PRELIMINARY AND INCOMPLETE

Why Recessions Good for your Health? Understanding Procyclical Mortality*

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ABSTRACT

A growing literature has established a link between mortality and the business cycle and documented robust countercyclical movements in health in the United States and elsewhere. We examine these findings more closely and attempt to identify mechanisms that may be driving this connection. Specifically we examine the link between mortality from different causes and in different age ranges over the business cycle, using data from the United States from 1978 through 2004. We show that most of the additional deaths arising from reductions in the unemployment rate are concentrated among the non-working age population, those under 18 and over 65. Thus, mechanisms involving direct effects of individual work hours or behavior on one's own health are unlikely to be driving these results. We investigate this further by using both peer-group specific- and overall business cycle indicators to explain age-, sex-, and race-specific death rates. Employment-to-population ratios that are specific to individuals' own age-race-sex group are not positively related to group mortality rates, supporting the hypothesis that the mechanisms connecting economic activity and mortality do not involve an individual's own employment status or hours of work.

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Introduction

A series of influential papers by Christopher Ruhm (2000, 2003, 2005) documents that recessions are “good for your health” – or more specifically, that mortality rates are strongly procyclical. These estimates focus on local (state) business cycle fluctuations. They typically come from state-year panel data, with state and year fixed effects and often state-specific time trends. A typical estimate (from Ruhm (2000) suggests that a one percentage point increase in a state's unemployment rate leads to a 0.54% **reduction** in that's state's mortality rate. This is meaningfully large. If it were applicable to the U.S. as a whole, then using 2004 mortality data it would imply that a one percentage point increase in unemployment would lead to about 13,000 fewer deaths.

Ruhm’s findings are widely cited in the health economics literature and have been echoed in work by Dehejia and Lleras-Muney (2004) who find that infant health outcomes and economic downturns are positively linked. This paper begins to investigate what factors drive this association. The most common interpretation is that work has a negative impact on individuals’ health at least partly because it increases the opportunity cost of time. Indeed, Ruhm (2000) shows that obesity and smoking both exhibit a procyclical pattern, and that diet and exercise also improve when the unemployment rate rises –patterns that are consistent with changes in the value of time associated with working. Recent work that links individual job displacements to individuals’ mortality (Sullivan and Wachter, 2007), however, finds that individuals who experience a job loss have higher probabilities of dying. These two related literatures have not yet been reconciled.

The purpose of this paper is to shed light on the mechanisms that are behind the procyclical mortality pattern. We put particular emphasis on separating out the effects of changes in individual behavior resulting from one’s own employment status or work effort from the effects of other factors that fluctuate with the unemployment rate. The question we examine is important for several reasons. First, changes in individuals’ health that result from changes in their own behavior will have different associated policy prescriptions than changes that result from external factors. Second, the effects of job loss on family income and a variety of other factors that fluctuate with the business cycle are commonly estimated by researchers, and understanding these effects is important for many policy questions. Much recent evidence suggests that job loss has lasting negative effects, many of which may operate through or affect physical or mental health. As Ruhm (2008) notes, this is not necessarily inconsistent with findings of an aggregate procylical mortality rate since the effects of the unemployment rate may not be concentrated among those who change employment status. It does suggest, however, that the mechanisms that lead to the procyclicality may be more complex than a connection between own employment and health. Third, this paper adds to the understanding of the effects of business cycles on individuals' behavior, and contributes to the effort to measure the welfare costs of business cycle fluctuations.

In the next section, we summarize the literature connecting unemployment and health, both at the aggregate and the individual level. We then describe the data we have used and how they are organized, along with a brief discussion of the econometric methodology. In section III, we begin presentation of our results. We first replicate and extend forward in time results similar to those in Ruhm (2000). We then present results disaggregated by age and cause of death. These results, although consistent with earlier findings, suggest a different focus on the mechanisms involved. We find that the vast majority of the effect of unemployment rates on mortality is not likely to be the direct result of changes in own economic status. Finally, we estimate a number of direct specifications involving group-specific and aggregate labor market indicators. These results show that even fairly broad own-group measures of employment status over the business cycle do not drive the aggregate relationship between unemployment rates and mortality.

