conditions in the labor market, unlike previous studies, we include unemployment rates for each population subgroup when we are attempting to analyze the determinants of each group's suicide rates. Furthermore, the inclusion of additional labor market indicator could prove useful in our understanding of the link between labor market conditions and suicide in the U.S. Therefore we introduce three novel variables in our analysis: labor force participation rate for each population subgroup, deviations of unemployment rates for each population subgroup from their underlying trends, and variability in the state-level unemployment rates. We expect for the latter two variables to play a role in explaining variations of suicide rates across years and states for the following reasons. First, in an analysis of the 1991 wave of the British Household Panel Study, Clark and Oswald

[11] See http://www.who.int/topics/suicide/en/, http://www.cdc.gov/ViolencePrevention/suicide/index.html, and http://www.suicidology.org/c/document_library/get_file?folderId=232&name=DLFE-186.doc.

[12] See Brainerd (2001), Koo and Cox (2008), Lester (1995), Markowitz et al. (2003), and Andres (2005).

[13] See Stack (1987) and Stack (1989) for a detailed review of literature on the direct and indirect links between divorce and suicide. Also see Minoiu and Andres (2008), Neumayer (2003), and Stack (1989). However, Chuang and Huang's (1997) panel analysis of 23 Taiwanese cities and counties during the period 1983–1993 does not find any statistically significant evidence for the link between suicide and divorce.

[14] Also see Bentzen and Smith (2002), Stevenson and Wolfers (2006), Newman et al. (1973), Fernquist (2009) and Stack (1987). The latter study provides a detailed review of the sociological literature on the links between FLFPR and suicide.

[15] See Chuang and Huang (1997) and Neumayer (2003).

[16] Also see Wisman (2008) for a detailed review of the literature on the link between unemployment and quality of life.

[17] See 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).

[18] See Goodwin and Jamison (1990), Meares et al. (1981), Lambert et al. (2003), Lester and Frank (1988), and Parker and Walter (1982).

[19] See Goodwin and Jamison (1990), Meares et al. (1981), Lambert et al. (2003), Lester and Frank (1988), and Parker and Walter (1982).

[20] 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.

[21] Appendix Tables A.1 and A.2 also support the findings of Minoiu and Andres (2008) regarding higher suicide rates in the states of the U.S. located in the mountain region.

[22] See Fernquist and Cutright (1998) and Seeman (1996).

(1994, 658) 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". Specifically, distress from unemployment appears to be lower in some groups than in others. The authors find that the psychological effects of unemployment are notably lower in the younger population and among workers in high-unemployment regions. The study also finds that "people who have been unemployed for a long time show less distress than those who have recently lost their jobs" (Clark and Oswald, 1994, 658). This suggests that it is not much the level of unemployment that matters as much as it is the difference between the current rate and the rate that people are used to.

Second, 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" in Calvo (2008) and Calvo and Dercon (2005), psychological and physical wellbeing are adversely affected by not only the level of deprivation, but also by the fear of facing hardships in the future.[23] Graham (2010, 1) 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".

4. Econometric specifications and data

In order to characterize the effects of macroeconomic conditions on the suicide rate, we estimate a fixed-effect econometric specification of the following form:

$$S_{i,j,t} = X_{i,t}\beta + Y_{i,j,t}\gamma + D_t\eta + \mu_i + \varepsilon_{i,j,t} \quad (1)$$

where $S_{i,j,t}$ is the suicide rate of population subgroup j in state i at year t. Suicide rates are measured as the number of suicides for each population group per 100,000 residents in that particular group.[24]

$X_{i,t}$ is a matrix of aggregate state-level explanatory variables for state i at year t. In its most parsimonious format, $X_{i,t}$ include a dummy for states in the mountain region, alcohol consumption, fertility rate, divorce rate, share of the population over 65 years of age, and variability of overall unemployment rate of each state measured as the annual variance of the month-to-month seasonally adjusted overall state-level unemployment rates.

$Y_{i,j,t}$ is a matrix of disaggregated explanatory variables for population subgroup j in state i at year t. It includes labor force participation rate for each population subgroup. This matrix also includes either group specific unemployment rates (referred to as MODEL 1 in the presentation of results) or deviations of group specific unemployment rates from their underlying trends (referred to as MODEL 2 in the presentation of results). Detailed definitions of the variables and the data sources are given in Table 1, while basic descriptive statistics can be found in Table 2. The most important piece of information conveyed in Table 2 is that different demographic groups face different labor market conditions, which furthermore supports the disaggregation strategy employed in the study. Finally, μ_i reflects time-invariant heterogeneity across states in their suicide rates, D_t is a vector of year dummies capturing shifts common to all states in year t, and $\varepsilon_{i,j,t}$ reflects random variation.

Tables A.1–A.3 in the Appendix provide some relevant statistics. Table A.1 depicts the average suicide rates for the 50 states and the District of Columbia between 1979 and 2004 for different gender and age groups.[25] As seen from this table and Table A.2, on average, Alaska and the states located in the mountain region of the United States have higher suicide rates in comparison to other states, which is consistent with the theories and empirical evidence presented earlier. Finally, Table A.3 shows a table of correlation coefficients between the suicide rates of each different demographic group and other variables in the regressions.

