Suicidal Behaviors in Youths and Young Adults: On the Causal Effect of Local Unemployment[1]

Maxwell Kellogg[2]

Last Edited: April 20th, 2015

This paper considers the effect of census tract-level unemployment on committed suicides, suicide attempts, and suicidal ideation in respondents of the National Longitudinal Study of Adolescent Health. This paper contributes to the current literature by specifically considering this effect in youths and young adults, and by testing the extent through which it operates through own unemployment or other pathways. This paper finds no consistent associations between unemployment rate and completed suicides, due presumably to the rarity of completed suicides and the sample size. It finds positive associations for suicide attempts which required medical attention, particularly among whites. It provides evidence of an effect of local unemployment on risk of suicide attempt which appears to operate through risk of unemployment in one's own household, and may operate as well through correlation with other environmental stressors such as local crime and poverty rate. This paper concludes that the effect explained by own and parental unemployment reflects evidence of a causal pathway. It finds no consistent associations between local unemployment and suicidal ideation, which it attributes to measurement error in reporting suicidal ideation.

[1] *This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle assistance in the original design. Information on how to obtain the Add Health Data Files is available on the Add Health website (http://www.cpc.unc.edu/addhealth). No direct support was received from grant P01-HD31921 for this analysis.*

[2] *Department of Policy Analysis and Management, Cornell University*
Email: mdk233@cornell.edu

The author expresses sincere appreciation to John Cawley, whose support enabled the acquisition of the data used in the analyses contained herein, and who provided valuable comments throughout the process of composing this thesis.

Introduction

Suicide represents a significant cause of death in the United States. Overall, suicide was the 11th leading national cause of death from 1999-2010, responsible for 396,592 deaths which translates to 1.4% of all deaths occurring in that period and 1.24 suicides per 10,000 people in 2010 (Center for Disease Control and Prevention, 2013). Suicide accounts for a disproportionate number of deaths in youths and young adults. It was the third leading cause of death across all races and both sexes age 10-19 and the second leading cause of death among those 20-34 years of age, with 22,136 and 92,623 attributed deaths respectively (Center for Disease Control and Prevention, 2013). From a more historical perspective, the second half of the 20th century saw a substantial increase in suicide among the young and a substantial decrease in suicide among the elderly, to the point that suicide and age no longer exhibit the positive monotonic relationship predicted by Durkheim's seminal work on the theory of suicidal behavior(Cutler, Glaeser, & Norberg, 2001; Durkheim, Spaulding, & Simpson, 2010; Shaffer, Garland, Gould, Fisher, & Trautman, 1988). The increase over time in youth suicide rates was reflected almost exclusively in males; rates for female youths remained relatively unaffected (McKeown, Cuffe, & Schulz, 2006; Shaffer & Pfeffer, 2001).

Men appear much more likely to commit suicide by use of firearms whereas women appear much more likely to commit suicide by poisoning, as can be seen in Figure 1. Males who committed suicide favored firearms more heavily and avoided poisoning, with 57.8% of cases involving firearms, 22.8% involving suffocation, and 12.1% involving poisoning (Center for Disease Control and Prevention, 2013). Top causes of death for women who committed suicide according to National Vital Statistics Data from 1999-2010 are poisoning at 38.2%, firearms at 32.3%, and suffocation at 19.5% of cases. The National Survey on Drug Use and Health suggests

3.7% of all adults 18 and older had suicidal thoughts in the past year in 2008 and 2009, with 0.5% reporting an actual attempt (Crosby, Han, Ortega, Parks, & Gfroerer, 2011). Comparing that information with population estimates from the U.S. Census and the CDC's suicide data suggests there were about 40 reported attempts for every completed suicide and about 300 people who thought about suicide for every completed suicide in 2008 (US Census Bureau, 2011). Whereas National Vital Statistics data indicates that roughly five times more males than females died by suicide in the United States in 1999-2010, females are more likely to report suicidal ideation and are at least as likely to report attempting suicide (Crosby et al., 2011; Cutler et al., 2001). Differences also exist in suicide by race, with some evidence that both youth and overall state-level suicide rates are negatively associated with the percentage of state population which is black after controlling for other factors (Cutler et al., 2001). Furthermore, blacks may be over twice as likely to commit suicide by violent means such as firearms or hanging than whites though whites are overall more likely to attempt suicide (Cutler et al., 2001; Stack & Wasserman, 2005).

Analyses on the association between suicide and macroeconomic measures such as income per capita, income inequality, and unemployment have produced mixed findings. Studies have more often found countercyclic associations or no significant associations between suicide and these macroeconomic measures, but these findings have been vulnerable to choice of model specification and to publication bias (Chen, Choi, Mori, Sawada, & Sugano, 2012). Associations between unemployment specifically and suicide though, even at aggregate levels, appear relatively more robust than findings for the other measures. Evidence suggests short-term rises in unemployment are positively associated with death by suicide in the United States, and that suicide more generally rises in periods of economic recession (Granados, 2005; Luo, Florence, Quispe-Agnoli, Ouyang, & Crosby, 2011; Ruhm, 2000). This positive aggregate association between unemployment and suicide rates has been observed in the context of mass-layoffs, and suicide rates have been found to increase with the duration of unemployment periods experienced by the unemployed (Classen & Dunn, 2012). At the individual level, unemployment is associated in the United States with a significantly greater three-year risk of subsequent death by suicide after controlling for basic demographic characteristics (Kposowa, 2001). More mixed results have been found internationally, with positive associations between suicide rates and unemployment appearing to exist in the European Union, but not in Germany or OECD countries more generally (Gerdtham & Ruhm, 2006; Neumayer, 2004; Stuckler, Basu, Suhrcke, Coutts, & McKee, 2009).

A smaller set of studies have exploited longitudinal data in an attempt to address the question of causality in the observed relationship between unemployment and suicidal behaviors. At the individual-level, this research has been mostly international. A longitudinal study of New Zealand adults finds associations between unemployment and later suicide which is not observed between unemployment other causes of death (Blakely, Collings, & Atkinson, 2003). Unemployment after leaving school has also been found to predate mental health, substance use, and criminal problems in New Zealand youths as well (Fergusson, John Horwood, & Woodward, 2001).

There also exists evidence that unemployment is associated with depression, and that depression is associated with risk of committing suicide. These associations suggest one clear pathway by which unemployment may be operating on suicide risk. The loss of employment has been consistently found to increase scores on standardized measures of depressive affect, whereas gaining employment has been found to reduce those scores (Murphy & Athanasou, 1999). Those who committed suicide have also been found to disproportionately suffer from mental illnesses in the United States and across the world. As few as 60% of those committing suicide in Finland suffer from depressive disorders and as many as 90% in Taiwan suffer from some kind of depressive disorder, with rates observed in other countries lying between those two values (A. T. Cheng, 1995; A. T. A. Cheng, Chen, Chen, & Jenkins, 2000; Dorpat & Ripley, 1960; Henriksson et al., 1993; Rihmer, 1996). Furthermore, longitudinal evidence in the United States, and in young British men, suggests that unemployment predicts later depressive symptoms, but clinical depression does not predict later unemployment (Dooley, Catalano, & Wilson, 1994; Montgomery, Cook, Bartley, & Wadsworth, 1999).

Theory

An economic approach to modeling suicidal behavior would naturally posit that suicidal behaviors act as some functions of utility. However, there exist multiple frameworks for specifying suicidal behaviors as functions of utility which are consistent with the principles of microeconomics and which make meaningfully different predictions about reality. One of the earliest of these frameworks, as it appears in the works of Hamermesh & Soss (1974), predicts that increased consumption of economic goods (defined loosely as any positive input into the utility function) should be unambiguously and negatively associated with suicidal behaviors. An alternative theoretical framework, as it appears in Marcotte (2003), generalizes the Hamermesh & Soss model to view suicidal behaviors as arising when the suicidal state is sufficiently preferable to the non-suicidal state.

I will, in this investigation, consider a generalized theoretical model similar to that outlined by Marcotte (2003). I view the decision to exhibit some suicidal behavior (suicidal ideation or suicide attempts of varying risk of fatality) as a comparison between lifetime present value of utility conditional on exhibiting that suicidal behavior and lifetime present value of utility conditional on not exhibiting that behavior. This model can be formalized by evaluating the equation:

$$s_i = \begin{cases} 1, & \min_{\omega} [(U_i(\omega | \, s_i = 1) - (U_i(\omega | \, s_i = 0)] - \, b_i > 0 \\ 0, & \min_{\omega} [(U_i(\omega | \, s_i = 1) - (U_i(\omega | \, s_i = 0)] - \, b_i \leq 0 \end{cases}$$

Where $s_i = 1$ represents an individual exhibiting a suicidal behavior and $s_i = 0$ represents an individual not exhibiting that behavior. The term b_i is a measure of individual preference against suicidal behavior, assumed to be fixed and randomly and independently endowed to individuals. It functions primarily to allow for individual variation in the threshold at which suicidal behavior will be exhibited. The term U_i is a function representing the individual's discounted present value of lifetime utility function up to some age ω, with ω chosen to minimize the value of the difference $(U_i | \, s_i = 1) - (U_i | \, s_i = 0)$. The individual U_i is a function of the form

$$U_i \, (\omega | \, \mathrm{s_i}) = \int_{\alpha}^{\omega} e^{-r(m-\alpha)} P(m \mid s_i)(U_m \mid s_i) \, dm$$

where α is the first point in time contributing to one's utility. The variable ω can take any value $\omega > \alpha$, representing any possible point in time following the present. With ω known, the integral represents the individual's present value of lifetime utility from point in time α to point in time ω. Some discount rate corresponds to the term r, $P(m)$ is the expected probability of living to period m, and U_m is the net utility one expects in period m.

Thus, this model suggests that an individual exhibits a suicidal behavior when, for all possible ω, the individual expects that living from α to ω given exhibiting that suicidal behavior at time α will be worth more than its opportunity cost, even after including a fixed distaste for exhibiting that suicidal behavior. The opportunity cost in this context, $(U_i | \, s_i = 0)$, could correspond to the discounted present value of utility associated with exhibiting some other suicidal behavior (where these behaviors are mutually exclusive) or to that associated with exhibiting no suicidal behavior.

The empirical predictions one makes from this model depends on how individuals perceive that a given value of s_i will alter expected utility at each age m and the probability of living to that age m: the values U_m and $P(m)$. Relating this model to previous work, the Hamermesh & Soss model implicitly assumes that individuals believe a suicidal behavior will certainly lead to death: $P(m) = 0$ given that $s_i = 1$. The predictions which Marcotte (2003) makes based on his model instead assumes that, for some suicidal individuals, discounted present value of utility conditional on not exhibiting a suicidal behavior is actually positive, but present value of utility conditional on exhibiting that suicidal behavior is sufficiently greater. This arises because the suicidal behavior is allowed to modify U_m at each m while only reducing $P(m)$ to some extent, meaning that a net increase can occur if U_m increases with a suicidal behavior enough to offset the decrease in $P(m)$. In practice, this might occur where an individual believes that suicidal behavior may lead to a reallocation of resources which is sufficiently more favorable that it outweighs the risk of death and any other costs of exhibiting suicidal behavior. We might expect that suicidal behaviors which are more likely to be fatal are also more likely to induce a reallocation of resources, meaning that an individual may be willing to make a suicide attempt which is more likely to lead to death when he or she has more to gain from a reallocation. The Marcotte-style interpretation of this model requires rational behavior only to the extent that one acts to maximize present value of expected lifetime utility. In other words, $U_i|s$, as it pertains to an individual's decision-making, could be interpreted as the individual's *perceived* present value of net utility, which might suffer from imperfect information or biases. Consequently, even if one observes individuals systematically making "mistakes" from a true utility-maximizing point of view, those individuals could still be acting in accordance with this model.