II. Previous Literature

Ruhm's 2000 study documents a strong inverse relationship between state unemployment rates and individuals' health. Specifically, Ruhm estimates regressions of the log of state level mortality rates on state unemployment rates, state fixed effects, year fixed effects, linear state trends, and a set of state-specific demographic variables, and finds that a one percentage point rise in the state unemployment rate is associated with a 0.5 to 0.6 percent decrease in total mortality. He also estimates these regressions separately by age group and cause of death. He finds that the effect is stronger among young adults than among older men and women, and that motor vehicle accidents are more tightly associated with economic conditions than other causes of death, although the estimated coefficient on the unemployment rate is still of substantive magnitude and statistically significant for several other causes of death. The estimates are based on data from *Vital Statistics of the United States*, the Bureau of Labor Statistics, and other sources, covering the years 1972-1991.

Additional analyses using data from the Behavioral Risk Factor Surveillance System suggest that mortality rates are not the only health indicator that exhibit pro-cyclical fluctuations: Measures of obesity and smoking are also higher when the economy is strong. For example, a one percentage point increase in unemployment is associated with a statistically significant 0.06 percent decline in average BMI , and a one percent drop in the fraction of individuals smoking. Diet and exercise also seem to improve when the economy takes a downturn. In related work, Dehejia and Lleras-Muney find that babies conceived in times of high unemployment are healthier than those conceived when the economy is strong, and they link the health improvements to selection (changes in the types of women who choose to conceive) as well as other changes in mothers' behavior during pregnancy. Taken together, these results suggest that individuals make less healthy choices when they are working.

In contrast, using a matched file of administrative earnings and death records, Sullivan and von Wachter (2007) find that individuals who experience a job loss via a mass-layoff also experience a 15-20% increase in the probability of dying over the next 20 years. Their results, which are robust to a wide variety of controls for selection, would seem to be at odds with the studies mentioned above. An important difference, however, is that the Sullivan and von Wachter study is based on individual level data whereas the Ruhm studies have been based on state level aggregates. The two sets of findings can be consistent with each other if the increase in mortality rates that corresponds to improvements in the economy is mostly driven by factors other than changes in individuals' own health behaviors in response to changes in own employment status.

The purpose of this study is to gain a better understanding of which factors contribute to the pro-cyclical relationship between macroeconomic conditions and mortality rates, with a particular emphasis on changes in an individual's own behavior vs. changes in the probability of dying that are related to "externalities" associated with the business cycle. While some of these possibilities have been explored in Ruhm's earlier work, we bring additional light to bear on the question by focusing on more detailed mortality rate decompositions by age, sex, race and cause of death; and by investigating the relationship between a particular demographic group's mortality and that same group's unemployment relative to other demographic groups.

III. Data and Methodology

We begin by replicating Ruhm's analysis with his own data which he generously shared with us. The basic regression equation takes the following form:

$$H_{jt} = \alpha_t + X_{jt}\beta + E_{jt}\gamma + S_j + S_jT + \varepsilon_{jt} \qquad (1)$$

where H is the natural log of the mortality rate in state j and year t, E is a measure of state's economic health, X is a vector of demographic controls including the fraction of the population who are less than five years old and the fraction who are greater than 65 years old, the fraction who are high school dropouts, with some college, and college graduates, percent black and percent Hispanic. The fixed effect, α_t, captures national time effects, and S_j controls for time-invariant state characteristics, and state-specific time trends are also included. Most of the control variables come from the Census decadal counts and are interpolated in between Census years. The main indicator of a state's economic health, E, is the state unemployment rate, which comes from unpublished statistics put together by the Bureau of Labor Statistics. Death rates come from Vital Statistics publications. Ruhm's analysis is based on data from 1972-1991.

The results of this analysis are presented in Table 1. We present estimates produced by both unweighted regressions and regressions weighted by state population: if one wants to estimate the degree to which economic conditions contribute to overall fluctuations in U.S. health, then weighting is appropriate. On the other hand, one could argue that big states and small states are contributing equal amounts of information to our analysis, and that population weighted regressions place too much emphasis on large states. We find that weighting makes little difference in the magnitude of the estimated coefficient on the state unemployment rate, which is nearly identical to Ruhm's, at between 0.0054 and 0.0056. In other words, a one percentage point increase in the unemployment rate is associated with a 0.5 percent decrease in the predicted death rate.