In estimating (1) we may encounter several econometric problems. OLS estimates of (1) will be biased as OLS fails to address the unobserved heterogeneities that are characteristic of panel data. Given the presence of autocorrelation in any given panel unit, potential issues regarding groupwise heteroskedasticity, and concerns about contemporaneous correlation of errors terms across cross-sectional units, we report panel corrected standard errors (PCSE) for our fixed-effects estimator as suggested by Beck and Katz (1995). In doing so, we account for first order panel specific autocorrelation. We also assume that variance–covariance matrices vary across panels.

Considering the existence of some evidence on the persistent or contagious nature of suicide,[26] we also estimate a dynamic panel model of the following form:

$$S_{i,j,t} = S_{i,j,t-1}\alpha + X_{i,t}\beta + Y_{i,j,t}\gamma + D_t\eta + \mu_i + \varepsilon_{i,j,t} \quad (2)$$

where $S_{i,j,t-1}$ is lagged suicide rates for population subgroup j in state i. Besides the introduction of the lagged dependent variable in the right hand side (RHS), (2) is similar to (1) otherwise.

In estimating (2) we may encounter several econometric problems. First, OLS estimates of (2) will be biased as OLS fails to address the unobserved heterogeneities that are characteristic of panel data. The presence of lagged dependent variable (i.e. suicide rates) as an independent variable on the right hand side (RHS) is also a source of bias in our model. This is because $S_{i,j,t-1}$ is affected by $\varepsilon_{i,t-1}$, making $E(\varepsilon_{i,t-1}, \varepsilon_{i,t}) \neq 0$. To overcome this, we can use the generalized methods of moments (GMM) techniques developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). However, the properties of these GMM estimators usually hold for large number of cross-sectional units (i.e. $N \geq 500$). In our case we have 51 cross-sectional units. While these numbers of units are not small in comparison to majority of macro studies, it is certainly not large enough for GMM estimators. As a result, we suspect that our GMM estimates may suffer from biases. In this case, we can employ an alternative method proposed by Bun and Kiviet (2003) for balanced panels and Bruno (2005a), an extension of the former to unbalanced panels. This method which is known as fixed-effect bias-corrected least-squares dummy variable (LSDVC), outperform GMM estimators in correcting biases for dynamic panel data with small number of cross-sectional units. Performing Monte Carlo simulation using 2500 replications and different numbers of cross-sectional units (N) and auto-correlation coefficients (α), Buddelmeyer et al. (2008) show that when the α is small ($\alpha < 0.4$) and N is small ($N < 500$) the LSDVC estimator outperforms that of GMM in correcting for the biases caused by introducing lagged-dependent variable on the RHS. Bruno (2005b) also provides evidence to this end.

5. Results and discussion

Tables 3–9 present the results for different gender-by-age population subgroups examined in this study. Each table depicts the

[23] Also see Basu and Nolen (2004).

[24] Centers for disease control's causes-of-death database contains suicide rates broken down by state, gender, age, and race.

[25] The annual suicide count for each state, gender and age group 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). Thereafter, using respective subpopulations, the annual suicide rates (i.e. number of committed suicides per 100,000 residents) are constructed for each gender, age, and gender-by-age groups for a given year and state.

[26] For example see Gould et al. (1990), Hedström et al. (2008), and Phillips and Carstensen (1988).

Table 1
Source and description of explanatory variables.

Indicator	Description	Source
Mountain dummy	Dummy variable equal to one for states in the U.S. Census Bureau's "Mountain" region (Nevada, Wyoming, New Mexico, Montana, Arizona, Colorado, Idaho, and Utah) plus Alaska	U.S. Census Bureau
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
Fertility rate	Annual birth rate (per 1000 residents)	Center for Disease Control, National Center for Health Statistics (CDC NCHS)
Divorce rate	Annual divorce rate (per 1000 residents)	Center for Disease Control, National Vital Statistics Report (CDC NVSR)
Percentage of elderly population	Percent of residents 65 and above in total state population	United States Bureau of Labor Statistics (BLS) (calculation by author)
Variability in overall unemployment rates	Annual variance of month-to-month seasonally adjusted unemployment rates	BLS (calculation by author)
Labor force participation rate[a]	Percentage of population in labor force (%)	BLS (calculation by author)
Unemployment rate[a]	Annual Average unemployment rate (%)	United States Bureau of Labor Statistics (BLS)
Deviation of unemployment rate from its trend[a]	Deviation of annual unemployment rate from its three-year moving average	BLS (calculation by author)

[a] Available for each of all population subgroups analyzed in the study. All variables are available at the state level.

findings for two variants of the model explained above: MODEL 1 includes unemployment rates for each population subgroup while MODEL 2 includes the deviation of unemployment rates from their trends for each population subgroup.

5.1. Labor markets and suicide

The results depicted in Tables 3–9 suggest that across different estimation methods, deteriorations in labor market conditions of the United States – higher unemployment rates, larger deviations of unemployment rates from their long-term trends, and greater volatility in the overall state-level unemployment rates – are associated with higher rates of suicide only for men and women in the 35–64 age range, that is, in the prime working-age. This supports the hypothesis of this study that, in comparison to other age groups, the mental wellbeing of workers in prime-working age is more dependent on labor market conditions. This, as hypothesized earlier, could be traced back to lower levels of occupational and

Table 2
Descriptive statistics.