This investigation will evaluate associations between individual-level suicidal behaviors and tract-level unemployment rate. To the extent that exposure to unemployment makes one worse off, one would expect that an increase in tract-level unemployment rate over one's lifetime would decrease U_m at every age m and therefore bring an individual closer to viewing a perfectly fatal suicidal behavior as preferable. However, exposure to unemployment may change U_m differently conditional on a suicidal behavior. For example, an increase in local unemployment may reduce the resources available for reallocation to a suicidal individual, but being unemployed may increase the value of those resources to the individual. Consequently, it is unclear which effect should dominate in the relationship between local unemployment and suicidal behaviors, a priori. For the sake of brevity, I will refer to the prediction that suicidal behaviors are positively associated with local unemployment as one consistent with the Hamermesh & Soss model, whereas I will refer to the prediction that they are negatively associated as one consistent with the Marcotte model.

Attention will be dedicated primarily to unemployment as the variable of interest for several reasons. First, the literature on suicide and the macroeconomy has generally favored studying unemployment, so there exists a broad literature with which findings specific to American youths can be compared and contextualized. Second, because employment in a household is often accompanied by access to resources such as private health insurance, in addition to income, one might expect a more salient relationship between the unemployment rate and suicidal behaviors in nonworking youths than one would observe between suicidal behaviors and a direct measure of income. The loss of parental income may represent a stress on the household which could increase the risk of suicide for youths in the household, but an increase in the unemployment rate represents greater exposure to the risk of not only losing income, but potentially losing additional resources such as familial social status or access to mental and physical health care. Increasing local unemployment may also mean greater general participation in public programs and greater burdens on local budgets, which might reduce individual's access to public services even if one is not personally exposed to unemployment. Additionally, the local unemployment rate can be correlated with other environmental factors as well, such as criminal activity and local educational attainment, which could make an individual's living environment more stressful and less pleasant even if his or her own household is fully employed.

This investigation concerns aggregate economic measures rather than individual-level measures for a few reasons. First, the use of aggregate measures can answer a fundamentally different question which is not well-addressed in current literature. An observed association between census tract-level unemployment and suicidal behaviors does not necessarily reflect the causal effect of one's own employment on one's own suicidal behaviors. It might also, or instead, reflect the effect of living in an environment where people are less likely to have work. This effect could include the fact that the individual is directly exposed to a greater risk of unemployment, but it could also include effects from other environmental changes related to an increase in the unemployment rate. For instance, a higher local unemployment rate might simply be an environmental factor associated with an area being more dangerous, stressful, and generally less pleasant. This could lead to physiological or mental health problems, leading to a greater risk of suicidal behaviors. Second, observed associations between tract-level unemployment and suicidal behaviors conceivably suffer from fewer problems of endogeneity. An individual does not have direct control over the local unemployment rate to the extent that one has over own employment, except that one can move residences. Consequently, reverse-causal and spurious pathways which can arise with respect to individual-level employment may appear at least less plausible. For example, an individual's poor mental or physical health might cause own unemployment and suicide risk but it seems less plausible that the individual's poor health would have a noticeable causal effect on the local unemployment rate.

Methods

This section outlines the empirical models with which the above predictions will be tested. Empirical models utilizing suicide attempts and suicidal ideation as dependent variables will take the form of linear probability models. This investigation uses LPM models to avoid the issues of convergence with probit or logit models due to the fact that suicide is a rare event, particularly among the smaller subsamples use for later models. The models conform to the following equation:

$$s_i = \beta_1 UE_i + \boldsymbol{\beta_2 X_i} + e_i$$

where s_i is an indicator variable corresponding to whether or not individual *i* reported the suicidal behavior being predicted. On the right-hand side, UE_i represents a census tract-level macroeconomic measure of interest. This measure will correspond to the tract-level unemployment rate associated with that respondent in that survey wave. Lastly, $\boldsymbol{X_i}$ represents a vector of strictly exogenous (dummy variables controlling for gender, race, number of people in household, respondent age, survey wave), and e_i is the unobserved individual error term. Standard errors in these basic models, and all following models, will be clustered by respondent identifiers as standard errors may be correlated for the same individual surveyed across time. Testing the hypotheses driving this investigation will involve a consideration of the direction, significance, and magnitude of the coefficient $\beta_1$in each model.

When the dependent variable is a respondent's completed suicide rather than attempt or ideation, the model will be evaluated as a Cox proportional hazards model to avoid the biases in coefficients which would arise in OLS models due to suicide being by definition a terminal event. Hazard models will take the form:

$$h_i(t) = \lambda_0(t)e^{\beta_1 UE_i + \boldsymbol{\beta_2 X_i} + e_i}$$

where $\lambda_0(t)$ corresponds to an unspecified hazard function, $h_i(t)$ corresponds to the probability that individual *i* will commit suicide having survived to time *t*, and the remaining terms are as defined previously.

It is also worth considering the mechanism by which any association observed in the above models might operate. Higher unemployment in an individual's local area implies a greater likelihood that the individual or others in the individual's household are experiencing unemployment. That exposure to unemployment might be the true source of any observed associations. Consequently, I will run variations of the above models to test the extent to which associations observed between local unemployment and individual risk of suicidal behaviors are explained by own or family employment and income. This will consist of simply controlling for those additional, more endogenous factors in the vector $\boldsymbol{X_i}$. A coefficient on β_1 of lesser magnitude in these more endogenous models would be consistent with the notion that these local area measures affect individual suicide behaviors through their effect on employment and income in the individual's household. The controls which will be added in $\boldsymbol{X_i}$ include individual educational achievement, employment status of parents, and own employment status, and household income. Parental employment status is recorded in Waves I and II, whereas own employment and household income are recorded in Waves III and IV. Parental employment dummy variables will be coded to zero for respondents in Waves III and IV, with wave dummies soaking up the effect of unmeasured parental employment due to perfect correlation with parents being "unemployed" for respondents in those waves. The same method will be applied for own employment status and household income dummy variables in Waves I and II.

However, local unemployment could affect individual risk of suicidal behavior through other pathways as well. A last set of endogenous models will, rather than controlling for employment and income in the respondent's family, instead control for other local environmental factors. These factors include proportion of tract-level population with a college degree, proportion in poverty, tract-level population density, county-level adult arrests per 100,000 people, tract-level median family income, and county-level violent arrests per 100,000 people. The inclusion of these endogenous local area covariates will more fully capture the extent to which an individual lives in a stressful or economically distressed area. These models should therefore reveal the extent to which any observations in our exogenous models are explained by this environmental stress rather than simply higher risk of own unemployment (which should not be correlated with these factors, holding constant local area unemployment rate).

The robustness of observed associations to different model specifications will be tested as well. These robustness checks will consist of two sets of models. First, I will estimate fixed effects versions of the exogenous regression models specified above. These will determine the extent to which observed associations are being derived from variation in outcomes across individuals rather than within individuals, and therefore the extent to which conclusions derived from our models may simply be caused by other unmeasured and fixed individual-level characteristics. Failing to observe associations with suicidal behavior in these fixed effects models similar to those found in the original models would suggest that local area unemployment and median family income may not truly be the variables driving those originally observed associations. The second set of robustness checks will substitute tract-level measures in each OLS model with the same measures taken at the county level. This will include the dependent variable of interest, local unemployment rate, and the other control measures used in the local area endogenous models. To the extent that county-level measures are a less precise measure of the immediate environment in which an individual lives, we might expect coefficients from these models to be noisier than those using tract-level measures. However, wildly different coefficients in these models would be cause for concern regarding the validity of conclusions drawn from tract-level measures.

Lastly, in order to test for a possible mechanism by which unemployment may be operating on suicidal behaviors, the set of LPM models described above will also be estimated on a dependent variable capturing a respondent's recent depressive feelings. This will test whether or not, and how, local unemployment is associated with a respondent's feeling depressed. Associations observed in those models may contradict or corroborate one possible mechanism by which local unemployment may be operating on risk of suicidal behaviors through a greater risk of feeling depressed.

Data

The sample for all the models outlined above will consist of all respondent-wave observations with sufficient local area and suicidal behavior information available for the relevant variables. Models will be stratified by survey wave, gender, and race to look for associations over time and within specific demographic groups. These stratifications are motivated by the empirical literature previously discussed. Models stratifying by wave are motivated by evidence of variation in risk of suicide by age. Models stratifying by gender are motivated by evidence that females are equally likely or even more likely to attempt suicide, but much less likely than males to die by suicide. Models stratifying by race are motivated by evidence that race may play a nontrivial role in risk of suicide and mode of suicide used. Each measure by which models will be stratified can be found in Table 1.

This section introduces the data with which the previously described empirical models will be estimated: the National Longitudinal Study of Adolescent to Adult Health (Add Health). Add Health is a longitudinal survey that follows a nationally representative sample of youths from Wave I at age 12-18 in the 1994-95 school year to Wave IV at age 24-32 in 2008, with survey waves occurring at Waves II and III in 1996 and 2001-2002 respectively (Harris, 2012). These individuals were drawn from 132 schools of various sizes associated with 80 communities across the country. It consists of approximately 20,000 respondents surveyed in Wave I and approximately 15,000 respondents tracked for Waves II, III and IV. At each wave of the survey, respondents were asked how frequently they had thought seriously about suicide in the last year and whether or not they had made a suicide attempt which required medical attention in the last year. Considering that these two measures (as well as completed suicides discussed below) represent the dependent variables on which this analysis hinges, their validity is worth careful consideration. A twelve month recall period might be broad enough to cause issues with reliability of self-reports for a more common and less salient event such as suicidal ideation, even when respondents give them honestly. However, with suicide attempts being rare and presumably memorable events, a wide recall window might be expected to cause fewer problems. What exactly a self-reported suicide attempt or self-reported ideation means, though, is a question more difficult to answer. A study of youths aged 14-24 in the Munich area found that 33% of those reporting a suicide attempt claimed to have never attempted suicide 4 years later, and a study of depressed individuals in the Netherlands found that 23% of those who reported a suicide attempt reported never having ever made a suicide attempt at two year follow up (Christl, Wittchen, Pfister, Lieb, & Bronisch, 2006; Eikelenboom, Smit, Beekman, Kerkhof, & Penninx, 2014). Given that suicide attempts are likely rarer, more salient, and more memorable events than suicidal behaviors, these findings might legitimize concerns about the reliability of self-reported suicidal ideation. However, these concerns are contingent upon the generalizability of two small, regional studies in Europe to the population of youths in the United States. Furthermore, the Add Health measure of suicide attempts may not suffer from the same inconsistency, as this measure concerns specifically suicide attempts which required medical attention. As discussed below, completed suicides in this sample are made almost entirely by males whereas females are more likely to report ideation and attempts. If these differences cannot be otherwise explained, they may represent evidence that ideation and attempts are fundamentally different behaviors than completed suicides. This notion is reinforced by the study of youths in Munich, which found that 81% of those who did not report suicide attempts again on four year follow-up were female, while they composed 71% of the youths who initially reported attempts (Christl et al., 2006).