To extend Ruhm's work and investigate the potential mechanisms behind procyclical mortality, we utilize several additional sources of data. First, we use less aggregate data from Vital Statistics that allows us to construct state-level death rates by single year of age. This allows us to examine age-specific mortality patterns and to adjust mortality rates for population aging over time. Second, in order to construct unemployment and employment rates for demographic subgroups within states, we pool monthly CPS files for each year from 1978 through 2004. Starting with this micro data from the CPS allows us to construct labor market or business cycle indicators that are defined for specific demographic subgroups, and pooling all 12 monthly CPS files for each year provides the largest possible sample size for constructing these measures. Third, we use state- and demographic-group specific population counts collected by the National Cancer Institutes Surveillance Epidemiology and End Results program (Cancer-SEER).

These population estimates are likely to be an improvement over population estimates interpolated from the Census because they are based on a sophisticated algorithm that incorporates information from Vital statistics, IRS migration files and the Social Security database.

The remaining columns of Table 1 show what happens to the estimated relationship when we make various changes to the data and/or specification. In particular, we would like to include more recent business cycles in our analysis, but we do not have access to a consistent measure of the unemployment rate between 1972 and years beyond 2000. We also wish to replace some of Ruhm's control variables, which are interpolated between census years, with year-by-state measures of the same variables in the CPS. The earliest that the CPS data are available at the state level is 1979. Our analysis, will, therefore, be based on data covering the years 1979-2004. We will also replace Ruhm's dependent variable with mortality rates calculated from micro-record "multiple cause of death" mortality files downloaded from the NBER website. Like Ruhm, the death counts produced from these files are based on Vital statistics, but they have the advantage of including more detailed age and cause of death information, which we will make use of. Our state/year level mortality rate is calculated by dividing the death count by population estimates taken from Cancer-Seer files.

To see whether these changes affect the magnitude of the estimated effect, the next six columns show how the estimate is affected when we make these changes sequentially. Column 2 shows what happens to the estimate when we continue to use Ruhm's data but eliminate years between 1972 and 1978. The estimated impact of a one percent rise in the unemployment rate continues to be close to -0.005. In the next column we show how the estimates are affected when we replace Ruhm's mortality rate with our own measure. This change reduces the estimated unemployment effect by about 20% (from

-0.005 to -0.004) although it continues to be strongly statistically significant. Most of this difference is driven by differences in the denominators of the two mortality rate series. In the fourth column we use state/year control variables taken from the CPS instead of interpolating between Census years; we use an up-to-date version of the unemployment rate; we weight by up-to-date population numbers, and we add in richer age distribution covariates. These changes have virtually no effect on the estimated unemployment effect when the regressions are weighted although they do increase the magnitude of the estimate in the unweighted regressions by 0.001 from a base of -.004.

In the next column we extend the dataset to include data through 2004; this substantially reduces the magnitude of the coefficient, although it remains statistically significant. A major change here is perhaps not entirely surprising since this adds another major business cycle to the state-specific time-series being used for identification of the unemployment coefficient.

In column 6 we make a more substantively important change, by replacing the dependent variable, the log of a simple, unadjusted mortality rate, with the log of an age-adjusted mortality rate. The age distribution of the U.S, and thus within individual states, has changed substantially between 1978 and 2004. In 1978, for example, the average state population in the U.S. had 10.7 percent of its residents over age 65. By 2004, the comparable figure was 12.6 percent. If this shift in the age distribution has occurred unevenly across states, the changing age distribution could prove to be an important omitted variable in any regression making use of time-series variation within states, given the tight relationship between age and mortality. Indeed, different parts of the country have faced quite different evolution of the age structure during this time period. In California, the fraction over age 65 increased by just over half a percentage point, from 10.0 to 10.6 percent between 1978 and 2004. In contrast, Michigan saw an increase in the fraction of its residents over age 65 of nearly 3 percentage points, from 9.5 to 12.3 percent. Thus, it may be particularly important to control for the changing age structure over time.

