The Impact of Recessions on Suicide Mortality in the United States

S.Harper\textsuperscript{1}  T.Charters\textsuperscript{1}  E.Strumpf\textsuperscript{1,2}  A.Nandi\textsuperscript{1,3}

\textsuperscript{1}Epidemiology, Biostatistics & Occupational Health, McGill University

\textsuperscript{2}Economics, McGill University

\textsuperscript{3}Institute for Health and Social Policy, McGill University

Society for Epidemiologic Research, Boston, 20 June 2013
Sir Austin Bradford Hill’s “Reasons for Writing”

1. Why did you start?
2. What did you do?
3. What did you find?
4. What does it all matter, anyway?
Why Did You Start?
Suicide and the Economy

- Historical idea dates to Falrat (1822) Durkheim (1897)
- Focus on rapid social changes:
  - Greater social integration and regulation lowers suicide.
  - Economic booms and busts lead to social disintegration.

- More recent work by sociologists, economists, and epidemiologists:
  - Stress and insecurity during periods of economic uncertainty
  - Links to potentially buffering environments, social protections
  - But theorized as both pro-cyclical and counter-cyclical.
Recent Crises

Suicide Rates Rise Sharply in U.S.

By Tara Parker-Pope
Published: May 2, 2013 | 996 Comments

Suicide rates among middle-aged Americans have risen sharply in the past decade, prompting concern that a generation of baby boomers who have faced years of economic worry and easy access to prescription painkillers may be particularly vulnerable to self-inflicted harm.

Suicide rate rose sharply among middle-aged Americans, CDC finds

By Abosa Anosa Abrahamian
NEW YORK | Thu May 2, 2013 3:46am EDT

(Reuters) - The suicide rate among Americans aged 35 to 64 rose sharply between 1999 and 2010, a trend that could reflect the stresses of a sharp economic downturn as well as other traditionally overlooked challenges of middle age, according to a federal report released on Thursday.

Austerity Sparks Suicides When Recession Hits: Cutting Research

By Simon Kennedy - May 2, 2013 7:00 PM ET

Recessions and austerity are proving deadly.

In a book to be released this month, professors David Stuckler and Sanjay Basu say suicide rates in both the U.S. and the U.K. increased after the end of 2007, which marked the beginning of the recession in the U.S. They calculate there were 4,750 “excess” suicides during the slump in the U.S., compared with average rates before the recession. For the U.K., they estimate a 1,000-suicide rise.

THE BODY ECONOMIC
WHY AUSTERITY KILLS

RECESSIONS, BUDGET BATTLES, AND THE POLITICS OF LIFE AND DEATH

DAVID STUCKLER, MPH, PhD
SANJAY BASU, MD, PhD
Previous Work on Great Recession

- Reeves et al. extrapolated linear secular trends 1999-2007
- Compared observed vs. expected suicide deaths 2007-2010
- Estimate 1330 suicides attributable to Great Recession

Reeves et al., *Lancet* (2012)
Limitations of Previous Work

- **Unmeasured confounding:**
  - Inadequate accounting for secular trends.
  - Seasonality.
  - Unmeasured state characteristics.

- **Measurement error:**
  - Prior studies use only GDP or unemployment.
  - May not capture more systemic changes in economic conditions.

- **Heterogeneity of effects by social group:**
  - Prior use of overall suicide rate may mask heterogenous effects.
  - No prior studies have assessed socioeconomic differences.
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What Did You Do?
Data and Definitions

Data Sources:

- Detailed Mortality Files, 1980-2010
  - Deaths for each state and month
- ICD coding
  - ICD-9: E950-959, ICD-10: X60-X84, Y87.0.
  - ICD-9 to-10 comparability ratio=0.996.
  - Have to assume consistency across states.
- Population Estimates
  - Census (1980-2010)
  - Interpolation for monthly estimates in some small states.
Demographic Groups

- **Age**
  - 15-24 years
  - 25-44 years
  - 45-64 years
  - 65+ years

- **Gender**
  - Male, Female

- **Race**
  - White, Non-White

- **Education (45 states, 1994 forward):**
  - 12 years
  - 12+ years
Methods: Measuring Economic Conditions