Variable	*N*	Mean	Standard deviation	Minimum	Maximum
Overall state-level					
Alcohol consumption (gallons per capita)	1326	2.48	0.67	1.20	6.44
Fertility rate (births per 1000 residents)	1326	15.21	2.75	10.4	37.3
Divorce rate (per 1000 residents)	1326	4.84	1.64	0.26	17.60
Percentage of elderly population (percentage of total population)	1326	11.45	1.98	2.63	16.81
Variability in overall unemployment rate (annual variance of month-to-month seasonally adjusted unemployment rate)	1326	0.13	0.29	0.56	5.13
All (20+)					
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
Male (20–34)					
Labor force participation rate	1326	90.76	2.61	78.44	97.06
Unemployment rate	1326	7.09	2.86	1.64	26.44
Deviation of unemployment rate from its trend	1173	−0.08	2.15	−6.51	10.73
Male (35–64)					
Labor force participation rate	1326	86.27	3.45	71.31	94.37
Unemployment rate	1326	4.05	1.71	0.00	14.60
Deviation of unemployment rate from its trend	1173	0.03	1.41	−4.78	7.85
Male (65+)					
Labor force participation rate	1326	17.84	3.93	6.19	33.33
Unemployment rate	1326	2.31	2.76	0.00	25.00
Deviation of unemployment rate from its trend	1173	0.07	2.82	−11.86	24.97
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 3
Adults aged 20 years old and over.

	MODEL 1	MODEL 2
Mountain dummy	9.414** (9.57)	5.364** (8.04)
Alcohol consumption	2.212** (5.72)	2.157** (4.46)
Fertility rates	−0.0476 (−1.29)	−0.0267 (−0.60)
Divorce rates	−0.0366 (−0.44)	−0.0070 (−0.07)
% of 65+ population	0.161+ (1.82)	0.147 (1.54)
Variance of overall state unemployment rate	−0.110 (−0.70)	−0.0370 (−0.21)
Labor force participation rate (adults 20+)	0.128* (2.45)	0.0965 (1.60)
Unemployment rate (adults 20+)	0.119* (2.07)	
Deviation of unemployment rate from trend (adults 20+)		0.129+ (1.93)
N	1326	1173
R-sq	0.952	0.956

Robust *t*-statistics in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

Table 4
Males 20–34 years old.

	MODEL 1	MODEL 2
Mountain dummy	5.159 (1.51)	13.57** (6.09)
Alcohol consumption	5.700** (4.66)	5.593** (3.57)
Fertility rates	−0.106 (−0.84)	−0.0078 (−0.06)
Divorce rates	0.257 (0.99)	0.221 (0.72)
% of 65+ population	0.671** (3.39)	0.667** (3.09)
Variance of overall state unemployment rate	−0.761 (−1.27)	−0.695 (−1.03)
Labor force participation rate (male 20–34)	−0.113 (−0.92)	−0.101 (−0.76)
Unemployment rate (male 20–34)	0.112 (1.02)	
Deviation of unemployment rate from trend (male 20–34)		0.136 (1.14)
N	1326	1173
R-sq	0.811	0.829

Robust *t*-statistics in parentheses.
** $p < 0.01$.

Table 5
Males 35–64 years old.

	MODEL 1	MODEL 2
Mountain dummy	16.48** (7.69)	10.47** (7.66)
Alcohol consumption	2.492** (3.33)	3.499** (3.90)
Fertility rates	0.0585 (0.89)	0.00512 (0.06)
Divorce rates	−0.0839 (−0.47)	0.0744 (0.35)
% of 65+ population	0.283+ (1.93)	0.337* (2.20)
Variance of overall state unemployment rate	0.529 (1.57)	0.642+ (1.70)
Labor force participation rate (male 35–64)	0.0637 (0.79)	0.0285 (0.32)
Unemployment rate (male 35–64)	0.270* (2.44)	
Deviation of unemployment rate from trend (male 35–64)		0.366** (3.10)
N	1326	1173
R-sq	0.885	0.884

Robust *t*-statistics in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

Table 6
Males 65 years old and over.

	MODEL 1	MODEL 2
Mountain dummy	9.704** (−3.55)	9.405** (−3.31)
Alcohol consumption	−0.636 (−0.34)	−1.287 (−0.61)
Fertility rates	−0.189 (−1.03)	−0.223 (−1.04)
Divorce rates	−0.242 (−0.51)	0.677 (1.42)
% of 65+ population	−2.028** (−6.59)	−2.075** (−6.47)
Variance of overall state unemployment rate	−1.127 (−1.29)	−1.422 (−1.44)
Labor force participation rate (male 65+)	−0.00527 (−0.05)	−0.0337 (−0.30)
Unemployment rate (male 65+)	−0.0892 (−0.92)	
Deviation of unemployment rate from trend (male 65+)		−0.148 (−1.63)
N	1326	1173
R-sq	0.830	0.853

Robust *t*-statistics in parentheses.
** $p < 0.01$.

Table 7
Females 20–34 years old.