Add Health has recorded notices of respondent death received when contacting respondents for the next survey wave. Information on cause of death and on the date of death for these respondents has been acquired for use in this investigation. Cause of death designations in the Add Health data include accidents, intentional self-harm, and assault. We might expect these cause of death designations to suffer from a similar kind of problem described for ideation and attempts. Here, one could reasonably expect that some suicides may be misclassified as other causes of death, such as accidents, considering the fact that suicide is defined by a motivation rather than a mechanism. Given that one's death being classified as a suicide can be stigmatizing, medical examiners may be reluctant to make that classification in the absence of clear evidence. If this is the case, then the fact that this evidence existed for the suicides recorded in this data may mean that they are different in some meaningful way from suicides classified under other causes of death. To address this issue, models regressing completed suicides will be rerun to include deaths classified as accidents in the dependent variable, to see if the inclusion of those deaths makes a difference in estimated hazard ratios.

The variable to be used to measure respondent's depressive feelings will be an indicator variable corresponding to whether or not he or she has felt depressed "a lot of the time" or "all of the time" in the last 7 days. While the questions exist to construct the CES-D scale in Waves I and II, fewer than half of the 20 questions appear in Waves III and IV. Consequently, this simpler measure is used across all waves.

Contextual data coming from external sources has been attached to each of the current waves of the Add Health survey. These attached datasets are the source of the information on local socioeconomic measures referenced in this investigation's stated hypotheses. Relevant to this investigation, this data includes median family income in the respondent's census tract and unemployment rate for individuals over 16 years old in the respondent's census tract, both coming from the U.S. Census Bureau. Information at the county-level and census block level are also provided for certain waves. However, information at the county and census block level attached to respondents is not consistently available across all four waves of the Add Health survey; county-level socioeconomic characteristics are available only in Waves I, II, and III. Consequently, robustness checks using those measures will be restricted to those waves. The Census Bureau data attached to Waves I, II, and III correspond to cross-sectional estimates of varying temporal distance from the survey period, whereas measures attached to Wave IV correspond to average estimates across a five year interval which overlaps with the survey period. The data attached to Waves I and II corresponds to cross-sectional estimates from the 1990 census. Census Bureau data attached to Wave III corresponds to cross-sectional estimates from Summary File 3 of the 2000 census. Census Bureau data attached to Wave IV corresponds to 5-year estimates measured over the years 2005-2009 as part of the American Community Survey. The actual surveying periods for Waves I, II, III, and IV were 1994-1995, 1996, 2001-2002, and 2007-2008 respectively. Information from FBI Uniform Crime Reports on overall adult arrest rates and adult violent arrest rates in the respondent's county will also be used in the evaluation of the robustness of associations of interest to the inclusion of controls for other local socioeconomic measures. These crime measures were produced using information from 6-12 months of the calendar year to which the data corresponds. These county-level crime rates will be used as controls in both the primary, tract-level models and in the robustness check models which use county-level local area measures. This is simply because local crime measures are provided only at the county level. Uniform Crime Report data comes from 1993 for Waves I and II, 2001 for Wave III, and 2007 for Wave IV.

Empirical Findings

The prevalence of suicidal thoughts and attempts in the data is depicted in Figure 2. Add Health data suggests females are unconditionally more likely to report both ideation and suicide attempts which led to medical treatment, though discrepancies by gender converge in Waves III and IV. This appears to be in relative agreement with CDC reports that gender is the most notable demographic across which disparities exist in suicidal behaviors, finding women regardless of age as being more likely to have suicidal thoughts, but find no statistically significant difference in suicide attempts("Suicide Facts at a Glance," 2012). Both of the CDC's conclusions were consistent with prior studies (Crosby et al., 2011).

Table 2 shows deaths over the course of the first four Add Health survey waves, categorized by cause of death. A total of 218 respondents died by Wave IV, with 22 of these deaths classified as intentional self-harm. Virtually all of these 22 deaths were male deaths. Another 68 respondent deaths are classified as accidents. Regardless of cause, the number of deaths following each wave increases over time, with over a doubling of deaths by self-harm and accidents from the period after Wave I to the period after Wave II. However, comparisons in deaths over time are complicated by the fact that survey waves are not evenly spaced temporally, and not all Wave I respondents were approached for surveying in Wave II. Figure 3 shows the mean tract-level unemployment rate across all respondents in each wave. Relative to the variation within wave, the mean tract-level unemployment rate across waves stays fairly close to the overall mean of 7.70%.

In interpreting coefficients arising from the empirical models, note that only 0.68% of respondent-wave observations include reports of having required medical attention for a suicide attempt in the past year, so coefficients which are small in an absolute sense may be large with respect to the relative change in risk of suicide attempt which they represent. Similarly, 9.46% of respondent-wave observations report having had seriously thought about committing suicide in the past year. The local unemployment measure has been rescaled such that a one-unit change in the unemployment rate variable corresponds to a one percentage point change in the unemployment rate.

Exogenous Models

The first set of models regress the suicidal behaviors on local unemployment, controlling for some basic demographic characteristics. The coefficients of interest from these models can be found in Table 4. In the full sample consisting of all available respondent-wave observation, having made a suicide attempt in the past year appears positively and significantly associated with the local unemployment rate ($\beta = 0.000149$, $p < 0.05$). This corresponds to a 0.015 percentage point increase in risk of committing suicide for a 1 percentage point increase in tract-level unemployment. While the magnitude on this coefficient appears quite small, it is not negligible with only 0.68% of respondent-wave observations reporting having made a suicide attempt in the past year, Ideation, on the other hand, demonstrates no significant association with local unemployment. Despite the fact that almost ten percent of respondent-wave observations reported suicidal ideation, the coefficients observed on local unemployment rate are of unilaterally lesser magnitude than those on suicide attempts. The incidence of completed suicide in this sample may actually decline with an increasing unemployment rate; the Cox Proportional Hazard model estimates that the incidence of suicidal behavior changes by a factor of 0.918 with a one percentage point increase in the unemployment rate. That is, a respondent's risk of dying by suicide prior to the next survey wave is about 8% with a one percentage point increase in the local unemployment rate associated with the last wave in which the respondent was surveyed. This association does not achieve any of our significance cutoffs, though it reaches a t-score of -1.47 with the number of completed suicides reaching only 22 by Wave IV. Output from the models ran which reclassified accidental deaths as "completed suicides" have been omitted because they yielded identical results.

Stratification of the survey sample by gender, by race, and by wave does not appear to reveal any associations between suicidal ideation and local unemployment which might have been obscured in models using the full sample. The exceptions to this generalization are the two sets of models which use the sample of respondent-observations in Wave III and Wave IV only. Coefficients reverse in direction and significance between the two waves: association with the unemployment rate is significantly negative in Wave III ($p < 0.01$) but insignificantly positive in Wave IV.

Stratification reveals perhaps more nuanced associations where suicide attempt is taken as the dependent variable. Among males, having made a suicide attempt in the last year is significantly associated with the local unemployment rate ($\beta = 0.000202$, $p < 0.10$). Relative to the coefficient for the overall sample, the magnitude of this coefficient is substantial also because of the fact that only 0.54% of male respondent-wave observations reported a suicide attempt in the past year. The effect for the female subsample, on the other has about half the magnitude of the male effect and is not significantly different from zero, despite 0.81% of females reporting attempts. However, the unemployment rate coefficients are not significantly different across these two subsamples.

Striking differences in coefficients for these more basic models arise when stratifying by race. The coefficient on unemployment rate for the sample of whites is, relatively speaking, very large and significant. Among whites, a 1 percentage point increase in the unemployment rate is associated with a 0.0363 percentage point increase in the probability of reporting a suicide attempt ($p < 0.01$). The coefficient on unemployment for whites is significantly greater than that for Blacks ($p < 0.05$) and for Asians ($p < 0.01$), but not for Hispanics. Coefficients on these measures for respondents identifying as black, Asian, and Hispanic all fail to achieve any statistical significance, and are generally of the same direction but lesser magnitude. The coefficient on local unemployment for those identifying as Asian is an exception to this generalization due to its direction and magnitude; while not achieving significance, it actually indicates that a one percentage point increase in the local unemployment rate is associated with a 0.0329 percentage point decrease in probability of having reported a suicide attempt.

Weak magnitude and lack of significance for coefficients on the unemployment rate among respondent observations in each of Wave I, II, and III suggest that the associations observed in the overall sample are to some extent driven by the greater magnitude of these associations in Wave IV. We see, in Wave IV, a one percentage point increase in the unemployment rate is associated with a 0.0337 percentage point increase in probability of having attempted suicide in the last year ($p < 0.05$). This coefficient, though, is significant greater than only that for Wave III ($p < 0.05$).

Individual-Level Endogenous Models

I next control for own and parental employment, household income, and educational attainment in models regressing suicidal behavior on tract-level unemployment. This should help me determine the extent to which own socioeconomic wellbeing explains observed exogenous associations between the local area variables of interest and our measures of suicidal behavior. Coefficients from these models can be found in Table 5.

Controlling for these factors in hazard models for completed actually increases the extent to which local unemployment is associated with a lower probability of committing suicide before the next survey wave, though the statistical significance of that coefficient does not change at all. A one percentage point increase in the tract-level unemployment rate is associated with being 10% less likely to commit suicide. The magnitude of this coefficient may not be worth much consideration given the fact that it remains equally insignificant. It should still be noted that the fact that the hazard ratio on local unemployment increases with the inclusion of controls for own income, education, and exposure to unemployment is not consistent with those measures explaining association between suicide and local unemployment. With regards to suicidal ideation, coefficients remain insignificant with local unemployment for the full sample, for both gender subsamples, and for all race subsamples except for the Hispanic subsample. For Hispanic respondents, local unemployment is associated with less ideation after controlling for own employment and education ($p < 0.05$).

Considering suicide attempt as our dependent variable, we see the inclusion of own and parental employment controls and education controls reduces the coefficient on local unemployment by about 45% and to statistical insignificance for the full sample. The coefficient on local unemployment similarly loses its weak significance and 34% of its size for the male subsample. Only the coefficient for the white subsample remains significant. This coefficient is weakened by 30% but retains the weakest level of significance ($p < 0.10$). Each of these observations is consistent with own exposure to unemployment explaining the association between local unemployment and suicide attempts, at least to some extent.

Local-Area Endogenous Models

The inclusion instead of potentially endogenous local area covariates may shed light into how other environmental factors might explain the association between local unemployment and risk of suicidal behavior. Results from the set of empirical models ran including these covariates can be found in Table 6, while a list of the additional variables included in these models can be found in Table 3. With respect to completed suicides, the inclusion of these covariates brings the estimated hazard ratio for an increase in the unemployment rate closer to a value of 1 with a point estimate of 0.9387 (90% CI of [0.8676, 1.063]).