To more fully control for the age structure, we construct a set of age adjusted state-level mortality rates that abstract from within-state changes in the age structure of the population. Consider a typical mortality rate for state j, and note that it can be written as the product of age-specific mortality rates and the age distribution in the state, or

$$MR_{jt} = \sum_{a=0}^{85+} MR_{ajt} f_{ajt}$$

To abstract from changes in f_{ajt} we replace the year- and state-specific fractions of individuals in each age interval with the nationwide fraction of individuals in each age category in 1990. In this way, the variation in the mortality rate is not driven by changes in the age distribution, but rather by variation in the relative numbers of deaths, holding constant the distribution of population age in the state.

Figure 1 shows the national time series of mortality rates, both adjusted for age-adjusted and unadjusted. The aging of the U.S. population means that the unadjusted series appears to be relatively flat, while the age-adjusted series reflects a fairly dramatic decline over time in mortality holding age constant.

In the sixth column of Table 1 we show that using the age-adjusted mortality rates raises the estimated effect of the unemployment rate on mortality back to -0.004. This suggests that the state-specific shifts in the age distribution are correlated with state-level unemployment movements over this period. Finally, in the last column of Table 1 we present the results from estimating a Poisson model instead of a linear model. Our motivation for doing this is that subsequent analyses will be based on more disaggregated groups where cell sizes will be small and death counts sometimes zero. In such cases, count models are more appropriate. The use of the Poisson model for the aggregate analysis does not substantially affect our estimated coefficients.

Taken as a whole, our changes to the data, years of analysis, and model specification have a fairly limited impact on the estimated association between macroeconomic fluctuations and health. The one exception is that age adjustment of the mortality rates, which more clearly controls for changes in the age distribution, has reasonably large effects on the estimated effects of interest. Consistent with Ruhm's study, every entry in Table 1 is negative, statistically significant, and of substantive magnitude. Because of the potential importance of the changing age distribution, in the remainder of the paper we focus on age-adjusted mortality rates or mortality rates calculated for single-year age groups. Since the weighted and unweighted regressions produce very similar results, we will focus on results from weighted regressions in the remainder of the paper. Unweighted results are available from the authors by request.

IV. Sensitivity of estimates to population measures and migration

As noted above, our preferred measure of the mortality rate uses a different denominator, coming from the Cancer-SEER population estimates. Throughout this analysis, and the previous literature, effects of unemployment rates on mortality rates are assumed to operate through altering the number of deaths, or altering the numerator of the mortality rate. As noted in the discussion of Table 1, however, there is some evidence that moving from mortality rates using Census-based denominators to those using our preferred measure has a noticeable effect on the estimated coefficient. For this reason, we have investigated the role of these population estimates a bit further.

Estimates of the population are generally based on Census counts, adjusted in non-census years for aging of the populations, births, deaths, and estimates of domestic and international migration. If these population estimates contain errors, and if the errors are systematically related to states' business cycles, the estimated coefficients on state unemployment rates will be biased. Higher estimated mortality rates associated with the business cycle will be reflecting a larger at-risk population, not higher actual mortality rates. We know, for example, that domestic migration is correlated with business cycle patterns; if this is not adequately reflected in the non-Census year population counts, there could be the possibility of a spurious correlation between measured mortality rates and the unemployment rates.

An initial look at the cyclicality of the Census-based population estimates suggests that there is some scope for errors of meaningful magnitude. We have estimated the relationship between the age-specific population denominators used in the Vital Statistics-based mortality measures and our business cycle indicator, the unemployment rate.

Figure 2 shows the results of this exercise. Each dot is an estimate of the semi-elasticity of population with respect to the unemployment rate. For example, the estimate of 0.02 for 2-year-olds suggests that when unemployment is 1 percentage point higher, there are about 2% more 2-year-olds in that state/year. We also plot 95% confidence intervals for the estimates. Controls include state and year fixed effects, and state trends. The figure has several interesting features. First, the population of kids aged 0-14 and of adults aged 27-33 appears to be counter-cyclical. The estimated populations of thosed aged 17-25 and 35-45 are pro-cyclical.