	MODEL 1	MODEL 2
Mountain dummy	2.868* (2.03)	3.301** (2.95)
Alcohol consumption	1.402** (3.39)	1.097* (2.53)
Fertility rates	−0.149** (−3.24)	−0.0938* (−2.07)
Divorce rates	0.144 (1.20)	−0.0292 (−0.28)
% of 65+ population	0.130* (1.99)	0.189** (2.78)
Variance of overall state unemployment rate	0.105 (0.58)	0.100 (0.54)
Labor force participation rate (female 20–34)	0.0599* (2.35)	0.0601* (2.31)
Unemployment rate (female 20–34)	0.0683+ (1.76)	
Deviation of unemployment rate from trend (female 20–34)		0.0320 (0.76)
N	1326	1173
R-sq	0.623	0.621

Robust *t*-statistics in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

Table 8
Females 35–64 years old.

	MODEL 1	MODEL 2
Mountain dummy	4.475** (4.11)	4.515** (7.06)
Alcohol consumption	1.677** (5.01)	1.208** (2.96)
Fertility rates	−0.0707** (−2.79)	−0.0810** (−2.74)
Divorce rates	−0.0376 (−0.41)	−0.0502 (−0.47)
% of 65+ population	0.160* (2.47)	0.175* (2.47)
Variance of overall state unemployment rate	0.396* (2.04)	0.545** (2.58)
Labor force participation rate (female 35–64)	0.0282 (1.15)	0.0227 (0.84)
Unemployment rate (female 35–64)	0.173** (3.07)	
Deviation of unemployment rate from trend (female 35–64)		0.0810 (1.52)
N	1326	1173
R-sq	0.789	0.770

Robust *t*-statistics in parentheses.
* $p < 0.05$.
** $p < 0.01$.

Table 9
Females 65 years old and over.

	MODEL 1	MODEL 2
Mountain dummy	1.186 (0.61)	−1.178 (−1.08)
Alcohol consumption	1.448* (2.49)	1.471* (2.13)
Fertility rates	−0.0848+ (−1.74)	−0.0672 (−1.18)
Divorce rates	−0.000249 (−0.00)	−0.0638 (−0.41)
% of 65+ population	−0.396** (−3.81)	−0.561** (−4.95)
Variance of overall state unemployment rate	−0.417 (−0.76)	−0.607 (−0.64)
Labor force participation rate (female 65+)	0.0738 (1.35)	0.0443 (0.81)
Unemployment rate (female 65+)	0.000532 (0.02)	
Deviation of unemployment rate from trend (female 65+)		−0.0193 (−0.96)
N	1326	1173
R-sq	0.576	0.633

Robust *t*-statistics in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

Table 10
Suicide persistence (coefficient of lagged suicide rates).

	MODEL 1	MODEL 2
Adults 20+	0.3151** (0.0306)	0.3035** (0.0338)
Male 20–34	0.2247** (0.0316)	0.1925** (0.0325)
Male 35–64	0.2612** (0.0299)	0.2655** (0.0317)
Male 65+	0.04739 (0.02918)	0.01328 (0.0341)
Female 20–34	0.14047** (0.0291)	0.1236** (0.0332)
Female 35–64	0.06015* (0.0293)	0.05475+ (0.0311)
Female 65+	0.0734 (0.0283)	0.0478 (0.0261)

Robust standard errors in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

geographic mobility of this demographic group. However, there seems to be some differences between men and women. While the suicide rate of men aged 35–64 seems to be more responsive to unemployment rate and its deviation from its long-run trend, the suicide rate of women in the same age group seems to respond more to changes in the volatility of the unemployment rate. In other words, growing uncertainties in the labor market seems have more of a negative effect on the mental wellbeing of prime-age working women than men. This result is in line with Mohseni-Cheraghlou (2012), where on average the growth trajectory of women suicide rates showed signs of increase more than that of men during 102 financial crises[27] from around the globe between 1981 and 2008. It is also important to notice that the suicide rate of prime-age working men is more sensitive to deviations from long-run unemployment trends than it is to unemployment rates (Table 5). This is consistent with the idea that in addition to the absolute level of unemployment rate itself, the psychological wellbeing of an individual is also significantly influenced by the size of a change in the rates of unemployment (Clark and Oswald, 1994). For example, an increase in the unemployment rates from 5 to 10% will have graver consequence on the mental wellbeing (and therefore suicide rates) of the prime working-age men than an increase from 8 to 10%.

In regards to labor force participation rates (LFPR), the statistically significant and positive correlation between LFPR and suicide rates among women 20–34 could be explained by Gibbs and Martin (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 conflict between married couples, which may eventually be manifested in forms decaying mental wellbeing and higher suicide rates, especially among younger females, who are at the beginning of their adults lives and therefore less experienced in maneuvering through the challenges associated with these sometimes seemingly conflicting roles.

5.2. Other factors and suicide

5.2.1. Mountain states and suicide

Tables 3–9 suggest that, ceteris paribus, residing in Alaska and other states located in the mountain region of the United States can increase the probability of suicide among all population groups, except for the case of the women aged 65 and above. This link seems to be much stronger among men in comparison to women and more so among prime working-age men (35–64) in comparison to other men.