State Index of Coincident Economic Indicators [Crone 2005]

1. Private sector employment:
   - Does not capture self-employed or farmworkers.

2. Unemployment rate:
   - Broad index of employment conditions.

3. Average weekly work hours of manufacturing workers:
   - Indicator of industrial activity.

4. Real wage and salary disbursements:
   - Major component of personal income.

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Modeling Suicide Mortality Trends

Assume suicides follow a Poisson distribution $y_{st} \sim Poisson(\mu^*_{st})$, but that the variance is overdispersed (negative binomial).

$$\mu^*_{sta} = \exp(\alpha + \beta ICEI_{st} + \sigma_s + \tau_t + X_{sta} + \ln(pop_{sta}) + \varepsilon_{st})$$

- $ICEI_{st}$ = level of economic conditions in state $s$ at time $t$.
- $\sigma_s$ is a fixed effect (i.e., a dummy variable) for each state.
- $\tau_t$ is a fixed effect for each period of observation (quarterly).
- $X_{sta}$ is a vector of demographic covariates group $a$ in state $s$ at time $t$.

- Fixed effects for state control for any time-invariant state characteristics.
- Fixed effects for time control for any common secular trends.
- Robust standard errors, clustered at state level.
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Basic Idea of Using Fixed Effects Models

▶ Why are state fixed effects important?
  ▶ Large regional variations in US suicide rates
  ▶ States with worse economic conditions may have high suicide rates for other reasons.

▶ Why are time fixed effects important?
  ▶ Strong national secular trend in suicide.
  ▶ Don’t want to mistakenly attribute these to changes in economic conditions.

▶ Using within-state changes in economic conditions, relative to changes in other states.
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Fixed Effects Assumptions

- There are no variables that are:
  - Omitted from the regression AND
  - Correlated with economic conditions AND
  - Correlated with suicide rates AND
  - Are time-varying

- Omitted variables could still be problematic.
  - But we have hopefully eliminated a substantial portion of potential problems
  - Applies also to effect measures modification by demographic groups.
What Did You Find?
Average state ICEI and recessions

Shaded areas indicate recessionary periods as defined by the National Bureau of Economic Research.
During the Great Recession, ICEI drops from 160.8 to 148.1.

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Crude monthly suicide trends

Loess-smoothed conditional means (bandwidth=0.25). Shaded areas indicate recessionary periods.
Crude monthly suicide trends by age

Loess-smoothed conditional means (bandwidth=0.25). Shaded areas indicate recessionary periods.
Crude monthly suicide trends by gender

Loess-smoothed conditional means (bandwidth=0.25). Shaded areas indicate recessionary periods.
Crude monthly suicide trends by race

Loess-smoothed conditional means (bandwidth=0.25). Shaded areas indicate recessionary periods.
Loess-smoothed conditional means (bandwidth=0.25). Shaded areas indicate recessionary periods.
### Results of Fixed Effect Models (Marginal Effects)

<table>
<thead>
<tr>
<th></th>
<th>Incidence Rate Difference per 100,000 (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td><strong>ICEI (10pts)</strong></td>
<td>0.15 (0.1, 0.3)</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>-16.1 (-17.1, -15.1)</td>
</tr>
<tr>
<td>Non-White</td>
<td>-8.3 (-9.2, -7.4)</td>
</tr>
<tr>
<td>Age (ref. 15-24)</td>
<td></td>
</tr>
<tr>
<td>25-44</td>
<td>3.2 (2.9, 3.5)</td>
</tr>
<tr>
<td>45-64</td>
<td>3.5 (2.9, 4.1)</td>
</tr>
<tr>
<td>65 +</td>
<td>5.2 (4.3, 6.2)</td>
</tr>
<tr>
<td><strong>Controls</strong></td>
<td></td>
</tr>
<tr>
<td>Demo</td>
<td>No</td>
</tr>
<tr>
<td>Quarter FE</td>
<td>No</td>
</tr>
<tr>
<td>State FE</td>
<td>No</td>
</tr>
<tr>
<td>SS Trends</td>
<td>No</td>
</tr>
</tbody>
</table>

Negative binomial regression. Robust standard errors, clustered at state level.
Demographic Group-specific Effects (10pt ΔICEI)

Models include state/time fixed effects and 2-way interactions with demographic group.
Heterogeneity by education group

Models include state/time fixed effects and 2-way interactions with demographic group.
Are the effects causal?