It is also apparent in Figure 2 that the estimated degree of population cyclicality is not continuous in age. There are several point of discontinuity in the measured responses. For example, the elasticities vary by almost 0.01 between ages 14-15, 16-17, and 24-25, and there are several noticeable jumps at older ages as well. To the extent that these jumps reflect Census modeling decisions in population, we can see that these decisions interact with the business cycle in non-random ways. Further, the magnitude of the jumps is of the same order as the main estimated mortality effect. This raises the possibility that there may be systematic errors in the population estimates.

Another initial test for whether the population estimates accurate reflect true population changes over the business cycle makes use of data from the Internal Revenue Service on interstate mobility in each year. The IRS tracks address changes of taxpayers and so has data detailing the number of individuals moving from one state to another in any particular year. If the population numbers that form the denominator of the mortality rates (either from the Census, or our preferred Cancer-SEER data) have adequately controlled for cross-state mobility, we would not expect these migration rates to affect the mortality rate in our standard regressions. We have re-estimated the regressions in Table 1, also including controls for the number of individuals moving into and out of the state in that year. One result of this exercise suggests that further investigation of the role of migration and population estimates is warranted; outflows from a state are significantly negatively related to the mortality rate in these regressions. On the other hand, the coefficient on the state unemployment rate barely changes when we include these measures. In future work, we will continue this line of investigation exploring whether either mis-measurement of the at-risk population or migration responses to the business cycle (that may contribute to such mis-measurement) are an important part of the response of mortality to unemployment rates.

V. Why are Recessions Good for your Health?

The previous analyses confirm Ruhm's finding that mortality rates exhibit a procyclical pattern, and that this pattern persists through the early 2000s. The question that we wish to investigate is *why* the probability of dying increases when economic times are good. At first glance, the sign of this relationship may seem counter-intuitive, but Ruhm elaborates on at least four reasons that fatalities might vary pro-cyclically. First, as discussed above, leisure time declines when the economy improves, making it more costly to undertake health-producing activities that are time-intensive. Second, health may be an input into the production of goods and services. For example, hazardous working conditions, job related stress and the physical exertion of employment may have negative effects on health, and these would all be expected to increase when the economy is expanding. Changes in health that result from changes in the opportunity cost of time and production both reflect changes in individuals' own behavior. In contrast, a third reason for the pro-cyclical relationship may be the effect of external factors that fluctuate with the economy. For example, when more people are working, roadways are more congested, which may lead to an increase in the probability of being involved in a fatal auto accident. Evans and Graham (1988) and Ruhm (1995) show that drinking and driving exhibit a pro-cyclical pattern, and Ruhm (2000) shows that motor vehicle fatalities are more sensitive to the business cycle than any other cause of death. Another possibility is that tight labor markets lead to reductions in the quality of health care workers, which subsequently affect mortality rates. We refer to these types of mechanisms as “external” or “other” factors. Finally, mortality rates might vary pro-cyclically because of selective migration.

We next focus on the relative importance of “own” vs. “other” factors. To begin, we have used the detailed mortality files to estimate equation (1) separately by single year of age. Figure 3 shows the coefficients on the unemployment rate and their associated confidence intervals from these separate regressions for each year of age. There is some variation in the extent of procylcality of mortality across the age distribution, echoing earlier work by Ruhm (2000), who notes that young adults have the most cyclical labor force behaviors, and also have the largest cyclical fluctuations in employment. Specifically, Ruhm shows that a one-percent increase in the state unemployment rate lowers deaths of 20-44 year olds by 2 percent, but has smaller (or no) effects on older workers. Our Figure 3 is consistent with this conclusion, but makes clear three additional points. First, our updated data suggst that the typical semi-elasticity in this age range (20 to 44) is much less than 2 percent - with only one coefficient out of 25 reaching this level. Second, this finding is mainly driven by those at the younger end of the 20 to 44 year old age range. Indeed, those aged 35-44 have on average **positive** coefficients. Finally, the larger magnitude of the cyclicality extends to ages younger than 20 as well, with children sharing the substantially larger coefficients of the unemployment rate on mortality. That this finding extends to children as well suggests that the greater cyclicality of mortality may reflect something beyond direct cyclicality of employment or labor market factors.