5.2.2. Alcohol consumption and suicide

Higher alcohol consumption in a given year and state is associated with higher suicide rates among all groups except the men aged 65+. However, this link seems to be strongest and more robust to different econometric specifications for younger men. This is not surprising, as alcohol abuse (which is a major suicide risk factor) is known to be more prevalent among this group. For example during 2004 and 2005, 22% of men aged 18 to 25 were considered alcohol abusers while 12.4 and 5% of men aged 26 to 49 and 50+ were respectively so.[28]

It is also important to note that there is some evidence 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).[29]

5.2.3. Fertility rate and suicide

The results suggest that fertility rates are negatively correlated to suicide rates of women aged 20–34 and 35–64 and to some extent for women 65+. Considering that spatial and temporal variations in total fertility rate is mainly driven by the fertility rates of women aged 20–34,[30] one could argue that most women with children below the age of 20 must be less than 54 years old themselves. As a result, the higher the fertility rates the higher the number of non-elderly women with children below 20. The findings here support Durkheim's (1988) "family feelings" hypothesis where he argues women with children in need of caring are less likely to commit suicide because of the strong emotional bond between them and their children.

5.2.4. Percentage of 65+ population and suicide

Higher percentage of the 65+ population, this study suggests, is positively correlated with suicide rates of non-65+ men and women and negatively correlated with suicide rates of men and women

[27] In Mohseni-Cheraghlou (2012) similar to Reinhart and Rogoff (2008), financial crises are defined as periods of significant distress in currency markets, the banking sector, domestic debt, external debt, and/or inflation. For more on this, please see Reinhart and Rogoff (2008).

[28] Source: SAMHSA, 2004 and 2005 NSDUHs.

[29] See Markowitz et al. (2003).

[30] 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 1000 women, while this rate stood at 20 and 18 births per 1000 women for females aged 10–19 and 35–54 respectively. See Hamilton et al. (2010) for more on this.

Table A.1
Mean of suicide rates for 50 U.S. states and the District of Columbia (1979–2004).

State	Rank	Overall	Female	Male	Age: 20–34	Age: 35–64	Age: 65+
Nevada[a]	1	30.9	13	48.9	27.9	31.7	41.2
Wyoming[a]	2	25.5	8.6	42.7	25.9	22.6	36.3
New Mexico[a]	3	25.3	9.7	42.1	28.3	23.1	26.4
Montana[a]	4	24.5	8.3	41.4	23.5	23.2	31.1
Alaska[a]	5	23.8	9	38.8	29.5	18.6	19.2
Arizona[a]	6	23.4	9.3	38.5	22.8	22.5	29.1
Colorado[a]	7	22.3	9.2	36	20.6	22.7	27.6
Idaho[a]	8	21.5	7.3	36.1	19.9	20.3	29.7
Utah[a]	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
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

[a] Mountain states and Alaska.

aged 65+. This finding may point to a dynamic that has been left undetected in aggregate studies of suicide. Specifically, previous work suggests that higher percentage of the elderly people in society leads to a higher aggregate suicide rates because older people are more likely to commit suicide than their younger counterparts (Hamermesh and Soss, 1974). The findings here however suggest that, although the elderly men have historically had higher suicide rates, higher concentration of elderly people in a locality may point to the favorable conditions toward elderly in that location and higher level of social support available for the elderly which may lead to improved mental and emotional wellbeing and reduced suicide rates among the elderly. 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), increasing the level of stress and economic struggle among the working men and women aged 20–64 which may increase the risk of suicide among this group of people in regions with higher share of elderly population.[31]

5.2.5. Is suicide persistent or contagious?

Table 10 captures the coefficients of the lagged suicide rates (α) in the dynamic panel model (2). This table presents some evidence that suicide rates may be persistent or contagious among adult men and women between 20 and 65, with relatively stronger persistence among men. The findings here are consistent with (Hedström et al., 2008) 1991–1999 study of suicides in Stockholm, where the authors point that men are more likely to "imitate" a suicide

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

Table A.2
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.3
Bivariate correlation between suicide rates and control variables (observation = 1326).

	All (20+)	Male (20–34)	Male (35–64)	Male (65+)	Female (20–34)	Female (35–64)	Female (65+)
Alcohol consumption	0.2136[a]	0.1668[a]	0.1171[a]	0.0816[a]	0.3049[a]	0.2741[a]	0.3428[a]
Divorce rate	0.6641[a]	0.4871[a]	0.5713[a]	0.5748[a]	0.5015[a]	0.5651[a]	0.4328[a]
Fertility rate	0.1983[a]	0.1993[a]	0.1110[a]	0.1125[a]	0.2017[a]	0.2282[a]	0.2736[a]
Percentage of elderly population	−0.3169[a]	−0.3181[a]	−0.1958[a]	−0.2205[a]	−0.3085[a]	−0.3096[a]	−0.3616[a]
Labor force participation rate	0.0696[a]	0.1398[a]	−0.0584[a]	−0.0628[a]	−0.1989[a]	−0.2688[a]	−0.0351
Unemployment rate	0.0769[a]	0.0312	0.0725[a]	−0.0331	0.1262[a]	0.1693[a]	−0.0129
Mountain	0.7184[a]	0.6350[a]	0.6354[a]	0.4960[a]	0.4517[a]	0.5244[a]	0.3628[a]
Deviation of unemployment rate from its trend	0.0018	−0.0319	0.0571[a]	−0.0367	0.027	0.0728[a]	−0.0023
Variability in overall unemployment rate	0.0512	−0.0117	0.0516[a]	0.045	0.1033[a]	0.1434[a]	0.0505[a]

[a] Statistical significance at the 10% level.

