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Unemployment and Mortality

Evidence from the Great Recession

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Abstract

Did unemployment in the Great Recession hurt people's health? The broad answer is no: job losses have statistically insignificant impacts on mortality. The exogenous sources of job losses in a U.S. county is the tradable job losses driven by external demand collapses during the Great Recession. The insignificant relationship holds for males and females, for all age groups, and for almost all categories of mortality. Three important exceptions are Alzheimer's, poisoning, and homicide.

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UNEMPLOYMENT AND MORTALITY:

EVIDENCE FROM THE GREAT RECESSION

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I. INTRODUCTION

The Great Recession is the most serious and painful economic downturn in the world economic history since the 1930s. Aggregate unemployment reached as high as 10% in the U.S. It is important to understand the causes and impacts of unemployment in the recession. In this paper, we focus on its health impact: did unemployment in the Great Recession create adverse health problems in the population?

The question is relevant, as temporary financial and psychological tensions from job losses could lead to more permanent damages, such as family fighting, divorces and stress-induced health issues. These could have lasting impacts on adults, and more importantly, on children. Furthermore, tensions could have repercussions on unemployment itself. Health issues, and more broadly, social instability, crime and community deterioration could discourage future employers and entrepreneurs to settle, establish businesses and create jobs. If the social cost channels of unemployment are indeed operative, this provides the basis for the government to combat unemployment and assist vulnerable groups before unemployment-induced social problems take root.

Establishing a causal relationship between unemployment and health is inherently difficult, because of the endogeneity problem. We are generally unsure if unemployment causes or is caused by deteriorating health. In addition, omitted variables can be problematic: a third factor can drive both unemployment and health. For example, the Great Recession was characterized by a great house price collapse that led to a vast number of foreclosures. This might have degraded health conditions and hurt construction jobs at the same time. In that case, both health and job losses are driven by the house price collapse.

To add to the complexity, while health is commonly thought to worsen during recessions, findings have surprisingly been mixed. Ruhm (2000, 2015a) are among the most prominent studies on this topic. They showed that recessions are actually good for health: health improves when the economy temporarily deteriorates. Ruhm (2000) used panel data for 50 states in the U.S. and D.C. and found consistently that most causes of deaths are actually pro-cyclical. He provided four reasons for this pro-cyclicality, which we will go into in detail in the literature review. That trend, however, has attenuated over time (Ruhm, 2015a).

This paper overcomes the identification difficulty by using a Bartik instrument. As will be clearer in the identification strategy section, the Bartik instrument captures *a county's tradable job losses that are only driven by declines in U.S. tradable aggregate demand*, and not by county-specific issues. Since there are more than 3,000 counties in the U.S, the U.S.'s tradable aggregate demand is largely exogenous to a county, that is, it is little affected by county-specific fundamentals. This implies that reverse causality and county-specific omitted variable problems, such as productivity shocks, are not likely at play.

Using demand-driven tradable job losses as an instrument for total job losses in a county, we examine the impacts of unemployment on different types of mortality. We find that when county-characteristics control variables are included, unemployment has statistically insignificant impacts on mortality. In other words, aggregate mortality in a county is not significantly affected by the county's job losses, *ceteris paribus*. This is consistent with Ruhm (2015a), where he found that mortality is becoming acyclical in recent years.

When disaggregating mortality by types, we find that most types of mortality have statistically insignificant relationship with unemployment. The only exceptions are Alzheimer's, poisoning, and homicide. We find that while unemployment increases mortality by Alzheimer's and poisoning, it decreases homicide.

Unemployment seems to have no impact on either males or females, and for most age groups. The only exception is the 25-34 age group. We find that mortality of the 25-34 displays a clear negative relationship with unemployment. In other words, during the Great Recession, counties that have higher job losses actually have smaller numbers of deaths in the 25-34 age group. We will discuss the potential reasons for this phenomenon in section 4.

This paper is organized as follows: Section 2 provides a literature review; section 3 details our methodology and data sources; section 4 presents our regression analyses; section 5 discusses robustness checks and the possibility of reverse causation. Finally, section 6 concludes.

2. Literature review

The cyclicality of health persists as a topic of much debate. Brenner (1973, 1975, and 1979) in his seminal analyses on the issue, concluded that health deteriorates in economic downturns. The author hypothesized that physical and mental health worsen due to increasing stress and risk-taking (leading to medication with alcohol or legal and illegal drugs). However, this finding has been reputed and criticized on statistical grounds in subsequent studies (see Wagstaff, 1985 for a survey). Subsequent studies, such as Forbes and McGregor (1984), Joyce and Mocan (1993), after correcting for the problems, no longer find that health is pro-cyclical.

More recently, Christopher Ruhm has a series of works on the cyclicality of health (Ruhm 2000, 2005, 2015a, 2015b). Ruhm (2000) used a fixed effects model with state-level data from the U.S.'s 50 states and District of Columbia to control for states' unobservable heterogeneity. The author found that surprisingly, health –measured by mortality- improves in recessionary periods, with one important exception of suicide. However, his most recent paper (Ruhm, 2015a) found that the relationship has weakened in recent years. Total mortality has shifted over time from being strongly pro-cyclical to essentially unrelated to macroeconomic conditions.