We also confirm that the cyclical response of mortality is lower in absolute value among those most likely to be retired. The coefficient on the unemployment rates is negative but generally much smaller among those beyond age 60. At ages 80 and over there is some evidence of an increased response of mortality to the business cycle.

We next use the individual year age coefficients summarized in Figure 3 to create weighted averages of these age-specific coefficient estimates for each of 11 age groups, where we weight by the total number of deaths for each age/cause cell. The results of this exercise are shown in Table 2, along with the total number of deaths in each age group in 2004, and the total increase in deaths that would be predicted from a one percent increase in the unemployment rate.

Ruhm also estimates the relationship between the unemployment rate and mortality rates for three broad age groups: 20-44 year olds, 45-64 year olds, and those older than 65. When we aggregate across age groups our estimates are fairly similar to Ruhm's and like Ruhm, we find that the estimated coefficient on the unemployment rate is an order of magnitude larger for the youngest adults than for those older than 44. Since young adults have the highest rates of labor force participation, this finding might be interpreted as evidence in support of the argument that pro-cyclical declines in health are mostly generated by changes in individuals' own behavior. However, careful inspection of Table 2 confirms the general impression from Figure 3 and reveals several patterns, which suggest that external factors may be an important part of the mechanism linking unemployment rates and mortality. First, the biggest coefficient estimates are for those age groups that are unlikely to be working, namely those less than a year old, and those under 15. The coefficient estimates for these groups are approximately -0.015, which suggests that a one percentage point increase in the unemployment rate decreases the predicted death rate for that group by approximately 1.5 percent. The estimated coefficients are similarly large among 15 to 34 year olds, but drop to -0.005 or less during the prime working ages of 35-65. The coefficient estimates increase slightly for those who are over 65, a group that also has limited labor force participation. Taken together, these negative estimates suggest that at least part of the mechanism is unrelated to individual behaviors that change when individual work effort increases.

The relationship between the age-specific coefficients and the overall mortality effect depends on the number of deaths in each age group. Even though the coefficient estimates are largest among young individuals, who are only weakly attached to the labor force, large percentage changes in their mortality rates may not increase overall fatalities by much because deaths among children and adolescents are rare. In order to investigate this issue further, we have used the number of deaths in each age group in 2004, together with the estimated coefficients to predict the number of additional deaths that would occur in each age group if the unemployment rate were to rise by 1 percent. The results of this exercise are displayed in column 2 of Table 2. The top line of Table 2 shows that there were 2,397,269 recorded deaths in the United States in 2004. When this number is multiplied by -0.0047, we see that a 1 percent rise in the unemployment rate would lead to approximately 12,000 additional deaths in the population as a whole. The bulk of these additional deaths, however, would occur among age-groups with relatively weak labor force attachment: only 7% of the additional predicted deaths would occur among those between the ages of 25 and 64. In contrast, 71% of the additional deaths, or more than 8000, are predicted to occur among those over age 80. This strongly suggests that whatever mechanism is behind the bulk of additional deaths associated with increased economic activity must go beyond direct effects of individuals' own labor market involvement.

Table 3 shows the results that are produced from estimating equation (1) separately by cause of death. Ruhm also conducts this exercise, and our coefficient estimates are similar in magnitude to his: the largest estimated coefficient, by far, is that for motor vehicle accidents, which is -0.029. Since it is harder to tell a story that motor vehicle accidents are driven by changes in the opportunity cost of time, or additional inputs into the production process, the fact that these causes of death are most sensitive to the business cycle suggests, again, that pro-cyclical fluctuations in the mortality rate are mostly driven by external factors. However, the second column shows that motor vehicle accidents account for only approximately 11% of the additional deaths that occur when the unemployment falls by 1 percent. The next largest cyclical coefficient is for kidney-related deaths, at -.023. This also seems inconsistent with stories involving the opportunity cost of time, but also lacks an obvious connection to external factors associated with increased economic activity. The vast majority of additional deaths are due to cardiovascular (36%) and "other" (35%). In future work we will obtain additional detail on what is included in the "other" category.