The inclusion of local area endogenous covariates mostly reduces the magnitude of association between the local unemployment rate and reports of suicidal ideation. Only two coefficients remain significant at any level. The first is that on local unemployment in the subsample of respondents in Wave III, which corresponds to a 0.0877 percentage point decrease in ideation with a one percentage point increase in unemployment ($p < 0.05$). The second, the coefficient on local unemployment in the sample of respondents in Wave II, actually goes in the opposite direction with a one percentage point increase in unemployment being associated with a 0.158 percentage point increase in ideation ($p < 0.10$).

The addition of endogenous, local-area covariates in suicide attempt models causes coefficients on the local unemployment rate to all fall in magnitude. None except for the coefficient on the white subsample achieve statistical significance. The coefficient on the subsample of white respondents is decreased by about 33%, roughly comparable to the reduction in magnitude which came with the inclusion of own and parental employment controls. As with the inclusion of those controls, the inclusion of local area endogenous controls still leaves the smaller coefficient on the unemployment rate ($\beta = 0.000265$) weakly significant ($p < 0.10$). These findings are consistent with variation in other environmental factors explaining at least part of the association between local unemployment and suicide attempts.

Models with Both Individual-Level and Local Area Controls

Lastly, the inclusion of both individual-level endogenous controls and local area endogenous controls within the same model will help us determine the extent to which these two variables together might explain the associations observed between local unemployment rate and suicidal behaviors. Coefficients from these models can be found in Table 7. For completed suicides, we see that the association with local unemployment falls in magnitude between that of the coefficient in the individual-level endogenous model and local area endogenous model. This coefficient is not significant, nor is it significantly different from coefficients from these other models.

Looking at suicidal ideation, we observe that coefficients on local unemployment are somewhat weaker in magnitude than the same coefficients in models controlling only for individual-level endogenous factors, but not necessarily weaker in magnitude than coefficients in models controlling only for local area factors. No coefficient in the full sample, samples stratified by gender, or samples stratified by race comes close to statistical significance. We observe significance only for the subsample of respondents in Wave III ($\beta = -0.000906$, $p < 0.05$) and respondents in Wave II ($\beta = 0.00156$, $p < 0.10$). As in the models controlling for endogenous local area factors, these coefficients reverse in direction across the two waves.

With measures of own exposure to unemployment and measures of other local area factors both apparently explaining part of the association between local unemployment and suicide attempts, including both of these sets of additional controls in one model will help determine the extent to which these sets of controls explain different parts of the association between local unemployment and suicide attempts. We see that including both of these sets of controls within the same model yields coefficients on local unemployment comparable to those from models including only local area controls or only individual-level controls, which is not consistent with these two sets of controls explaining different parts of that association. Differences across these three sets of models are not statistically significant. Perhaps the only noteworthy observation drawn from these models is that the coefficient in the white subsample is marginally smaller than the coefficient on that subsample in the models including local and individual-level controls separately, though this coefficient still remains weakly significant (β = 0.000246, $p < 0.10$).

Self-Reported Depression Models

As a check for a possible mechanism by which local unemployment may be causally associated with suicidal behaviors, a series of models regressing whether or not a respondent reported feeling depressed “a lot of the time” or “always” over the previous seven days on our sets of independent variables were estimated. Coefficients on local unemployment from select models can be found in Table 8. Controlling only for exogenous variables, local unemployment is very significantly associated with this self-reported measure of depression ($p < 0.0001$), with the coefficient for the full sample being nearly half the size of that for the white subsample (β = 0.00113, β = 0.00214 respectively). With 8.37% of respondent-wave observations in the full sample and 7.70% of observations in the white subsample reporting feeling depressed, a 0.113 and 0.214 percentage point increase in probability of feeling depressed for a 1 percentage point increase in local unemployment is small but not negligible. Including individual-level endogenous measures reduces this coefficient to 1/3rd its original value for the full sample, but it still retains weak statistical significance ($p < 0.10$). For the white subsample, that coefficient is roughly halved but retains full significance (β = 0.0012, $p < 0.0001$). The inclusion instead of local area endogenous controls reduces coefficients in both of these samples to a greater extent, leaving the association between local unemployment and self-reported depression insignificant in the full sample, and significant to a lesser extent in the white subsample (β = 0.000343 and β = 0.000925, $p < 0.05$ respectively). Including both individual-level and local area endogenous controls in the same model leaves the full sample coefficient comparable to that of local area endogenous model, while further reducing the coefficient for the white subsample to insignificance ($\beta = 0.000324$ and $\beta = 0.000684$ respectively).

Robustness Checks: Fixed Effects and County-Level Models

To ensure that associations observed in the LPM models for suicide attempt and suicide ideation are not being driven by unobserved fixed effects, a series of individual fixed effects regressions were ran as a robustness check. These models test the extent to which, for example, associations between local unemployment and suicide attempts are being driven by the possibility that people who are more likely to be exposed to higher local unemployment are simply different from those who are more likely to be exposed to lower unemployment. The results from these models can be observed in Table 9. Relative to the exogenous LPM suicide attempt models, the coefficient on local unemployment is of a magnitude about 40% smaller and achieves no significance in the full model. Controlling for fixed effects in the white subsample, though, leaves the association between local unemployment and suicide attempt risk virtually identical to that in the original exogenous model, and leaves it achieving the same level of statistically significant ($p < 0.01$). Similarly, controlling for fixed effects in the male subsample provides an association of only marginally lower magnitude between unemployment and suicide attempt risk, which remains statistically significant ($p < 0.10$). Looking at suicidal ideation, we see that controlling for fixed effects leaves ideation significantly negatively associated with local unemployment ($\beta = -0.000572$, $p < 0.05$) for the full sample, whereas that coefficient achieves no significance for the corresponding exogenous or the individual-level endogenous models. This association is also observed in both the male subsample and female subsample, neither of which showed this association in the exogenous models.

The second set of robustness checks substitutes tract-level socioeconomic measures for county-level socioeconomic measures (and limits the sample to exclude Wave IV due to lack of county-level socioeconomic information in that wave) in the LPM models for suicide attempts and suicidal ideation. The measures being substituted includes the measure of local unemployment and the additional local-area controls included in certain models. These models evaluate the extent to which findings are sensitive to the size of the local area being considered. It could be that a census tract is too small a region to capture the type of environment to which an individual is exposed; the characteristics of adjacent census tracts might affect an individual's suicidal behaviors as well. On the other hand, a county may be too large a region, introducing too much noise in models. In the case of both suicidal ideation and suicide attempts, the use of county-level measures reveals a similar trend. Coefficients on county-level unemployment from a qualitatively representative subset of these models can be found in Tables 10 and 11. In the exogenous and individual-level endogenous models, county-level unemployment is negatively associated with the suicidal behavior of interest. After including local area controls though, the estimated effect of county-level unemployment on that suicidal behavior not only changes sign but increases in magnitude as well. This applies when controlling for both local area and individual-level endogenous controls. All of these effects, and changes in effects, are more significant for suicidal ideation than for suicide attempts. Similarly, they are more significant in the male and white subsamples than in the full sample. The tract-level models restricted to Waves I, II, and III though reflect the same associations observed in the models on the unrestricted sample, except that coefficients are indistinct from zero other than that corresponding to the white subsample.

Conclusions and Policy Implications

The findings of this investigation do not provide unilateral support for either of the theoretical models presented at the beginning of this investigation, or the original hypotheses that suicide attempts and completed suicides would reflect a Hamermesh & Soss type model whereas ideation would reflect a Marcotte type model. The association between incidence of completed suicides and tract-level unemployment can best be interpreted as unclear given the width of confidence intervals, regardless of whether or not we include other deaths which may represent misclassified suicides. There are simply too few events to precisely estimate our coefficient of interest. While no coefficients achieve statistical significance, the incidence of completed suicides decreasing with an increase in tract-level unemployment is consistent with a Marcotte type model rather than a Hamermesh & Soss type model. When individual-level and local area-level covariates are included in these hazard models, we find that this insignificant association diminishes further.

The associations observed for suicide attempts produce the most potentially cohesive narrative regarding suicidal behaviors. I find associations consistent with a Hamermesh & Soss type model of suicidal behavior, where being unemployed reduces the utility associated with not attempting suicide relative to that associated with attempting suicide. This conceivably occurs where the suicidal state is one in which the individual perceives a suicide attempt as one which will certainly lead to death. Suicide attempts might be expected to suffer from inaccurate reporting to a lesser extent than suicidal ideations, and suicide attempts are reported more frequently than completed suicides. Suicide attempts are positively associated with local unemployment, which is consistent with the Hamermesh & Soss model as predicted. This is driven by whites, by males, and by observations in Wave IV (where respondents have mostly reached working age). However, substantial variation how and when attached local unemployment rates were measured across waves may preclude meaningful comparison of coefficients on unemployment rates across waves. The fact that coefficients are consistent in sign across races but of greatest magnitude for whites is unsurprising to the extent that these behaviors appear more prevalent in whites than other races (Cutler et al., 2001). While some of the effect of unemployment on suicide attempt risk can be explained by individual fixed effects in the full model, virtually none of that effect for the white subsample or male subsample can be explained by those fixed effects. Own employment, parental employment, household income, and educational attainment explain about 30% of the effect of tract-level unemployment rate on risk of suicide attempt for whites, but there still remains a modest and statistically significant association between local unemployment and suicide attempt risk for whites, even after controlling for those factors. Including controls for local crime, educational attainment, and poverty rate explain about 23% of the association between unemployment and suicide attempt risk in whites. As with the inclusion of individual-level endogenous covariates, the inclusion of local area endogenous covariates still leaves a weakly significant association between tract-level unemployment rate and risk of suicide attempt for whites.

Thus, one might conclude that local unemployment operates on suicide attempts through causing a greater risk of exposure to unemployment and through correlation with other environmental problems, at least in whites. One might expect that this is evidence of a causal effect, simply to the extent that this author has failed to propose a convincing non-causal mechanism by which the effect of local unemployment on suicide attempts might be explained by own unemployment. The fact that measures corresponding to these two pathways together explain more of the association between local unemployment and feeling depressed together than they do independently might suggest one should expect the same for suicide attempts.

The set of models which include both individual-level and local area endogenous controls test whether these sets of variables explain different portions of the association between local unemployment and suicide attempts. These models show that they together do not explain more of the association between local unemployment and suicide attempts than is explained by including just one of those two sets of controls. Consequently, it may be wise to exercise caution in interpreting these results as definitive evidence for local unemployment affecting suicide attempts through the two pathways being discussed, even for the white subsample. It may simply be that the local area measures and own employment measures actually explain the association between local unemployment and suicide attempts through the same pathway. On the other hand, it may be unwise to conclude that this analysis provides evidence against the existence of two pathways. It could be that the individual-level measures used in this analysis do not properly capture the manner in which local unemployment operates through exposure to unemployment, or that the local area measures used do not properly capture the manner in which local unemployment interacts with other environmental factors in affecting risk of suicide attempt.