in family and work place. However, Gould et al. (1990) find that teenagers and young adults are more prone to contagious nature of suicide "with minimal effect beyond age 24" (211). Phillips and Carstensen (1988, 100) also suggest that the contagion effects of suicide are significantly larger for teenagers in comparison to other age groups. Therefore, the relatively small coefficients found here on the lagged suicide rates of men aged 20–64 are consistent with the findings of these studies. At the first glance such a weak autoregressive property may seem surprising. However, keeping in mind that imitation plays a minimal role in the suicide of individuals over 20 and that the suicide among this group of people is a complicated psychological response to various internal and external conditions, developments in any of the internal and external conditions could alter suicide rates, weakening the autoregressive linkage of suicide for adults in the U.S. Finally, it is important to note here that the addition of the lagged suicide rates to RHS does not change the statistical significance and the sign of the coefficients presented earlier and only the size of the coefficients are changed to some degree, pointing to the robustness of the results.

6. Concluding remarks

In 2009, suicide was the 10th leading cause of death in the United States. The recent upsurge in America's suicide rates (Fig. 1) suggests that one or more of suicide risk factors have become more prevalent in the U.S., which may in turn point to deteriorating mental health of some Americans. As seen from Figs. 3–5, the post-2000 increase in America's suicide rate is mainly driven by the suicide rates of the population 35 to 64 years old, especially that of the females.[32] Therefore, any successful suicide prevention policy should take into consideration different dynamics of suicide across different population subgroups. It was based on this logic that this study attempted to provide an analysis of suicide in the United States between 1979 and 2004 across six gender-by-age demographic categories.

The main findings of this study suggest that the deteriorations in labor market conditions may in fact be linked to higher incidences of suicide among prime working-age (35–64 years old) men and women. The results of different econometric specifications and techniques show that, the positive correlations between suicide rate and unemployment rate as well as its volatility and its deviation from trend are only present for men and women 35–64 years old. The main policy implication of this finding is that during periods of increasing unemployment and uncertainties in the labor market, suicide prevention efforts must target their resource toward the population aged 35–64 years old. However in doing so, gender differences must be heeded. The results suggest that suicide rates of prime working-age men is more responsive to changes in the deviation of the unemployment rate of this population group from its trend, while the suicide rate of females in the same age group is more sensitive to changes in the unemployment rate. Therefore, in states with historically high unemployment rates and relatively small changes in the trends (for example a jump from a historical rate of 15% to 18%) suicide prevention resources must be targeted more toward 35–64 females. Moreover, during cases of relatively large and sudden jumps of unemployment rates at relatively low levels (for example a jump from a historical rate of 4% to 8%), the focus of such program must be shifted more toward males 35–64. Finally, in cases where historically high unemployment rates are also coincided with relatively large deviation from trend (for example a jump from a historical rate of 15% to 25%) suicide prevention programs must target both male and females in the 35–64 age range.

Considering that there are tremendous degrees of variations across different localities in a given state, future studies of suicide in the United States need to exploit the available county- and city-level suicide data. The most challenging part of such research would be the availability of annual demographic and macroeconomic data at local levels, which is nonexistent at this time. Furthermore, the different behavior of suicide across racial groups warrants an analysis that also controls for racial factors in addition to gender and age.

[32] 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.

At the end, it is important to reemphasize here that given the complex nature of suicide, caution should be used in generalizing the result of the present work to other regions and time periods.

Appendix A.

See Tables A.1–A.3.

References

Andres, Antonio R., 2005. Income inequality, unemployment, and suicide: a panel data analysis of 15 European countries. Applied Economics 37 (4), 439–451.

Arellano, Manuel, Bond, Stephen, 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 58 (2), 277–297.

Arellano, Manuel, Bover, Olympia, 1995. Another Look at the Instrumental Variable Estimation of Error-Components Models". Journal of Econometrics 68 (1), 29–51.

Basu, Kaushik, Nolen, Patrick, 2004. Vulnerability, unemployment and poverty: a new class of measures, its axiomatic properties and application. In: Center for Analytic Economics, Working Papers. Cornell University, Ithaca.

Beck, Nathaniel, Katz, Jonathan N., 1995. What to do (and not to do) with time-series cross-section data. The American Political Science Review 89 (3), 634–647.

Bentzen, Jan, Smith, Valdemar, 2002. An empirical analysis of the effect of labor market characteristics on marital dissolution rates. In: Aarhus School of Business, Department of Economics Working Paper No. 02-14. Aarhus University, Aarhus.

Bernhardt, Annette, Morris, Martina, Handcock, Mark S., Scott, Marc A., 1999. Trends in job instability and wages for young adult men. Journal of Labor Economics 17 (S4), S65–S90.

Blundell, Richard, Bond, Stephen, 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87 (1), 115–143.

Brainerd, Elizabeth, 2001. Economic reform and mortality in the former Soviet Union: a study of the suicide epidemic in the 1990s. European Economic Review 45 (4–6), 1007–1019.

Bruno, Giovanni S.F., 2005a. Approximating the bias of the LSDV estimator for dynamic unbalanced panel data models. Economics Letters 87, 361–366.

Bruno, Giovanni S.F., 2005b. Estimation and inference in dynamic unbalanced panel-data models with a small number of individuals. The Stata Journal 5 (4), 473–500.

Buddelmeyer, Hielke, Jensen, Paul H., Oguzoglu, Umut, Webster, Elizabeth, 2008. Fixed effects bias in panel data estimators. In: IZA Discussion Paper No. 3487. Institute for the Study of Labor, Bonn.