Ruhm (2000) provided four reasons why health could worsen in good times. Health could be an input into the production of goods and services. What this means is in boom times, people have to work more, which is not necessarily healthy. Certain risky activities, as well as smoking and drinking may increase in good times. For example, Ruhm (2005) found that obesity and smoking both exhibit pro-cyclical pattern, and diet and exercise also improves when unemployment rises. In addition, in-migration to booming areas has the potential to raise death rates if the new migrants import diseases, or if they are unfamiliar with roads or the medical infrastructure. There may also be other unexplored pathways through which this phenomenon occurs. For example, Stevens et al (2015) offered an explanation for the pro-cyclicality of mortality: quality of health care can be counter-cyclical. Particularly, they found that most additional deaths that occur when the economy is strong are among the elderly, particularly those residing in nursing homes. This is because staff in nursing homes tend to move in good times to look for better opportunities.

Neumayer (2000) replicated Ruhm's framework and found similar results for Germany in 1980-2000. Controlling for state-specific effects, the author found evidence that total mortality and mortality for all age groups were pro-cyclical, as well as mortality from cardiovascular diseases, pneumonia and influenza, motor vehicle accidents and suicides. However, the research found no statistically significant effect on homicides, other external effects (transport accidents, accidental poisoning, fires, late effects of accidental injury, other accidents and adverse effects in therapeutic uses) and cancer. There were also few differences apparent between the effect on male and female mortality. Granados and Ionides (2008) found that economic growth is positively associated with health progress in Sweden throughout the 19th century, however, its cyclicality is completely reversed in the second half of the 20th century, when economic growth negatively affects health progress. Studies applying Ruhm's (2000) framework also established pro-cyclical relationships between mortality and unemployment in other countries (for example, Gerdtham & Ruhm (2006) for OECD countries, Lin (2009) for Pacific-Asian countries, Gonzalez and Quast (2011) for Mexico, Ariizumi and Shirle (2012) for Canada).

On the other hand, some studies found no impacts of unemployment on health. Schmitz (2011) used the German Socio-Economic panel of 1991-2008 and relied on fixed-effects methods and plant closures to establish causality. The author found no negative effect of unemployment due to exogenous unemployment. Similarly, Salm (2009) used business closure to control for reverse causality, and found no causal effect of job loss on various measures of physical and mental health.

Others have found some components of health to deteriorate during economic downturns. Ettner (1997) discovered that non-employment increased alcohol consumption and dependence symptoms. Sullivan and von Wachter (2009) established that individuals who experience a job loss via a mass-layoff experience a substantial increase in their mortality hazard that persists for 20 years. Ruhm (2015a) also found that deaths due to poisoning are counter-cyclical.

While the literature has mostly focused on a time-series relationship between unemployment and mortality, our identification strategy allows us to explore the cross-section relationship between unemployment and mortality across U.S. counties. With this approach, we can analyze the impact of unemployment on health during the Great Recession- a topic of great interest.

Finally, our paper is also related to the literature that utilizes the Bartik instrument. The instrument was first developed by Bartik (1991) to isolate exogenous shifts in labor demand in a local community. Therefore, the instrument is sometimes referred to as Bartik instrument. The instrument is used later by Blanchard and Katz (1992), Autor and Duggan (2003), Luttmer (2005), Wolzinak (2010), and Bertrand et al. (2015), among others.

3. METHODOLOGY AND DATA

3.1 Identification Strategy

To instrument for a county's total job losses, we use the Bartik instrument (Bartik, 1991) as a county's exogenous source of job losses. The Bartik instrument captures tradable job losses driven by aggregate demand, and not by county specific supply issues. Therefore, reverse causality and potential county specific omitted variable problems, such as productivity shocks or higher minimum wages, are not likely at play. To see the relationship between a county's job losses and the Bartik instrument, consider the total job losses of county *c*,

$$\Delta\log(l_c) \approx \frac{l_{c,2007} - l_{c,2010}}{l_{c,2007}} = \sum_{i}^{All}\left(\frac{l_{c,2007}^{i}}{l_{c,2007}} \times \frac{l_{c,2007}^{i} - l_{c,2010}^{i}}{l_{c,2007}^{i}}\right)$$

where $l_{c,t}$ is employment in county *c* at time *t;* $l_{c,t}^{i}$ is industry *i*'s employment in county *c* at time *t*. A positive number of $\frac{l_{c,2007}-l_{c,2010}}{l_{c,2007}}$ implies job losses.