The substitution of county-level for tract-level local area measures as a robustness check also does not support the conclusion that there exist two independent pathways through which local unemployment operates on suicide attempts. While the general reduction in both magnitude of coefficients and sample size in these models (arising due to the exclusion of respondents in Wave IV) may preclude meaningful tests of statistical significance, the relative trends in coefficients with the inclusion of endogenous covariates are not consistent with the trends observed when using tract-level measures. One may suppose that differences in trends in associations for tract-level measures and county-level measures are due to the differential influence of unmeasured endogenous covariates, but testing this hypothesis is beyond the scope of this investigation.

The analysis performed leave unclear whether own unemployment or other local area measures drive the majority of the association between local unemployment and suicide attempts, but they do rule out other important pathways. The possibility of a reverse-causal relationship between unemployment and suicide attempt risk, which would suggest that those who become suicidal are then more likely to also become exposed to unemployment, is addressed by the use of local area measures of unemployment. An individual's behavior could possibly have an effect on one's own employment prospects, but it seems less likely that an individual's behavior would have a meaningful effect on the local unemployment rate. With respect to the portion of the effect of local unemployment on suicide attempt risk which is explained by own and parental unemployment, previous works suggest that unemployment causes suicide risk through deteriorating mental health. Blakely et al. (2003) make this argument in a longitudinal study of New Zealand census data, having found that half of the effect of unemployment on risk of death by suicide is attributable to mental illness. Dooley et al. (1994), Fergusson et al. (2001), and Montgomery et al. (1999) provide evidence that unemployment causes mental health problems, risky behaviors and depression while ruling out reverse causal pathways and selection through the use of longitudinal methods. These studies are consistent with the fact that self-reported depressive feelings are also strongly and positively associated with local unemployment rate in the Add Health data, and that this association is explained somewhat by own and parental employment, educational attainment, and family income (which are in turn somewhat associated with suicide attempts).

Supposing that the effect of local unemployment on suicide attempts in young people causally operates through one of the two pathways being discussed, there are a few important policy implications which can be predicted. In the case of either pathway, one should expect an increase in risk of suicide attempt among young people with an increase in unemployment, particularly among young adults, among whites, and among males. If own exposure to unemployment is driving this association, in accordance with the findings of Kposowa (2001) on older Americans and the findings of Blakely et al. (2003) on New Zealand youths, then preventing an increase in youth suicide attempts when unemployment rises might involve policies which reduce the negative shock to utility associated with exposure to unemployment. These policies would look much like policies addressing unemployment in the broader population. They might include improved unemployment insurance benefits or providing the unemployed with opportunities to accrue productive human capital. Policies which address mental health consequences of relevant where those changes are particularly likely to cause an increased risk of depressive feelings or similar mental health issues, as suggested by Dooley et al. (1994) and Ferguson et al. (2001), and by the brief tests included in this investigation. However, if local unemployment operates on suicide attempts through correlation with changes in other environmental factors, interventions may need to target communities rather than those directly exposed to unemployment. Increases in suicide attempts may be mitigated by programs which intervene to disassociate local unemployment from, for instance, crime rates, poverty rates, or local educational attainment. To the extent that local unemployment may operate on suicide attempts through mental health, this pathway could operate by local unemployment's correlation with these other measures as well as through one's own exposure to unemployment. In other words, the effect of local unemployment rate on mental health may be underestimated by looking only at mental health outcomes for the unemployed; this investigation supports that local area correlates of unemployment affect an individual's depressive feelings as well. Consequently a policy response addressing the mental health outcomes of increases in unemployment may need to target mental health in the broader population rather than solely in those directly exposed to unemployment.

A similarly clear possible narrative does not arise for empirical associations with suicidal ideation to the extent it did with attempts, perhaps as a consequence of their greater susceptibility to measurement error. Exogenously, significant associations between tract-level unemployment and ideation do not exist in the full sample or in any demographic subsample, though the directions of these coefficients are generally negative as predicted. Significance is only observed for unemployment in Wave III, but the sign on that coefficient measures actually reverses in Wave IV. Theoretically, a natural economic interpretation of reported suicidal ideation would be that it occurs when an individual's present value of expected future utility has the characteristic that, by the Marcotte model, the lifetime utility associated with having seriously thought about suicide is sufficiently larger than that associated with not having seriously thought about suicide. These findings, however, do not provide solid evidence for this interpretation, at least when supposing that increased unemployment should reduce the possible gain from any kind of suicidal behavior. The inconsistency of coefficients in these models may in part be explained by the possibility of considerable measurement error involved in self-reporting suicide ideation, as discussed in the Data section.

Limitations

Interpretations of the findings of this investigation are subject to a series of important limitations. First is related to the representative nature of the Add Health survey. The Add Health survey is designed to be nationally representative of United States youths with the application of certain survey weights. The use of survey weights in this analysis was precluded by the fact that no such weights exist for the specific set of samples of which this investigation intended to make use. Consequently, if important non-representative characteristics of the sampling process are not accounted for in the controls used for these regression models, it is possible that associations observed may not be representative of the relevant populations within the United States.

Second, caution should be taken in using these analyses as evidence that the economic environment has a weaker effect on risk of suicide attempt of minors than it does for young adults. Recall that the two earlier survey waves, fielded when respondents were nearly all of high school age, were matched to unemployment and income information from the 1990 census. For respondents in Waves I and II, that would correspond to local area information from four to six years prior to hen they were surveyed. Wave III, on the other hand, was matched to this information from one to two years prior to interview. Wave IV, lastly, was matched to information averaged over a five year interval overlapping with the survey period. One might expect these discrepancies alone to explain any differences in association observed across age. Furthermore, this limitation means that the point estimates on unemployment and median family income also may not be particularly meaningful. Rather, the contribution of these models may lie much more heavily in overall direction and significance of associations between those measures and suicidal behaviors.

Third, in the context of the Marcotte model, this investigation has supposed that own exposure to unemployment or an increase in local unemployment would reduce the possible gains in utility from exhibiting a suicidal behavior. However, this may not be the case. One might suppose instead that, for example, own exposure to unemployment might increase the marginal value of certain resources for an individual. Specifically, own exposure to unemployment might affect mental health in a manner that increases the value of consuming mental health resources. If that change in value exceeds the value of available resources lost when exposed to unemployment or when local unemployment increases, then the Marcotte model would predict that suicidal behaviors increase when unemployment increases as well. Thus, one cannot completely rule out the possibility that the Marcotte model does in fact explain the findings of the models estimated in this investigation.

Fourth, it is worth keeping in mind that, aside from completed suicides, the suicidal behaviors used as dependent variables in these models were self-reported. As Eikelenboom et al. (2001) and Christl et al. (2006) suggest, there may be serious issues with consistency when relying on self-reported suicidal behaviors. While self-reports may be, realistically, the only means of detecting suicidal ideation, this is not the case with suicide attempts. Claiming to have made a suicide attempt and attempting suicide may be two behaviors which do not perfectly correspond, especially considering the extent to which suicidal behaviors might be a socially sensitive topic. We are somewhat reassured that this problem may be less grievous in suicide attempt models due to the fact that we consider only suicide attempts which led to medical treatment of some kind. This limitation applies in some form to the analyses with respect to completed suicides as well. In the absence of clear evidence that a death was the result of a suicide, it is plausible that some number of the non-suicide deaths observed over the survey period were actually suicides misclassified as events such as accidents or poisonings. If they exist, these misclassifications could be biasing coefficients in completed suicide models quite substantially considering the fact that so few completed suicides were observed. The fact that including accidental deaths in reruns of the completed suicide models yielded comparable results to models for only deaths classified as suicides is evidence that this problem may not be serious. This check is not a particularly conclusive one, though. Concerns related to the meaning of a self-reported suicide attempt are alleviated to some extent by the fact that this investigation defines a suicide attempt as an attempt which required medical attention. This helps narrow the possible interpretations respondents could have had in claiming to have made a suicide attempt, assuming they are reporting honestly.

Lastly, findings from the models looking at completed suicides might complicate interpretation of the findings for the suicide attempt models. The unexpected coefficients on macroeconomic factors for completed suicide are likely, given their lack of significance and the rarity of completed suicides, the consequence of random variation rather than reflective of a true procyclical association. If this is not the case, though, completed suicides exhibiting a procyclical association with socioeconomic measures does call into question how to interpret the countercyclical association between attempts and those measures, even if we are convinced that association is causal. Specifically, one should wonder how to interpret the meaning of a negative and causal effect of poorer economic conditions on suicide attempt risk if that does not result in an increased risk of death by suicide. In a more general sense, it again calls into question what exactly a reported suicide attempt means. These attempts being reported means that they were unsuccessful by definition, even if they were serious enough to need some kind of medical attention. That completed suicides were nearly all performed by males, whereas females were more likely to report ideation and attempts, does suggest that those who commit suicide are a nonrandom subsample of those who ideate and attempt. However, it may also be unwise to consider too seriously the associations (or lack thereof) between completed suicides and macroeconomic measures considering the few number of completed suicides which were observed over the course of the study.

Works Cited

Blakely, T. A., Collings, S. C. D., & Atkinson, J. (2003). Unemployment and suicide. Evidence for a causal association? *Journal of Epidemiology and Community Health*, *57*(8), 594–600. http://doi.org/10.1136/jech.57.8.594

Center for Disease Control and Prevention. (2013). *WISQARS Leading Causes of Death Reports*. Retrieved from http://webappa.cdc.gov/sasweb/ncipc/leadcaus10_us.html

Cheng, A. T. (1995). Mental illness and suicide. A case-control study in east Taiwan. *Archives of General Psychiatry*, *52*(7), 594–603.

Cheng, A. T. A., Chen, T. H. H., Chen, C.-C., & Jenkins, R. (2000). Psychosocial and psychiatric risk factors for suicide. *The British Journal of Psychiatry*, *177*(4), 360–365. http://doi.org/10.1192/bjp.177.4.360

Chen, J., Choi, Y. J., Mori, K., Sawada, Y., & Sugano, S. (2012). Socio-Economic Studies on Suicide: A Survey. *Journal of Economic Surveys*, *26*(2), 271–306. http://doi.org/10.1111/j.1467-6419.2010.00645.x

Christl, B., Wittchen, H.-U., Pfister, H., Lieb, R., & Bronisch, T. (2006). The Accuracy of Prevalence Estimations for Suicide Attempts. How Reliably Do Adolescents and Young Adults Report Their Suicide Attempts? *Archives of Suicide Research*, *10*(3), 253–263. http://doi.org/10.1080/13811110600582539

Classen, T. J., & Dunn, R. A. (2012). The effect of job loss and unemployment duration on suicide risk in the United States: a new look using mass-layoffs and unemployment duration. *Health Economics*, *21*(3), 338–350. http://doi.org/10.1002/hec.1719

Crosby, A. E., Han, B., Ortega, L. A. G., Parks, S. E., & Gfroerer, J. (2011). Suicidal Thoughts and Behaviors Among Adults Aged ≥18 Years --- United States, 2008-2009. *Morbidity and Mortality Weekly Report*, *60*(13). Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6013a1.htm?s_cid=ss6013a1_e.