The previous two tables make clear that both the age and cause of death information can provide at least some hints about what is driving the overall cyclicality of mortality. In order to explore this possibility further, Tables A1 and A2 further decompose the estimated B's and predicted deaths by cause and age. Focusing first on cardiovascular deaths by age, we see that the biggest (negative) estimated coefficient is for those over age 80 (-.007), followed by infants. Thus, while cardiac deaths might be suggestive of a connection to work-related stress, the age-specific patterns of cardiac deaths do not support this idea. In Table A2, the distribution of additional cardiac deaths from a decline in the unemployment rate make this point even more strongly, with 96% of these additional deaths occurring for those over age 65. Viewed another way, only 23% of the additional cyclical deaths to those ages 25 to 64 are classified as cardiovascular.

The estimated coefficients for motor vehicle fatalities are also notable, because of their uniformity across age groups. The fact that death rates due to motor vehicle accidents experience nearly the same percentage increase across all age groups when the economy expands is again indicative of something that is changing beyond the individual's own health behaviors. Further, for prime working age persons, motor vehicle accidents are an extremely important part of the overall increase in deaths during improving economic times. We estimate that there will be 771 additional deaths of 25 to 64 year olds from a one percentage point decline in unemployment, of which 731 are due to motor vehicle accidents.

The results by age for deaths due to "other" causes further confirms the need to investigate more fully the nature of this residual category. These deaths are quite important in understanding the cyclicality of prime working age individuals. The coefficients on the unemployment rate for this cause of death are around -.04 for all ages from 15 through 54. Further, there are relatively large numbers of additional deaths (approximately 1300) to working age individuals generated by this cause category.

Note that this cause generates a larger number of additional deaths to those ages 25 to 64 than the total category, reflecting that several causes are associated with substantially *fewer* additional deaths due to a decline in unemployment among prime age individuals, notably suicide and cancer.

VI. Additional Evidence on the Presence of Externalities

We continue to investigate the relative importance of "own" vs. "other" behaviors associated with the business cycle by dividing our sample into more narrowly defined demographic subgroups and estimating equation (1) for each subgroup, including in the regression the group's unemployment rate along with the aggregate unemployment rate in the state. If most of the pro-cyclical mortality effect is driven by changes "own" behaviors, then we would expect the estimated coefficient on the group unemployment rate to be large and negative relative to the estimated effect of the state's aggregate unemployment rate. Because a very high fraction of the elderly are no longer in the labor force, we also include the results of regressions that replace the unemployment rates with the employment/population ratio.

Table 4 shows the results of this exercise for subgroups defined by 5 year age windows. Each column corresponds to a Poisson regression in which the age-adjusted mortality rate for that age group is regressed on all of the covariates included in the previous tables, along with measures of the business cycle defined for both the group itself and the overall labor market. The first row shows the estimated coefficient on the state unemployment rate from a regression like equation (1). Because some of the state*age group cells are very small, precision is compromised, but general pattern is clear: for most age groups, higher unemployment rates are associated with lower mortality rates, as would be expected from Table 2. Two exceptions are individuals who are between 40 and 49, for whom the estimated coefficient is actually positive, albeit not statistically significant.[1] The next row repeats the exercise, replacing the state unemployment rate with the state employment rate. We use the employment rate because, when focusing on groups beyond age 65 who are likely to be out of the labor force, group-specific unemployment rates may not reflect labor market conditions very well. The estimated coefficients on this regressor are nearly always smaller and in the opposite direction from those on the unemployment rate. This is particularly notable among those older than 65, the groups for whom we would most expect the employment/population ratio to be a better measure of own labor market activity.

The next two panels of Table 4 show the results from estimating regressions that include either the unemployment rate or the employment rate for each age group, along with the state level aggregate measure. What is striking about the estimated effects of own-group work effort is that most of them are in the opposite direction of what one would predict if the pro-cyclical mortality pattern were generated by individuals taking on less healthy behaviors when their labor market activity increased. Among those coefficients on the own group unemployment rate that are statistically different form zero, none of the estimated coefficients are in the expected direction. In contrast, all of the coefficient estimates on the overall state unemployment rate continue to be negative and many are statistically significant. The estimated effects of the aggregate unemployment rate are particularly strong among the elderly, which is the group that is least likely to be working. Patterns are similar when we replace the unemployment rate with the employment/population ratio, although the magnitudes are consistently smaller (this is in part due to the fact that the employment/population ratio has greater conditional variability than the unemployment rate does). Again, the only statistically significant effects of own-group employment/population are in the opposite direction of the overall employment measures. Interestingly, these statistically significant negative estimates are seen among individuals who are in the prime working