We split the job losses to those in tradable industries (T), and those in the remaining economy.

$$\Delta\log(l_c) = \sum_{i}^{T}\left(\frac{l_{c,2007}^{i}}{l_{c,2007}} \times \frac{l_{c,2007}^{i} - l_{c,2010}^{i}}{l_{c,2007}^{i}}\right) + \sum_{i}^{Others}\left(\frac{l_{c,2007}^{i}}{l_{c,2007}} \times \frac{l_{c,2007}^{i} - l_{c,2010}^{i}}{l_{c,2007}^{i}}\right)$$

$$\approx \sum_{i}^{T}\left(\frac{l_{c,2007}^{i}}{l_{c,2007}} \times \Delta\log l_{c}^{i}\right) + \sum_{i}^{Others}\left(\frac{l_{c,2007}^{i}}{l_{c,2007}} \times \Delta\log l_{c}^{i}\right)$$

where $\sum_{i}^{T}\left(\frac{l_{c,2007}^{i}}{l_{c,2007}} \times \Delta\log l_{c}^{i}\right)$ are the job losses of all tradable industries in county *c* (as a fraction of the county's total employment).

Tradable job losses $\sum_i^T \left(\frac{l_{c,2007}^i}{l_{c,2007}} \times \Delta \log l_c^i\right)$ might not be exogenous to a county's fundamentals. For example, health deterioration, labor supply issues (such as a rise in minimum wages) or changes in regulations in a county could affect tradable employment in that county. The Bartik instrument captures only change in tradable job losses driven by changes in aggregate demand. To see this, rewrite tradable job losses $\sum_i^T \left(\frac{l_{c,2007}^i}{l_{c,2007}} \times \Delta \log l_c^i\right)$ as:

$$\sum_i^T \left(\frac{l_{c,2007}^i}{l_{c,2007}} \times \Delta \log l_c^i\right) = \sum_i^T \left(\frac{l_{c,2007}^i}{l_{c,2007}} \times \Delta \log l_{USA}^i\right) + \left\{\sum_i^T \left(\frac{l_{c,2007}^i}{l_{c,2007}} \times (\Delta \log l_c^i - \Delta \log l_{USA}^i)\right)\right\}$$

The first term, $\sum_i^T \left(\frac{l_{c,2007}^i}{l_{c,2007}} \times \Delta \log l_{USA}^i\right)$, is the Bartik instrument. It is the sum of all individual Bartik instruments of all tradable industries. For each industry *i*, it is the product of the county's pre-existing exposure to the sector, $\frac{l_{c,2007}^i}{l_{c,2007}}$, and the national job losses of the industry's employment, $\Delta \log l_{USA}^i = \log\left(l_{USA,2007}^i\right) - log\left(l_{USA,2010}^i\right)$. We interpret $\Delta \log l_{USA}^i$ as change in industry *i's* aggregate demand. Since there are more than 3000 counties in the U.S., the aggregate demand changes are not affected by a county's fundamentals. A positive Bartik instrument implies demand-driven tradable job losses.

The only situation that an industry's Bartik instrument might not be exogenous to a county is when production of that industry is heavily concentrated in one county. In that case, $\Delta \log l_{USA}^i$ could be influenced by county *c*-industry *i* specific supply issues. We examine such possibility among 61,714 county-industry pairs in 2007 and do not find it to be problematic. The average concentration of an industry in a county in 2007 is very small, at 0.013%. The only two pairs with more than 20% of national employment concentrated in one county are *cut and sew apparel manufacturing* in Los Angeles, CA (33.9%), and *railroad rolling stock manufacturing* in Erie, Pennsylvania (23.2%). Therefore, generally, the tradable Bartik instrument is exogenous to a county.

Armed with the Bartik instrument, we run a two-stage least square regression, where we regress change in a mortality **y** of county *c*, against the county's total job losses (as a fraction of pre-crisis population), instrumented by tradable job losses.

$$\log(D_{c,after}) - log(D_{c,before}) = c + \beta_2\ Instr.Job\ Losses + \ control_c + \varepsilon_c \quad (2)$$

The first stage regression will be as follows:

$$log(l_{c,2007}) - log(l_{c,2010}) = \ c + \gamma\ Bartik + control_c + \varepsilon_c \ (3)$$

The dependent variable is the log change in mortality ($D_{c,t}$) in a county *c*. This measure captures the percentage change of mortality within a county. The use of log is intended to be consistent with the literature (see Ruhm, 2000 for example). Since there is little evidence of emigration during the Great Recession (Mian and Sufi, 2014), population is relatively constant and thus we are reasonably confident that the log change of mortality captures a county's mortality problems. The explanatory variable is the log change of total employment in county c: $log(l_{c,2007}) - log(l_{c,2010})$. Positive numbers imply job losses, and negative numbers imply job gains.

Total job losses are instrumented by the Bartik instrument (equation 3). Tradable job losses could affect total job losses because they could spill-over to job losses in other sectors, via aggregate demand effects (Nguyen, 2015). For example, laid-off RV workers could cut back on shopping and restaurant meals, which hurts the local retail and restaurant sectors. Alternatively, tradable job losses could hurt local supporting sectors via production linkages (Nguyen and Rezaei, 2015). Job losses could be driven by a labor-unrelated transmission mechanism, such as a local credit crunch induced by tradable job losses. Therefore, the instrumented total job losses is intended to capture all types of job losses driven by the initial rounds of tradable job losses.