Cutler, D. M., Glaeser, E. L., & Norberg, K. E. (2001). *Explaining the Rise in Youth Suicide* (NBER Chapters) (pp. 219–270). National Bureau of Economic Research, Inc. Retrieved from http://ideas.repec.org/h/nbr/nberch/10690.html

Dooley, D., Catalano, R., & Wilson, G. (1994). Depression and unemployment: Panel findings from the Epidemiologic Catchment Area study. *American Journal of Community Psychology*, *22*(6), 745–765. http://doi.org/10.1007/BF02521557

Dorpat, T. L., & Ripley, H. S. (1960). A study of suicide in the seattle area. *Comprehensive Psychiatry*, *1*(6), 349–359. http://doi.org/10.1016/S0010-440X(60)80058-2

Durkheim, E., Spaulding, J. A., & Simpson, G. (2010). *Suicide*. Simon and Schuster.

Eikelenboom, M., Smit, J. H., Beekman, A. T. F., Kerkhof, A. J. F. M., & Penninx, B. W. J. H. (2014). Reporting suicide attempts: consistency and its determinants in a large mental health study. *International Journal of Methods in Psychiatric Research*, *23*(2), 257–266. http://doi.org/10.1002/mpr.1423

Fergusson, D. M., John Horwood, L., & Woodward, L. J. (2001). Unemployment and psychosocial adjustment in young adults: causation or selection? *Social Science & Medicine*, *53*(3), 305–320. http://doi.org/10.1016/S0277-9536(00)00344-0

Gerdtham, U.-G., & Ruhm, C. J. (2006). Deaths rise in good economic times: Evidence from the OECD. *Economics & Human Biology*, *4*(3), 298–316. http://doi.org/10.1016/j.ehb.2006.04.001

Granados, J. A. T. (2005). Increasing mortality during the expansions of the US economy, 1900–1996. *International Journal of Epidemiology*, *34*(6), 1194–1202. http://doi.org/10.1093/ije/dyi141

Hamermesh, D. S., & Soss, N. M. (1974). An Economic Theory of Suicide. *Journal of Political Economy*, *82*(1), 83–98.

Harris, K. (2012). The Add Health Study: Design and Accomplishments. Carolina Population Center, University of North Carolina at Chapel Hill. Retrieved from http://www.cpc.unc.edu/projects/addhealth/data/guides/DesignPaperWIIV.pdf

Henriksson, M., Aro, H., Marttunen, M., Heikkinen, M., Isometsa, E., Kuoppasalmi, K., & Lonnqvist, J. (1993). Mental disorders and comorbidity in suicide. *American Journal of Psychiatry*, *150*(6), 935–940. http://doi.org/10.1176/ajp.150.6.935

Kposowa, A. J. (2001). Unemployment and suicide: a cohort analysis of social factors predicting suicide in the US National Longitudinal Mortality Study. *Psychological Medicine*, *31*(01), 127–138.

Luo, F., Florence, C. S., Quispe-Agnoli, M., Ouyang, L., & Crosby, A. E. (2011). Impact of Business Cycles on US Suicide Rates, 1928-2007. *American Journal of Public Health*, *101*(6), 1139–1146. http://doi.org/10.2105/AJPH.2010.300010

Marcotte, D. E. (2003). The Economics of Suicide, Revisited. *Southern Economic Journal*, *69*(3), 628–643. http://doi.org/10.2307/1061698

McKeown, R. E., Cuffe, S. P., & Schulz, R. M. (2006). US Suicide Rates by Age Group, 1970-2002: An Examination of Recent Trends. *American Journal of Public Health*, *96*(10), 1744–1751. http://doi.org/10.2105/AJPH.2005.066951

Montgomery, S. M., Cook, D. G., Bartley, M. J., & Wadsworth, M. E. (1999). Unemployment pre-dates symptoms of depression and anxiety resulting in medical consultation in young men. *International Journal of Epidemiology*, *28*(1), 95–100. http://doi.org/10.1093/ije/28.1.95

Murphy, G. C., & Athanasou, J. A. (1999). The effect of unemployment on mental health. *Journal of Occupational and Organizational Psychology*, *72*(1), 83–99. http://doi.org/10.1348/096317999166518

Neumayer, E. (2004). Recessions lower (some) mortality rates:: evidence from Germany. *Social Science & Medicine*, *58*(6), 1037–1047. http://doi.org/10.1016/S0277-9536(03)00276-4

Rihmer, Z. (1996). Strategies of suicide prevention: Focus on health care. *Journal of Affective Disorders*, *39*(2), 83–91. http://doi.org/10.1016/0165-0327(96)00007-9

Ruhm, C. J. (2000). Are Recessions Good for Your Health? *The Quarterly Journal of Economics*, *115*(2), 617–650. http://doi.org/10.1162/003355300554872

Shaffer, D., Garland, A., Gould, M., Fisher, P., & Trautman, P. (1988). Preventing Teenage Suicide: A Critical Review. *Journal of the American Academy of Child and Adolescent Psychiatry*, *27*(6), 675–687. http://doi.org/10.1097/00004583-198811000-00001

Shaffer, D., & Pfeffer, C. R. (2001). Practice Parameter for the Assessment and Treatment of Children and Adolescents With Suicidal Behavior. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(7, Supplement), 24S–51S. http://doi.org/10.1097/00004583-200107001-00003

Stack, S., & Wasserman, I. (2005). Race and Method of Suicide: Culture and Opportunity. *Archives of Suicide Research*, *9*(1), 57–68. http://doi.org/10.1080/13811110590512949

Stuckler, D., Basu, S., Suhrcke, M., Coutts, A., & McKee, M. (2009). The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. *The Lancet*, *374*(9686), 315–323. http://doi.org/10.1016/S0140-6736(09)61124-7

Suicide Facts at a Glance. (2012). Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/violenceprevention/pdf/suicide_datasheet_2012-a.pdf

US Census Bureau, D. I. D. (2011, December 8). Population Estimates. Retrieved May 22, 2014, from http://www.census.gov/popest/data/historical/2000s/vintage_2008/

Appendix

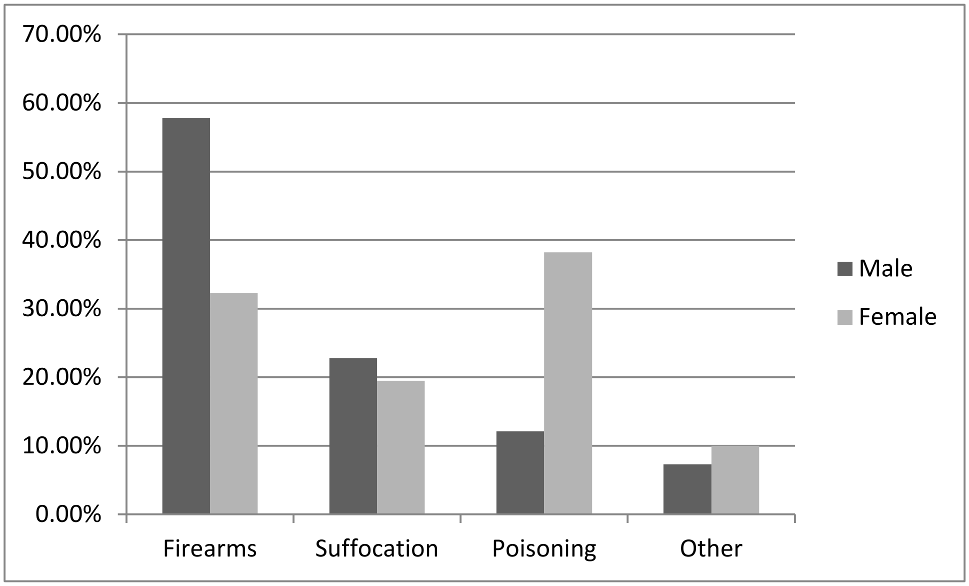

Figure 1: Modes of Suicide Death in the United States by Gender, 1999-2010, data from the Center for Disease Control 2013, *WISQARS Leading Cause of Death Reports*. Available from: <http://webappa.cdc.gov/sasweb/ncipc/leadcaus10_us.html> [3 Feb 2015]