Are they important?
“Negative Control”: Cancer Mortality

- Immediate effects less plausible for cancer.
- We find little evidence for any impact:

<table>
<thead>
<tr>
<th>Period</th>
<th>Incidence Rate Difference (95% CI)</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 4</td>
</tr>
<tr>
<td>1980-2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICEI (10pts)</td>
<td>6.6 (5.4, 7.8)</td>
<td>9.3 (8.1, 10.5)</td>
<td>1.0 (-1.7, 3.8)</td>
<td>1.0 (-0.8, 2.6)</td>
<td></td>
</tr>
<tr>
<td>1994-2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICEI (10pts)</td>
<td>12.6 (7.2, 18.1)</td>
<td>11.1 (7.0, 15.1)</td>
<td>5.4 (1.3, 9.5)</td>
<td>-0.1 (-2.8, 2.6)</td>
<td></td>
</tr>
</tbody>
</table>

Controls
- Demographics: No, Yes, Yes, Yes
- Quarter FE: No, No, Yes, Yes
- State FE: No, No, Yes, Yes
- State linear trends: No, No, No, Yes
## Scale of Effects: Potential “Extra” Deaths

- How many extra deaths might be due to worsening economic conditions?

- Estimated rates and differences during the Great Recession:

<table>
<thead>
<tr>
<th>Group</th>
<th>Suicide rate per 100,000 (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-2010</td>
<td>ICEI=160</td>
</tr>
<tr>
<td>Ages 15+</td>
<td>12.96</td>
</tr>
</tbody>
</table>

Estimated for population of 250 million (ages 15+).

### Comparison with Annual Seasonal Fluctuations:

<table>
<thead>
<tr>
<th>1980-2010</th>
<th>Winter</th>
<th>Spring</th>
<th>Difference (95% CI)</th>
<th>Deaths (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ages 15+</td>
<td>13.09</td>
<td>14.31</td>
<td>1.22 (1.09, 1.35)</td>
<td>3050 (2728, 3371)</td>
</tr>
</tbody>
</table>

Estimated for population of 250 million (ages 15+).
Are things different during recessions?

“the size and (sometimes) the significance of the increase in suicide rates...tend to be greater in the context of “massive” increases in unemployment.” [Shruke and Stuckler, 2012]

We fit additional models allowing for effect measure modification by state recessionary periods:

<table>
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<tbody>
<tr>
<td>ICEI=160</td>
<td>12.73 (11.7,13.8)</td>
<td>12.95 (11.9,14.0)</td>
<td>0.22 (0.13, 0.31)</td>
<td></td>
</tr>
<tr>
<td>ICEI=150</td>
<td>12.93 (12.0,13.9)</td>
<td>13.14 (12.2,14.1)</td>
<td>0.20 (0.11, 0.30)</td>
<td></td>
</tr>
</tbody>
</table>

Adj. for demographics, state/year FE, state-specific time trends.
Summary of Results

- Negative changes in economy affect suicide rates.
- Heterogeneity by social group. Mortality increases concentrated among:
  - Whites
  - Men
  - Low-educated (strongest contrast)
- Scale of effects:
  - We estimate around 300 “extra” deaths.
  - Substantially fewer than prior investigations (~1000-1500).
- No differential effects of economic conditions during recessionary periods.
What does it all mean, anyway?
Final Thoughts

- Effects of changes in economic conditions are statistically detectable, but relatively weak.
- Larger social and economic trends (risk factors, access to means to complete suicide, policy) may be stronger determinants of changes in suicide rates.
- Important challenges in modeling economic conditions.
- Future work on lags, other geographic areas.
Thank You!

sam.harper@mcgill.ca