Finally, note that all regressions in this paper are weighted by each county's number of households, and standard errors are clustered at the state level.

3.2 Data

The primary source of our data is the Census Bureau. We use employment data in March 2007 and March 2010 from the County Business Pattern (CBP) data set, because these dates represent the lowest and highest points of the US aggregate unemployment rate during the Great Recession. This data comes with flags representing employment ranges, which we replace with average employment values. We follow Mian and Sufi (2014)'s classification of the tradable sector based on global trade data: a 4-digit NAICS industry is defined as tradable if it has imports plus exports equal to at least $10,000 per worker, or if total exports plus imports exceed $500M. Table 3.2 shows that tradable jobs on average account for 14.5% of a country employment. During the Great Recession tradable jobs suffered devastatingly: their employment shrank by about 19%. The average Bartik instrument takes the value of 0.0271. This means that demand-driven tradable job losses account for about 2.71% of total 2007 employment.

We use data from the United States Department of Health and Human Services (US DHHS) Centers for Disease Control and Prevention (CDC) WONDER online database to construct our dependent variables. The dependent variable is the log difference in the number of deaths between 2008-2010 and 2005-2007 periods. While single-year numbers are more straightforward, there are not enough observations to yield meaningful analyses at the disaggregated level (by types of mortality and age groups). Thus, we resort to 3-year totals, which we extract from the CDC WONDER database (2005-2007 instead of 2007, 2008-2010 instead of 2010). The idea is to capture the difference between the number of mortality during the Great Recession and that before the Great Recession. Hence the dependent variable measure is $log(D_{c,2008-2010}) - log(D_{c,2005-2008})$. Table 3.2 indicates that on average, mortality increased about 1.38% between the two periods.

Table 3.2: Summary Statistics:

	N	Mean	SD	10th percentile	90th percentile
Tradable employment/Employment, 2007	3079	0.1456	0.1065	0.0314	0.2880
log($l_{c,2007}$)-log($l_{c,2010}$)	3135	0.0727	0.1124	-0.4629	0.1924
log($l_{c,2007}^{Tradable}$)- log($l_{c,2010}^{Tradable}$)	3048	0.1903	0.4073	-0.1328	0.6092
Bartik	3128	0.0271	0.0267	0.0035	0.0602
Mortality Rate, 2005-07	3132	0.0100	0.0026	0.007	0.0132
Change in log of Mortality	3130	0.0138	0.0868	-0.083	0.107
Housing supply elasticity	868	2.5090	1.3488	1.0591	4.0038
Fraction white	3135	0.8700	0.1502	0.6583	0.9883
Median Household Income	3135	35,597	9,147	26,312	46,608
Median Home Value	3135	82,862	45,629	45,378	127,121
Home Owner	3135	0.7406	0.0754	0.6432	0.8182
Education - Less than High school	3135	0.2257	0.0871	0.1258	0.3497
Education - High school diploma	3135	0.3471	0.0657	0.2640	0.4290
Unemployment Rate	3135	0.0582	0.0273	0.0300	0.0907
Poverty rate	3135	0.1415	0.0645	0.0726	0.2261
Fraction Urban	3135	0.3932	0.3088	0.0000	0.8461

Finally, we use Mian and Sufi (2014)'s data in several of our regressions. Most notably, we use several variables as pre-crisis controls: household leverage, fraction of white population, median household income, fraction of homes occupied by owners, fraction of population with less than high school diploma, fraction of population with only high school diplomas, unemployment rate, poverty rate, and fraction of urban population.

4. RESULTS

4.1 OLS relationship between unemployment and mortality

Before analyzing the causal relationship between unemployment mortality, it is useful to examine the simple, OLS relationship between unemployment and mortality. Table 4.1 shows that job losses are negatively correlated with mortality. In other words, counties with higher job losses have lower increases in mortality during the Great Recession. Note that this relationship does not infer causality, but only represents an association between unemployment and mortality. Many channels could be at play here. First is reverse causality: unemployment could affect mortality as we discussed in the literature review. Second, a county's mortality could affect the county's labor supply and hence the equilibrium unemployment. Finally, a third factor, such as house price collapse, could affect both unemployment and mortality at the same time.

The control variables include important pre-crisis county's characteristics, such as fractions of different age groups, income, education, poverty and urbanization. The most noteworthy control variable is household leverage in 2006. This represents how leveraged an average household in that county was before the Great Recession. Mian and Sufi (2014) show that pre-crisis household leverage is strongly correlated to the declines in households' consumption and job losses in non-tradable industries, such as retails and restaurants. This is because highly leveraged counties had to cut back their consumption during the Recession, which hurts local service sectors. We have to control for household leverage because non-tradable job losses could affect mortality as well.