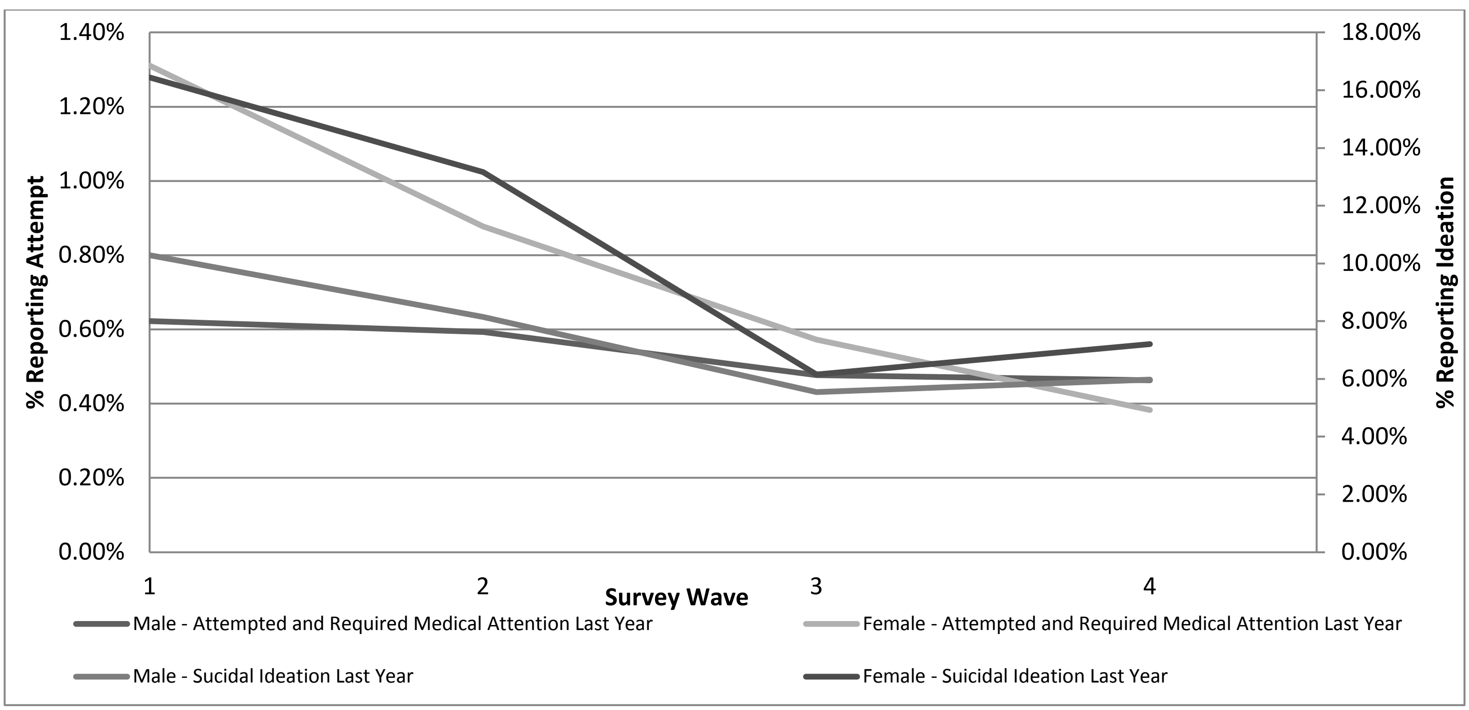

Figure 2: Trends in Non-Fatal Suicidal Behaviors

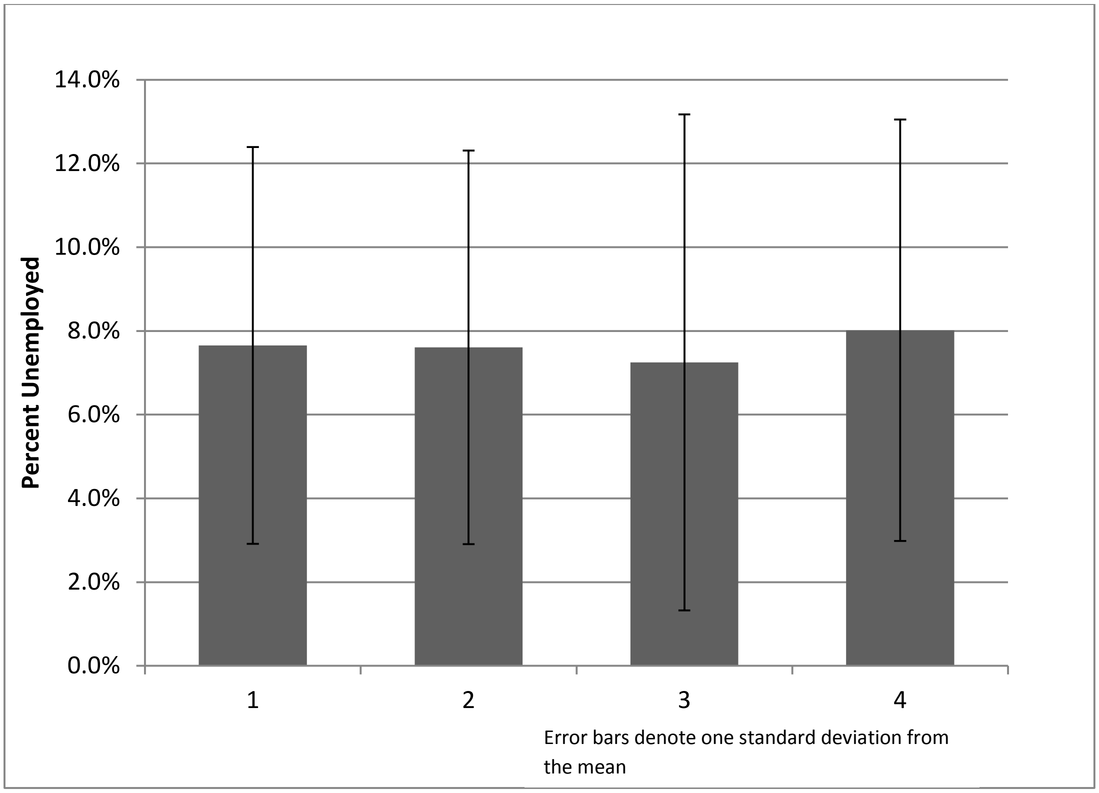

Figure 3: Mean Tract-Level Measures by Wave

Table 1: Model Samples and their Specifications

Model Samples	N
Full Survey Sample (OLS* & Hazard**)	66,381
Males Only (OLS*)	34,418
Females Only (OLS*)	31,961
Respondents who Identify as White (OLS*)	42,490
Respondents who Identify as Black (OLS*)	15,287
Respondents who Identify as Asian (OLS*)	5,060
Respondents who Identify as Hispanic (OLS*)	11,008
Wave I Only (1994-1995) (OLS*)	20,745
Wave II Only (1996) (OLS*)	14,738
Wave III Only (2001-2002) (OLS*)	15,197
Wave IV Only (2007-2008) (OLS*)	15,701

*Dependent variables of OLS models: seriously thought about committing suicide in the last 12 months, attempted suicide in the last 12 months and required medical attention.

**Dependent variable of hazard models: died by intentional self-harm since last surveying period.

Table 2: Respondent Causes of Death by Wave

	Last Wave Surveyed			
	Wave 1	**Wave 2**	**Wave 3**	**Total**
Intentional Self-Harm	3	7	12	22
Accidents	12	23	33	68
Other/Unclassified	33	51	44	128
Total	48	81	89	218

Table 3: Regression Model Variables

Dependent Variables	1. Exogenous Controls	2. Individual-Level Endogenous Controls	3. Local Area Endogenous Controls
- Committed suicide before next interview date (Cox) - Made a suicide attempt in last year which required medical attention (OLS) - Seriously Thought about committing suicide in last year (OLS)	- Respondent Identifies as Female - Respondent Identifies as White - Respondent Identifies as Black - Respondent Identifies as Asian - Respondent Identifies as Hispanic - Number of People in Respondent's Household (dummy variables) - Respondent Age (dummy variables) - Survey Wave (dummy variables)	- Mother currently employed - Mother employed full-time -Father currently employed - Father employed full-time - Currently employed - Currently employed full-time - Household Income < $5,000 - Household Income $5,000 - $9,999 - Household Income $10,000-$14,999 - Household Income $15,000- $19,999 - Household Income $20,000-$24,999 - Household Income $25,000-$29,999 - Household Income $30,000-$39,999 - Household Income $40,000-$49,999 - Household Income $50,000-$74,999 - Household Income $75,000-$99,999 - Household Income $100,000-$149,999 - Household Income $150,000 or More	- Proportion of tract-level population with college degree - Proportion of tract-level population in poverty - Tract-level population Density - County-level adult arrests per 100,000 people - County-level adult violent arrests per 100,000 people - Tract-level median family income

Table 4: Coefficients on Tract-Level Unemployment Rate from Regression Models With Exogenous Controls Only[ǂ]

		Full Sample		Female Only		Male Only	
	Completion[ǂǂ]	Attempt ($\mu = 0.00680$)	Ideation ($\mu = 0.0948$)	Attempt ($\mu = 0.00810$)	Ideation ($\mu = 0.111$)	Attempt ($\mu = 0.00538$)	Ideation ($\mu = 0.0771$)
β	0.918	0.000149**	-0.000103	0.000107	-0.000175	0.000202*	-0.0000861
t	(-1.47)	(1.98)	(-0.40)	(1.03)	(-0.46)	(1.87)	(-0.26)
N	65,667	65,340	65,348	33,934	33,938	31,406	31,410

	White Only		Black Only		Asian Only		Hispanic Only	
	Attempt ($\mu = 0.00716$)	Ideation ($\mu = 0.0987$)	Attempt ($\mu = 0.00629$)	Ideation ($\mu = 0.0792$)	Attempt ($\mu = 0.00699$)	Ideation ($\mu = 0.104$)	Attempt ($\mu = 0.00691$)	Ideation ($\mu = 0.0908$)
β	0.000363***	0.0000333	0.0000310	-0.0000129	-0.000329	-0.0000717	0.000241	-0.00110
t	(2.73)	(0.09)	(0.34)	(-0.04)	(-1.39)	(-0.04)	(1.22)	(-1.63)
N	41,918	41,920	14,949	14,953	5,004	5,005	10,847	10,848

	Wave 1 Only		Wave 2 Only		Wave 3 Only		Wave 4 Only	
	Attempt ($\mu = 0.00956$)	Ideation ($\mu = 0.134$)	Attempt ($\mu = 0.00740$)	Ideation ($\mu = 0.107$)	Attempt ($\mu = 0.00517$)	Ideation ($\mu = 0.0591$)	Attempt ($\mu = 0.00421$)	Ideation ($\mu = 0.0663$)
β	0.000221	-0.0000735	0.000152	0.0000447	-0.0000659	-0.000785***	0.000337*	0.000591
t	(1.32)	(-0.14)	(0.89)	(0.07)	(-0.82)	(-2.61)	(1.93)	(1.29)
N	20,287	20,294	14,469	14,470	14,889	14,889	15,695	15,695

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

ǂ Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-IV. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies). T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

ǂǂ Completed suicide coefficients comes from Cox Proportional Hazard models, attempt and ideation coefficients come from OLS models

Table 5: Coefficients on Tract-Level Unemployment Rate from Regression Models With Endogenous, Individual-Level Controls[†]

Dep Var:	*Full Sample* Completion[††] (Cox)	Attempt ($\mu = 0.00680$)	Ideation ($\mu = 0.0948$)	*Female Only* Attempt ($\mu = 0.00810$)	Ideation ($\mu = 0.111$)	*Male Only* Attempt ($\mu = 0.00538$)	Ideation ($\mu = 0.0771$)
β	0.8914	0.0000817	-0.000443*	0.0000367	-0.000534	0.000133	-0.00042
t	(-1.47)	(1.09)	(-1.72)	(0.35)	(-1.39)	(1.23)	(-1.26)
N	65,667	65,340	65,348	33,934	33,938	31,406	31,410

Dep Var:	*White Only* Attempt ($\mu = 0.00716$)	Ideation ($\mu = 0.0987$)	*Black Only* Attempt ($\mu = 0.00629$)	Ideation ($\mu = 0.0792$)	*Asian Only* Attempt ($\mu = 0.00699$)	Ideation ($\mu = 0.104$)	*Hispanic Only* Attempt ($\mu = 0.00691$)	Ideation ($\mu = 0.0908$)
β	0.000254*	-0.000566	0.0000088	-0.00013	-0.000397	0.000232	0.000169	-0.00139**
t	(1.91)	(-1.48)	(0.09)	(-0.36)	(-1.62)	(0.14)	(0.85)	(-2.05)
N	41,918	41,920	14,949	14,953	5,004	5,005	10,847	10,848

Dep Var:	*Wave 1 Only* Attempt ($\mu = 0.00956$)	Ideation ($\mu = 0.134$)	*Wave 2 Only* Attempt ($\mu = 0.00740$)	Ideation ($\mu = 0.107$)	*Wave 3 Only* Attempt ($\mu = 0.00517$)	Ideation ($\mu = 0.0591$)	*Wave 4 Only* Attempt ($\mu = 0.00421$)	Ideation ($\mu = 0.0663$)
β	0.000161	-0.000307	0.000095	-0.000235	-0.0000878	-0.000846***	0.000205	-0.000245
t	(0.96)	(-0.57)	(0.56)	(-0.38)	(-1.08)	(-2.78)	(1.16)	(-0.53)
N	20,287	20,294	14,469	14,470	14,889	14,889	15,695	15,695

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, ****$p < 0.0001$

[†] Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-IV. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies), Household income category dummies, Employed, full-time employed, mother employed, father employed, mother full-time employed, father full-time employed. T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

[††] Completed suicide coefficients comes from Cox Proportional Hazard models, attempt and ideation coefficients come from OLS models

Table 6: Coefficients on Tract-Level Unemployment Rate from Regression Models With Endogenous Local Area Controls[†]