Bun, M.J.G., Kiviet, J.F., 2003. On the diminishing returns of higher order terms in asymptotic expansions of bias. Economics Letters 79, 145–152.

Calvo, Cesar, 2008. Vulnerability to multidimensional poverty: Peru, 1998–2002. World Development 36 (6), 1011–1020.

Calvo, Cesar, Dercon, Stefan, 2005. Measuring individual vulnerability. In: Economics Series Working Papers: 229. University of Oxford, Department of Economics, Oxford.

Chuang, Hwei-Lin, Huang, Wei-Chiao, 1997. Economic and social correlates of regional suicide rates: a pooled cross-section and time-series analysis. Journal of Socio-Economics 26 (3), 277–289.

Chung, Andy, 2009. Gender difference in suicide, household production and unemployment. Applied Economics 41 (August–September (19–21)), 2495–2504.

Clark, Andrew E., Oswald, Andrew J., 1994. Unhappiness and unemployment. Economic Journal 104 (424), 648–659.

Cumming, Elaine, Lazer, Charles, Chisolm, Lynne, 1975. Suicide as an index of role strain among employed and not employed married women in British Columbia. Canadian Review of Sociology and Anthropology 12 (4), 462–470.

Davis, Richard A., 1981. Female labor force participation, status integration and suicide, 1950–1969. Suicide and Life-Threatening Behavior 11 (2), 111–123.

Davis, Steven J., Faberman, Jason R., Haltiwanger, John, 2006. The flow approach to labor markets: new data sources and micro–macro links. Journal of Economic Perspectives 20 (3), 3–26.

Di Tella, Rafael, MacCulloch, Robert J., Oswald, Andrew J., 2003. The macroeconomics of happiness. Review of Economics and Statistics 85 (4), 809–827.

Dixon, Sylvia, 2003. Implications of population ageing for the labour market. In: Special Feature Series. Labour Market Division, UK Office for National Statistics, London.

Durkheim, Emile, 1988. Suicide and birth rate: a study of moral statistics. Philosophical Review in France and Abroad 26, 446–463.

Fernquist, Robert M., 2009. Suicide rates and status integration in America. Archives of Suicide Research 13 (3), 291–296.

Fernquist, Robert M., Cutright, Phillips, 1998. Societal integration and age standardized suicide rates in 21 developed countries, 1955–1989. Social Science Research 27, 109–127.

Frey, William H., 2012. America's young adults: a generation on the move. In: Metropolitan Policy Program. Brookings, Washington.

Gibbs, Jack, Martin, Walter T., 1964. Status Integration and Suicide: A Sociological Study. University of Oregon Press, Eugene.

Goodwin, Fredrick K., Jamison, Kay R., 1990. Manic-Depressive Illness. Oxford University Press, Oxford.

Gould, M.S., Wallenstein, S., Kleinman, M.H., O'Carroll, P., Mercy, J., 1990. Suicide clusters: an examination of age-specific effects. American Journal of Public Health 80 (2), 211–212.

Graham, Carol, 2010. Happy peasants and miserable millionaires. In: Happiness Research, Economics, and Public Policy. VOX.

Hamermesh, Daniel S., Soss, Neal M., 1974. An economic theory of suicide. Journal of Political Economy 82 (1), 83–98.

Hamilton, Brady E., Martin, Joyce A., Ventura, Stephanie J., 2010. Births: preliminary data for 2009. In: National Vital Statistics Reports.

Hazelden, 2010. Substance abuse among the elderly: a growing problem. http://www.hazelden.org/web/public/ade60220.page (accessed 13.09.12).

Hedström, Peter, Liu, Ka-Yuet, Nordvik, Monica K., 2008. Interaction domains and suicide: a population-based panel study of suicides in Stockholm, 1991–1999. Social Forces 87 (2), 713–740.

Jungeilges, Jochen, Kirchgassner, Gebhard, 2002. Economic welfare, civil liberty, and suicide: an empirical investigation. Journal of Socio-Economics 31 (3), 215–231.

Kendall, R.E., 1983. Alcohol and suicide. Substance and Alcohol Actions/Misuse 4, 121–127.

Kochanek, Kenneth, Xu, Jiaquan, Murphy, Sherry L., Miniño, Arialdi M., Kung, Hsiang-Ching, 2011. Deaths: final data for 2009. In: National Vital Statistics Report.

Koo, Jahyeong, Cox, Michael W., 2008. An economic interpretation of suicide cycles in Japan. Contemporary Economic Policy 26 (1), 162–174.

Kunce, Mitch, Anderson, April L., 2002. The impact of socioeconomic factors on state suicide rates: a methodological note. Urban Studies 39 (1), 155–162.

Lambert, Gavin, Reid, Christopher, Kaye, David, Jennings, Garry, Esler, Murray, 2003. Increased suicide rate in the middle-aged and its association with hours of sunlight. American Journal of Psychiatry 160 (April), 793–795.

Lester, David, 1995. The association between alcohol consumption and suicide and homicide rates: a study of 13 nations. Alcohol & Alcoholism 30 (4), 465–468.

Lester, D., Frank, M.L., 1988. Sex differences in the seasonal distribution of suicide. British Journal of Psychiatry 153 (July), 115–117.