Table 4.1: OLS relationship between job losses and mortality

VARIABLES	Δ Log (Mortality)	
Total Job Losses	-0.00154	-0.0632**
	(0.0698)	(0.0306)
Leverage 2006	0.000928	-0.00416
	(0.00718)	(0.00342)
Age 25-44, fraction		-5.90e-09
		(5.45e-09)
Age 45-54, fraction		-0.634**
		(0.282)
Age 55-64, fraction		0.394
		(0.300)
Age 65-74, fraction		0.424
		(0.469)
Age 75-85, fraction		-0.338
		(0.682)
Age over 85, fraction		-3.880***
		(0.776)
Fraction Female		1.322
		(1.185)
Unemployment Rate		-0.0451
		(0.149)
Fraction White		0.0705***
		(0.0223)
Median HH Income		-6.07e-07**
		(2.35e-07)
Fraction home-ownership		0.122***
		(0.0332)
No HS Diploma		-0.0726*
		(0.0362)
HS Diploma		-0.166***
		(0.0471)
Poverty Rate		-0.204**
		(0.0850)
Fraction Urban		-0.0151
		(0.0128)
Constant	0.00972	0.102**
	(0.0151)	(0.0402)
Observations	2,219	2,219
R-squared	0.000	0.445

Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

4.2 Instrumental relevance

Before proceeding to the main IV results, we would like to discuss the first-stage relationship between tradable job losses (as a fraction of population) and total job losses (as a fraction of population). As Table 4.2 shows, tradable job losses is a strong predictor of total employment losses. The coefficient of 1.109 is greater than 1, implying that tradable job losses did spill-over to other sectors, making the total induced job losses larger than the exogenous tradable job losses. 1.109 means that every 100 demand-driven tradable job losses cause another 10.9 lost jobs in the rest of the economy. Note that we restrict the sample of the first-stage regression to match the sample of the second-stage regression. F-statistics of the regression is 59.14, indicating a strong relationship between the instrumental and instrumented variables. Also note that pre-crisis household leverage has a strong impact on job losses during the Recession. Figure 4.2 highlights this relationship, where total job losses are plotted against the Bartik instrument, after other variables are controlled for. The relationship is robust and does not depend on any set of counties.

Figure 4.2: Partial Regression Scatterplot

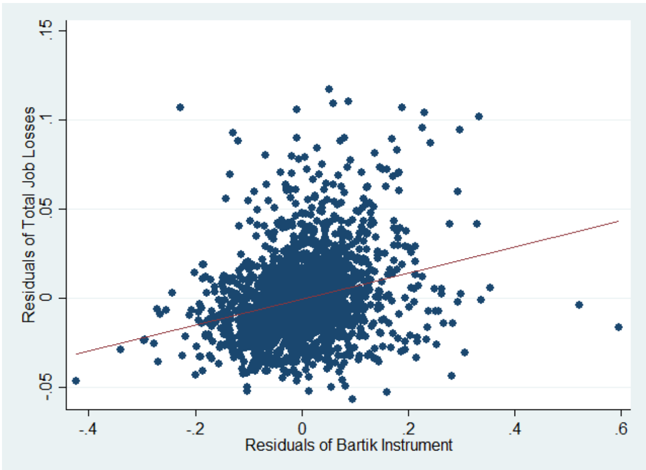

Table 4.2: First stage regression

VARIABLES	Total Job Losses	
Bartik	1.198***	1.109***
	(0.112)	(0.105)
Leverage 2006	0.0397***	0.0374***
	(0.00563)	(0.00450)
Age 25-44, fraction		-3.71e-09
		(7.03e-09)
Age 45-54, fraction		-0.764**
		(0.302)
Age 55-64, fraction		1.165***
		(0.397)
Age 65-74, fraction		-1.063**
		(0.441)
Age 75-85, fraction		1.277**
		(0.522)
Age over 85, fraction		-1.351
		(0.810)
Fraction Female		0.290
		(1.287)
Unemployment Rate		-0.0252
		(0.174)
Fraction White		-0.0443*
		(0.0229)
Median HH Income		-6.06e-07*
		(3.24e-07)
Fraction home-ownership		0.118***
		(0.0369)
No HS Diploma		0.0600
		(0.0527)
HS Diploma		-0.0268
		(0.0850)
Poverty Rate		-0.153
		(0.0925)
Fraction Urban		0.0286**
		(0.0138)
Constant	-0.0231*	-0.0219
	(0.0119)	(0.0519)
F-statistics	62.59	59.14
Observations	2,219	2,219
R-squared	0.231	0.281

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.3 Baseline results

This section presents the baseline results regarding the effect of unemployment on mortality during the Great Recession. Table 4.3a presents the reduced form and IV regressions, respectively. In both cases, they show that unemployment causes higher total mortality, but the relationship is not robust to county-characteristics control variables. The control variables are pre-crisis county characteristics and household leverage. The weak significance for household leverage reveals that highly leveraged counties did not see a drop in total mortality. Figure 4.3 shows the scatter plot between the instrumented total job losses and change in mortality, after all other variables are controlled for. Panel 4.3(a) shows the whole sample, while panel 4.3(b) shows the sample without six potential outliers. In both cases, it is clear that there is no relationship between the instrumented job losses and mortality. Table 4.3b shows the IV regressions without the six potential outliers. This will be the sample we work with for the rest of the paper.