	Full Sample			Female Only		Male Only	
Dep Var:	Completion[††] (Cox)	Attempt ($\mu = 0.00680$)	Ideation ($\mu = 0.0948$)	Attempt ($\mu = 0.00810$)	Ideation ($\mu = 0.111$)	Attempt ($\mu = 0.00538$)	Ideation ($\mu = 0.0771$)
β	0.9387	0.0000982	-0.0000816	0.0000602	-0.000218	0.000148	0.0000653
t	(-0.93)	(1.14)	(-0.25)	(0.48)	(-0.45)	(1.28)	(0.16)
N	65,667	65,340	65,348	33,934	33,938	31,406	31,410

	White Only		Black Only		Asian Only		Hispanic Only	
Dep Var:	Attempt ($\mu = 0.00716$)	Ideation ($\mu = 0.0987$)	Attempt ($\mu = 0.00629$)	Ideation ($\mu = 0.0792$)	Attempt ($\mu = 0.00699$)	Ideation ($\mu = 0.104$)	Attempt ($\mu = 0.00691$)	Ideation ($\mu = 0.0908$)
β	0.000279*	-0.000242	0.0000294	-0.000173	-0.0000336	0.00204	0.000273	-0.00565
t	(1.9)	(-0.52)	(0.24)	(-0.36)	(-0.13)	(1.02)	(1.05)	(-0.62)
N	41,918	41,920	14,949	14,953	5,004	5,005	10,847	10,848

	Wave 1 Only		Wave 2 Only		Wave 3 Only		Wave 4 Only	
Dep Var:	Attempt ($\mu = 0.00956$)	Ideation ($\mu = 0.134$)	Attempt ($\mu = 0.00740$)	Ideation ($\mu = 0.107$)	Attempt ($\mu = 0.00517$)	Ideation ($\mu = 0.0591$)	Attempt ($\mu = 0.00421$)	Ideation ($\mu = 0.0663$)
β	0.000139	0.000903	0.000231	0.00158*	0.00000379	-0.000877**	0.000204	-0.000717
t	(0.51)	(1.07)	(0.87)	(1.68)	(0.05)	(-2.40)	(1.17)	(-1.31)
N	20,287	20,294	14,469	14,470	14,889	14,889	15,695	15,695

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, ****$p < 0.0001$

[†] Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-IV. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies), proportion of tract with college degree, proportion of tract in poverty, tract population density, adult arrests per 100,000 people in county, adult violent arrests per 100,000 people in county, tract median family income. T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

[††] Completed suicide coefficients comes from Cox Proportional Hazard models, attempt and ideation coefficients come from OLS models

Table 7: Coefficients on Tract-Level Unemployment Rate from Regression Models With Endogenous Individual-level and Local Area Controls†

Dep Var:	Full Sample: Completion‡ (Cox)	Full Sample: Attempt ($\mu = 0.00680$)	Full Sample: Ideation ($\mu = 0.0948$)	Female Only: Attempt ($\mu = 0.00810$)	Female Only: Ideation ($\mu = 0.111$)	Male Only: Attempt ($\mu = 0.00538$)	Male Only: Ideation ($\mu = 0.0771$)
β	0.9282	0.000095	-0.000103	0.0000628	-0.000215	0.000129	-0.00000378
t	(-0.89)	(1.1)	(-0.32)	(0.5)	(-0.44)	(1.11)	(0.01)
N	65,667	65,340	65,348	33,934	33,938	31,406	31,410

Dep Var:	White Only: Attempt ($\mu = 0.00716$)	White Only: Ideation ($\mu = 0.0987$)	Black Only: Attempt ($\mu = 0.00629$)	Black Only: Ideation ($\mu = 0.0792$)	Asian Only: Attempt ($\mu = 0.00699$)	Asian Only: Ideation ($\mu = 0.104$)	Hispanic Only: Attempt ($\mu = 0.00691$)	Hispanic Only: Ideation ($\mu = 0.0908$)
β	0.000246*	-0.000417	0.0000366	-0.000182	-0.00002	0.0021	0.00027	-0.000552
t	(1.68)	(-0.90)	(0.3)	(-0.38)	(-0.08)	(1.05)	(1.03)	(-0.60)
N	41,918	41,920	14,949	14,953	5,004	5,005	10,847	10,848

Dep Var:	Wave 1 Only: Attempt ($\mu = 0.00956$)	Wave 1 Only: Ideation ($\mu = 0.134$)	Wave 2 Only: Attempt ($\mu = 0.00740$)	Wave 2 Only: Ideation ($\mu = 0.107$)	Wave 3 Only: Attempt ($\mu = 0.00517$)	Wave 3 Only: Ideation ($\mu = 0.0591$)	Wave 4 Only: Attempt ($\mu = 0.00421$)	Wave 4 Only: Ideation ($\mu = 0.0663$)
β	0.000138	0.000869	0.000227	0.00156*	-0.0000006	-0.000906**	0.000181	-0.00078
t	(0.51)	(1.03)	(0.91)	(1.65)	(0.01)	(-2.46)	(1.03)	(-1.43)
N	20,287	20,294	14,469	14,470	14,889	14,889	15,695	15,695

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.0001$

† Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-IV. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies), Household income category dummies, Employed, full-time employed, mother employed, father employed, mother full-time employed, father full-time employed proportion of tract with college degree, proportion of tract in poverty, tract population density, adult arrests per 100,000 people in county, adult violent arrests per 100,000 people in county. T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

‡ Completed suicide coefficients comes from Cox Proportional Hazard models, attempt and ideation coefficients come from OLS models

Table 8: Coefficients from Regressing Self-reported Depression on Tract-Level Unemployment Rate†

	Exogenous Controls Only		Individual Endogenous Controls††		Local Area Endogenous Controls‡		Individual & Local Endogenous Controls	
Sample:	Full Sample (μ =0.0837)	Whites Only (μ = 0.0770)	Full Sample (μ = 0.0837)	Whites Only (μ = 0.0770)	Full Sample (μ = 0.0837)	Whites Only (μ =0.0770)	Full Sample (μ = 0.0837)	Whites Only (μ = 0.0770)
β	0.00113****	0.00214****	0.000441*	0.00120****	0.000343	0.000925**	0.000324	0.000684
t	(4.54)	(6.04)	(1.79)	(3.44)	(1.09)	(2.07)	(1.03)	(1.55)
N	66,381	42,490	66,381	42,490	65,666,38167	42,490	66,381	42,490

* p < 0.10, ** p < 0.05, *** p < 0.01, ****p < 0.0001 T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

† Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-IV. Dependent Variable: reported feeling depressed "a lot of the time" or "always" in the last 7 days. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies)

††Additional controls: Household income category dummies, Employed, full-time employed, mother employed, father employed, mother full-time employed, father full-time employed

‡Proportion of tract with college degree, proportion of tract in poverty, tract population density, adult arrests per 100,000 people in county, adult violent arrests per 100,000 people in county.

Table 9: Coefficients on Tract-Level Unemployment from Fixed Effects Regression Models†

	Full Sample		Female Only		Male Only	
Dep Var:	Attempt (μ = 0.00680)	Ideation (μ = 0.0948)	Attempt (μ = 0.00810)	Ideation (μ =0.111)	Attempt (μ =0.00538)	Ideation (μ =0.0771)
β	0.0000897	-0.000572**	-3.49*10^{-8}	-0.000655**	0.000188*	-0.000612**
t	(1.29)	(-2.48)	(0.00)	(-1.98)	(1.87)	(-2.00)
N	65,340	65,348	33,934	33,938	31,406	31,410

	White Only		Black Only		Asian Only		Hispanic Only	
	Attempt (μ =0.00716)	Ideation (μ = 0.0987)	Attempt (μ = 0.00629)	Ideation (μ = 0.0792)	Attempt (μ = 0.00699)	Ideation (μ =0.104)	Attempt (μ = 0.00691)	Ideation (μ = 0.0908)
β	0.000357***	0.0000351	0.00000197	-0.000147	-0.000441*	-0.0000835	0.000307	-0.000739
t	(2.66)	(0.10)	(0.02)	(-0.42)	(-1.96)	(-0.06)	(1.44)	(-1.19)
N	41,918	41,920	14,949	14,953	5,004	5,005	10,847	10,848

* p < 0.10, ** p < 0.05, *** p < 0.01, **** p < 0.001

† Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-IV. Controls: # People in Household (dummies), age (dummies). T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

Table 10: Coefficients from Regressing Suicide Ideation on County-Level Unemployment Rate[†]

	Exogenous Controls Only		Individual Endogenous Controls[††]		Local Area Endogenous Controls[‡]		Individual & Local Endogenous Controls	
Sample:	Full Sample (μ =0.103)	Whites Only (μ =0.109)	Full Sample (μ = 0.103)	Whites Only (μ = 0.109)	Full Sample (μ = 0.103)	Whites Only (μ =0.109)	Full Sample (μ = 0.103)	Whites Only (μ = 0.109)
β	-0.00103	-0.00136	-0.00129*	-0.00192**	0.00431****	0.00445***	0.00420****	0.00409***
t	(-1.45)	(-1.52)	(-1.80)	(-2.14)	(3.57)	(2.95)	(3.48)	(2.72)
N	49,855	31,584	49,855	31,584	49,855	31,584	49,855	31,584

* p < 0.10, ** p < 0.05, *** p < 0.01, ****p < 0.0001 T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

[†] Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-III. Dependent Variable: reported feeling depressed "a lot of the time" or "always" in the last 7 days. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies)

[††]Additional controls: Household income category dummies, Employed, full-time employed, mother employed, father employed, mother full-time employed, father full-time employed

[‡]Proportion of tract with college degree, proportion of tract in poverty, tract population density, adult arrests per 100,000 people in county, adult violent arrests per 100,000 people in county.

Table 11: Coefficients from Regressing Suicide Attempts on County-Level Unemployment Rate[†]

	Exogenous Controls Only		Individual Endogenous Controls[††]		Local Area Endogenous Controls[‡]		Individual & Local Endogenous Controls	
Sample:	Full Sample (μ =0.00768)	Whites Only (μ =0.00794)	Full Sample (μ =0.00768)	Whites Only (μ =0.00794)	Full Sample (μ =0.00768)	Whites Only (μ =0.00794	Full Sample (μ =0.00768)	Whites Only (μ =0.00794)
β	-0.000175	-0.000271	-0.00026	-0.000407*	0.00042	0.000368	0.00041	0.000305
t	(-0.92)	(-1.18)	(-1.37)	(-1.77)	(1.4)	(1.01)	(1.36)	(0.83)
N	49,847	31,582	49,847	31,582	49,847	31,582	49,847	31,582

* p < 0.10, ** p < 0.05, *** p < 0.01, ****p < 0.0001 T-scores are reported in parentheses. Rows designated by N indicate sample size for each model. Sample limited to respondents with non-missing tract-level independent variable and dependent variable. Dependent variable means are for sample with non-missing tract-level unemployment.

[†] Data: National Longitudinal Study of Adolescent to Adult Health, Waves I-III. Dependent Variable: reported feeling depressed "a lot of the time" or "always" in the last 7 days. Controls: female, white, black, asian, Hispanic, # People in Household (dummies), age (dummies), wave (dummies)

[††]Additional controls: Household income category dummies, Employed, full-time employed, mother employed, father employed, mother full-time employed, father full-time employed

[‡]Proportion of tract with college degree, proportion of tract in poverty, tract population density, adult arrests per 100,000 people in county, adult violent arrests per 100,000 people in county.