Markowitz, Sara, Chatterji, Pinka, Kaestner, Robert, 2003. Estimating the impact of alcohol policies on youth suicides. Journal of Mental Health Policy and Economics 6 (1), 37–46.

Marks, Stephen, 1977. Multiple roles and role strain some notes on human energy, time and commitment. American Sociological Review 42 (6), 921–936.

Meares, R., Mendelsohn, F.A.O., Milgrom-Friedman, J., 1981. A sex difference in the seasonal variation of suicide rate: a single cycle for men, two cycles for women. British Journal of Psychiatry 138 (April), 321–325.

Minoiu, Camelia, Andres, Antonio R., 2008. The effect of public spending on suicide: evidence from U.S. state data. Journal of Socio-Economics 37 (1), 237–261.

Mohseni-Cheraghlou, Amin, 2012. Three essays in social economics. American University, Ph.D. diss. http://search.proquest.com/docview/1282355205?accountid=8285 (accessed 09.04.13).

Moscicki, Eve K., 2001. Epidemiology of completed and attempted suicide: toward a framework for prevention. Clinical Neuroscience Research 1 (5), 310–323.

Munnell, Alicia H., Sass, Steven, 2008. Working Longer. Brookings Institution Press, Brookings Institutions, Washington.

Neumark, David, 2000. Change in job stability and job security: a collective effect to untangle, reconcile, and interpret the evidence. In: Neumark, D. (Ed.), On the Job: Is Long-Term Employment a Thing of the Past? Russell Sage Foundation, New York.

Neumayer, Eric, 2004. Recessions lower (some) mortality rates: evidence from Germany. Social Science & Medicine 58, 1037–1047.

Neumayer, Eric, 2003. Socioeconomic factors and suicide rates at large-unit aggregate levels: a comment. Urban Studies 40 (13), 2769–2776.

Newman, John F., Whittemore, Kenneth R., Newman, Helen G., 1973. Women in the labor force and suicide. Social Problems 21 (2), 220–230.

Noh, Yong-Hwan, 2009. Does unemployment increase suicide rates? The OECD panel evidence. Journal of Economic Psychology 30 (4), 575–582.

Parker, G., Walter, S., 1982. Seasonal variation in depressive disorders and suicidal deaths in New South Wales. British Journal of Psychiatry 140, 626–632.

Phillips, David P., Carstensen, Lundie L., 1988. The effect of suicide stories on various demographic groups, 1968–1985. Suicide and Life-Threatening Behavior 18 (1), 100–114.

Robbins, M.C., DeWalt, B.C., Pelto, P.J., 1972. Climate and behavior: a biocultural study. Journal of Cross-Cultural Psychology 3, 331–344.

Reinhart, Carmen M., Rogoff, Kenneth S., 2008. This time is different: a panoramic view of eight centuries of financial crises. In: NBER Working Paper 13882. National Bureau of Economic Research, Cambridge.

Ruhm, Christopher J., 2000. Are recessions good for your health? Quarterly Journal of Economics 115 (2), 617–650.

Seeman, T.E., 1996. Social ties and health: the benefits of social integration. Annals of Epidemiology 6, 442–451.

Sieber, Sam D., 1974. Toward a theory of role accumulation. American Sociological Review 39 (4), 567–578.

Stack, Steven, 1987. The effect of female participation in the labor force on suicide: a time series analysis, 1948–1980. Sociological Forum 2 (2), 257–277.

Stack, Steven, 1989. The impact of divorce on suicide in Norway, 1951–1980. Journal of Marriage and Family 51 (1), 229–238.

Stevenson, Betsey, Wolfers, Justin, 2006. Bargaining in the shadow of the law: divorce law and family distress. Quarterly Journal of Economics 121 (1), 267–288.

Thorson, J.A., Kasworm, C., 1984. Sunshine and suicide. Death Education 8, 125–136.

Topel, Robert H., Ward, Michael P., 1992. Job mobility and careers of young men. Quarterly Journal of Economics 107 (2), 439–480.
Wisman, Jon, 2008. The moral imperative and social rationality of government-guaranteed employment and reskilling. In: American University, Department of Economics, Working Papers: 2008-20. American University, Washington.
Yang, Bijou, 1992. The economy and suicide: a time-series study of the U.S.A. American Journal of Economics and Sociology 51 (1), 87–99.
Yang, Bijou, Lester, David, 1995. Suicide, homicide and unemployment. Applied Economics Letters 2 (8), 278–279.
Yang, Bijou, Stack, Steven, 1992. Suicide and unemployment: predicting the smoothed trend and yearly fluctuations. Journal of Socio-Economics 21 (1), 39–41.
Yang, Bijou, Stack, Steven, Lester, David, 1992. Suicide and unemployment: predicting the smoothed trend and yearly fluctuations. Journal of Socio-Economics 21 (1), 39–41.

Amin Mohseni-Cheraghlou, is currently working as a consultant for the World Bank Group. He received a PhD in Economics from American University in Washington, DC on 2012. He also holds an MA in International Development and Economics and a B.S. in electrical engineering from the University of Maryland. Prior to starting his graduate studies in Economics he worked for Texas Instruments. He has taught courses in engineering, economics, mathematics, energy economics, and research methods. His research interests include development macroeconomics, social economics, economies of the MENA region, and Islamic finance.