Figure 4.3: Scatterplot of Mortality and Instrumented Total Job Losses

(a) Full sample (b) Without outliers

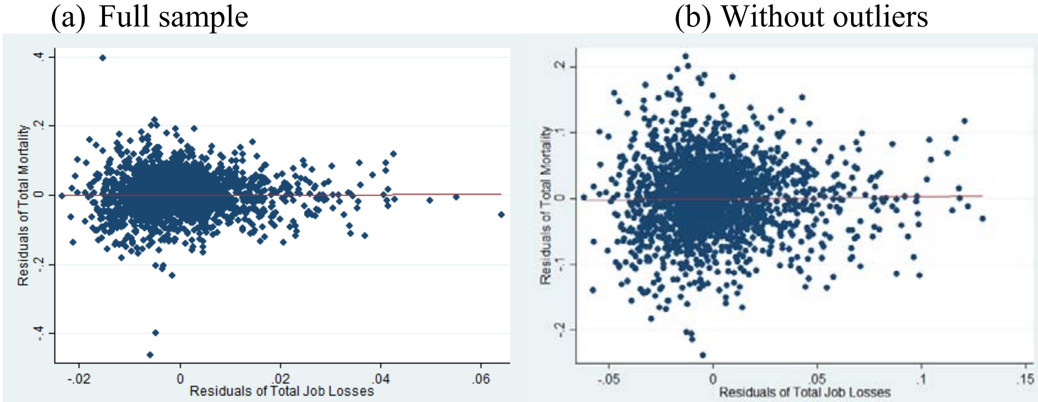

Table 4.3a: Total Mortality and Tradable Job Losses (Full sample)

	Δ Log (Total Mortality)			
VARIABLES	Reduced Form		IV	
Bartik	0.296**	0.0188		
	(0.140)	(0.0525)		
Total Job Losses			0.248**	0.0169
			(0.118)	(0.0471)
Leverage 2006	0.00298	-0.00621	-0.00684	-0.00685*
	(0.00854)	(0.00412)	(0.00589)	(0.00415)
Age 25-44, fraction		-5.96e-09		-5.90e-09
		(5.79e-09)		(5.81e-09)
Age 45-54, fraction		-0.566*		-0.554*
		(0.295)		(0.299)
Age 55-64, fraction		0.306		0.287
		(0.313)		(0.325)
Age 65-74, fraction		0.511		0.529
		(0.478)		(0.482)
Age 75-85, fraction		-0.378		-0.399
		(0.681)		(0.670)
Age over 85, fraction		-3.858***		-3.835***
		(0.790)		(0.789)
Fraction Female		1.417		1.412
		(1.183)		(1.170)
Unemployment Rate		-0.0327		-0.0323
		(0.148)		(0.146)
Fraction White		0.0733***		0.0741***
		(0.0229)		(0.0228)
Median HH Income		-5.36e-07**		-5.25e-07**
		(2.29e-07)		(2.22e-07)
Home-ownership		0.113***		0.111***
		(0.0338)		(0.0343)
No HS Diploma		-0.0864**		-0.0874**
		(0.0364)		(0.0370)
HS Diploma		-0.169***		-0.169***
		(0.0515)		(0.0517)
Poverty Rate		-0.180**		-0.177**
		(0.0861)		(0.0855)
Fraction Urban		-0.0160		-0.0165
		(0.0124)		(0.0124)
Constant	-0.000354	0.0954**	0.00536	0.0958**
	(0.0191)	(0.0411)	(0.0162)	(0.0409)
Observations	2,219	2,219	2,219	2,219
R-squared	0.011	0.440	-0.085	0.437

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4.3b: Mortality and Unemployment (Without Outliers)

	Δ Log (Total Mortality)			
VARIABLES	Reduced Form		IV	
Bartik	0.309**	0.0246		
	(0.145)	(0.0530)		
Total Job Losses			0.259**	0.0223
			(0.123)	(0.0482)
Leverage 2006	0.00284	-0.00625	-0.00741	-0.00709*
	(0.00853)	(0.00410)	(0.00583)	(0.00418)
Age 25-44, fraction		-6.15e-09		-6.07e-09
		(5.76e-09)		(5.81e-09)
Age 45-54, fraction		-0.490*		-0.473*
		(0.258)		(0.264)
Age 55-64, fraction		0.177		0.151
		(0.271)		(0.288)
Age 65-74, fraction		0.776**		0.800**
		(0.367)		(0.378)
Age 75-85, fraction		-0.770		-0.798
		(0.522)		(0.517)
Age over 85, fraction		-3.348***		-3.319***
		(0.682)		(0.689)
Fraction Female		1.413		1.406
		(1.183)		(1.171)
Unemployment Rate		-0.0402		-0.0396
		(0.145)		(0.144)
Fraction White		0.0739***		0.0749***
		(0.0235)		(0.0233)
Median HH Income		-5.63e-07**		-5.50e-07**
		(2.25e-07)		(2.18e-07)
Home-ownership		0.116***		0.113***
		(0.0334)		(0.0339)
No HS Diploma		-0.0839**		-0.0853**
		(0.0366)		(0.0375)
HS Diploma		-0.168***		-0.167***
		(0.0507)		(0.0512)
Poverty Rate		-0.176**		-0.173**
		(0.0852)		(0.0851)
Fraction Urban		-0.0113		-0.0119
		(0.00929)		(0.00932)
Constant	-0.000240	0.0848**	0.00571	0.0852**
	(0.0191)	(0.0388)	(0.0162)	(0.0388)
Observations	2,213	2,213	2,213	2,213
R-squared	0.012	0.453	-0.098	0.448

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5. DISAGGREGATED MORTALITY

5.1 By age groups

This section examines mortality by age, gender and types of diseases. Disaggregated by age, we observe that mortality for 25-34 years old is significantly and negatively affected by unemployment, that is, unemployment actually reduces deaths among this age group. This is probably because pro-cyclical accidents, suicides and homicides are accounted mainly for by individuals younger than 45, similar to Ruhm (2000).

Table 5.1a: Age, Unemployment and Mortality (IV with controls)

VARIABLES	<1	1-4	5-14	15-24	25-34	35-44
Instr. Job Losses	-0.0264	-1.184	0.232	0.194	-0.700***	0.0596
	(0.295)	(0.855)	(0.640)	(0.434)	(0.258)	(0.210)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.0898	-0.0531	1.246*	0.166	0.0395	-0.156
	(0.272)	(0.742)	(0.678)	(0.259)	(0.206)	(0.132)
Observations	1,107	245	310	1,409	1,599	2,035
R-squared	0.019	0.147	0.150	0.043	0.059	0.097

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5.1b: Age, Unemployment and Mortality (IV with controls)

VARIABLES	45-54	55-64	65-74	75-84	>85
Instr. Total Job Losses	0.00253	0.0961	-0.0166	-0.0849	0.0894
	(0.139)	(0.0942)	(0.0880)	(0.0804)	(0.0851)
Constant	-0.0971	0.108	0.118*	0.0711	0.227***
	(0.0682)	(0.103)	(0.0664)	(0.0589)	(0.0612)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	2,213	2,213	2,213	2,213	2,212
R-squared	0.210	0.142	0.245	0.360	0.275

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2 By gender

Disaggregated by gender, we observe that mortality among females and male is insignificantly affected by unemployment. Ruhm (2015) also documented that the pro-cyclicality of mortality is also decreasing for both males and females, but stronger for males.

Table 5.2: Gender, Unemployment and Mortality (IV)

VARIABLES	Female		Male	
Instr. Total Job Losses	0.273*	0.0131	0.394**	0.0299
	(0.146)	(0.0517)	(0.159)	(0.0584)
Constant	-0.0152	0.0955**	-0.0129	0.0785*
	(0.0148)	(0.0407)	(0.0173)	(0.0456)
Controls	No	Yes	No	Yes
Observations	3,047	2,213	3,057	2,213
R-squared	-0.081	0.335	-0.199	0.376

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.3 By types of diseases

We find no significant relationship between job losses and deaths from aggregate diseases (see the first column). When we break down to cancer, cardiovascular disease (CVD) and “other diseases”, mortality caused by “other diseases” significantly grows due to unemployment (table 5.3a). This significant relationship is not driven by outliers (scatterplot not shown). The coefficient of 0.265 implies that a 1% increase in instrumented job losses causes a 0.265% increase in mortality in other diseases, which include diabetes, Alzheimer’s, chronic lower respiratory, liver and kidney.

Table 5.3a: Diseases and Unemployment (IV with controls)

VARIABLES	Diseases	Cancer	CVD	Others
	[1]	[2]	[3]	[4]
Instr. Job Losses	0.0292	0.0196	-0.0784	0.265**
	(0.0621)	(0.0773)	(0.0734)	(0.127)
Constant	0.0923**	0.0762	0.179***	-0.0791
	(0.0441)	(0.0600)	(0.0461)	(0.0864)
Controls	Yes	Yes	Yes	Yes
Observations	2,212	2,213	2,213	2,212
R-squared	0.354	0.182	0.221	0.085

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Once we look at the different diseases under “Other Diseases”, we find only Alzheimer’s to be strongly counter-cyclical: unemployment causes higher deaths by Alzheimer’s. The relationship is not driven by outliers. Mortality for other types of diseases such as diabetes, liver and kidney diseases is not driven by employment.

It is interesting to find that Alzheimer's is significantly driven by unemployment. This could be a subject for more extensive research. In this paper, we speculate this could be due to the high cost of Alzheimer's. Total health care costs are more than three times higher for people with Alzheimer's and other dementias than for other people age 65 and older, according to the Alzheimer's Association's 2009 *Alzheimer's Disease Facts and Figures.* A substantial part of the costs derives from private insurance and out-of-pocket payments. Families and counties hit with large declines in employment were understandably financially disadvantaged to care for patients with Alzheimer's.

Table 5.3b: Other Diseases and Unemployment (IV with controls)

VARIABLES	Diabetes	Alzheimer	Chronic Lower Resp.	Liver	Kidney
Instr. Job Losses	0.272	1.067***	-0.141	-0.168	0.0588
	(0.248)	(0.374)	(0.170)	(0.289)	(0.382)
Constant	-0.0770	-0.962**	0.175	-0.273	0.120
	(0.175)	(0.382)	(0.117)	(0.214)	(0.175)
Controls	Yes	Yes	Yes	Yes	
Observations	2,071	2,018	2,199	1,362	1,852
R-squared	0.040	0.044	0.098	0.041	0.063

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.4 Deaths caused by external reasons

We continue to look for impacts of unemployment on deaths caused by external reasons (Table 5.4a). First of all, unemployment does not seem to have an impact on total deaths by external causes. However, when we break down to individual causes, we find that homicide is strongly *negatively* correlated with unemployment. What this means is in counties with higher job losses, the number of deaths from homicide is actually lower. Moreover, the relationship is robust and not driven on outliers (scatterplot not shown). The unemployment and crime relationship has been widely studied in the literature, with mixed results. Our finding is related to that of Raphael and Winter-Ebmer (2001), who found murders and rape pro-cyclical. The authors postulated that higher incidents of rape during economic upswing is due to greater frequency of interactions between potential victims and offenders when a larger proportion of the population is working. However, the authors do not propose a rationale for murders. Note that Ruhm (2015a) found mortality from homicide having an unstable relationship with unemployment.

Table 5.4a: Unemployment and mortality by external causes (IV with controls)

VARIABLES	External Causes	Transport Accidents	Non-Transport Accidents	Suicide	Homicide
Instr. Job Losses	-0.121	-0.455	0.413	-0.490	-2.645***
	(0.201)	(0.281)	(0.263)	(0.322)	(0.642)
Constant	-0.0928	-0.102	0.0238	0.153	0.489
	(0.141)	(0.204)	(0.192)	(0.216)	(0.454)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	2,213	1,971	2,126	1,526	576
R-squared	0.185	0.071	0.178	0.033	-0.021

Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5.4b presents a detailed analysis of other non-transport accidents, which comprises of falls, drowning, fires and poisoning. Mortality due to poisoning is the only category that is weakly *positively* correlated with job losses: as job losses increase by 1%, poisoning deaths *increase* 1.4%. Ruhm (2015a) also found that mortality from poisoning has dramatically become counter-cyclical in recent years: as a state's economy worsens, mortality from poisoning rises. This is a topic of great interest. Case and Deaton (2015), for example, found a marked increase in the mortality rate of middle-aged, white, non-Hispanic men and women in the United States between 1999 and 2013, while other racial groups continue to see mortality rates fall. They also find that this increase for whites was largely accounted for by increasing death rates from drug and alcohol poisonings, suicide, and chronic liver diseases and cirrhosis, which points to growing distress within this demographic.[2]

[2] Poisoning is accidental poisoning by and exposure to noxious substances. Includes: accidental overdose of drug, wrong drug given or taken in error, and drug taken inadvertently accidents in the use of drugs, medicaments and biological substances in medical and surgical procedures poisoning, when not specified whether accidental or with intent to harm. Excludes: administration with suicidal or homicidal intent, or intent to harm, or in other circumstances classifiable to transport accidents, assault, event of undetermined intent, and correct drug properly administered in therapeutic or prophylactic dosage as the cause of any adverse effect.

Table 5.4b: Unemployment and mortality by accidents (IV with controls)

VARIABLES	Other Acc.	Falls	Drowning	Fire	Poisoning
Total Job Losses	0.754*	0.172	-0.858	2.289	1.402*
	(0.429)	(0.755)	(2.116)	(2.511)	(0.772)
Constant	0.203	0.634**	-0.894	2.279	-0.0983
	(0.214)	(0.321)	(0.882)	(1.624)	(0.512)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	1,742	978	183	116	1,119
R-squared	0.132	0.103	0.155	0.240	0.101

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6. CONCLUSION

This paper examines the impacts of unemployment on mortality during the Great Recession. We employ a Bartik (1991) type of identification strategy to identify exogenous job losses, namely tradable job losses of a county driven by declines in aggregate demand. We find that generally, unemployment has little impact on mortality during the Great Recession.

Our results are mostly consistent with findings in Ruhm (2015a): total mortality is weakly pro-cyclical, and so selected cause-specific death rates, except for poisoning and other diseases (specifically Alzheimer's). Additionally, we found homicides to be strongly counter-cyclical. Our results therefore reconfirm that of Ruhm (2015a), although the contexts are different: while Ruhm's studies are based on state-level time series, our study is based on a cross-section of counties during the Great Recession.

The result that unemployment has little adverse impacts on most mortality rates helps mitigate concerns about adverse long-term health impacts of short-term, but very severe unemployment. Needless to say, further studies are needed to investigate different angles of health issues during the Great Recession.

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