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[1] This differs slightly from Table 2 as the result of slightly different age groupings, and different methods. Table 2 is constructed by taking weighted averages of the individual-year age coefficients; Table 6 is based on direct estimation of coefficients for the five-year age groups.

ages of 30-40 – groups for whom we would expect to observe large positive mortality responses if most of the observed aggregate fluctuations in the mortality rate are driven by changes in the degree to which individuals take care of their health. Note that one potential objection to this exercise if that the group-specific measures of labor force activity are more likely to be subject to measurement error due to relatively small cell sizes in the subgroup analysis. This could explain coefficients on the own group measures that are smaller than the overall measures, but does not immediately explain the generally wrong-signed, and sometimes significant, coefficients.

Table 5 shows the results from a similar exercise, in which we further categorize the sub-groups by age, sex, and race. In order to preserve sample size, we expand the age categories into 20 year groups instead of five year groups. Each column presents the results of regressing the mortality rate for a particular age*sex group on that group's employment rate, the employment rates of the other subgroups, and the additional covariates included in previous regressions. The regressions are run for all races, and separately for whites and blacks.

Beginning with the top panel, which provides the estimates for all races together, we see that when the estimated effects of own-group employment rates are substantive and statistically different from zero, they are always negative, which is the opposite of what we would expect if the pro-cyclical nature of the fluctuations in the aggregate mortality rate were driven by changes in individuals' own labor market status or activity. For all men and women between the ages of 24 and 44, for example, a one percentage point increase in the employment to population ratio will reduce mortality by 0.6 percent, holding constant the employment rates of those over age 44 in the state. This pattern of the group's own employment having a significant, negative effect on mortality holds only for those age 25 to 44, and appears to be driven by women. Echoing the results in Table 4 above, what is most striking about these results is the lack of any evidence that mortality within an age-sex group is positively related to that group's employment rate. Only the employment rates of other groups enter with positive and significant coefficients.

We have further disaggregated by race, and then include age- and gender-specific employment rates both for one's own racial group and the other group.[2] These results are summarized in the lower two panels of Table 5. Once again, the strongest results is that one's own group employment rate (defined now by age, gender, and race) is, if anything, negatively correlated with mortality in that group. In only one case out of 18 possibilities is the coefficient on own group employment positive and statistically significant.

VII. Preliminary Conclusions

This study of the relationship between mortality rates and the business cycle has confirmed a robust link between mortality and unemployment rates. Findings by Ruhm (2000,2003,2005), not surprisingly, are robust to a number of changes in the underlying data, additional controls, and to including an additional decade of data. We show that adjusting mortality rates for changes in the age distribution can be quite important, and that this appears to increase the magnitude of the estimated coefficient of unemployment on mortality.

Our primary contribution to this existing literature is to bring additional data to bear on the question of why such a relationship exists. Specifically, we focus on age-and cause-specific patterns of the cyclicality of mortality rates. Here, we confirm that the largest responses (in terms of estimated coefficients) are among relatively young adults, who also have the most cyclically sensitive employment responses. We also show, however, that children have responses that are just as large, casting some doubt on mechanisms that rely primarily on changes in own work hours or employment status. We also show

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2 Because of concern about small cell sizes, we include only blacks and whites in the analysis by race.

that, in terms of the number of additional deaths generated by a small change in the unemployment rate, understanding cyclical mortality requires an understanding of mortality among the elderly. Almost three-quarters of the increased mortality due to a decrease in unemployment occurs among those age 80 and over.

Finally, our analysis has attempted to compare the responsiveness of mortality within demographic groups (defined by age, sex, and race) to their group-specific measures of employment and to overall measures of employment in the state. We find no evidence that own-group labor market indicators are positively related to that group's mortality, and some suggestive evidence that the relationship may be negative. It seems unlikely that this finding is explained entirely by measurement error in the sub-group measures of employment.

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Figure 1

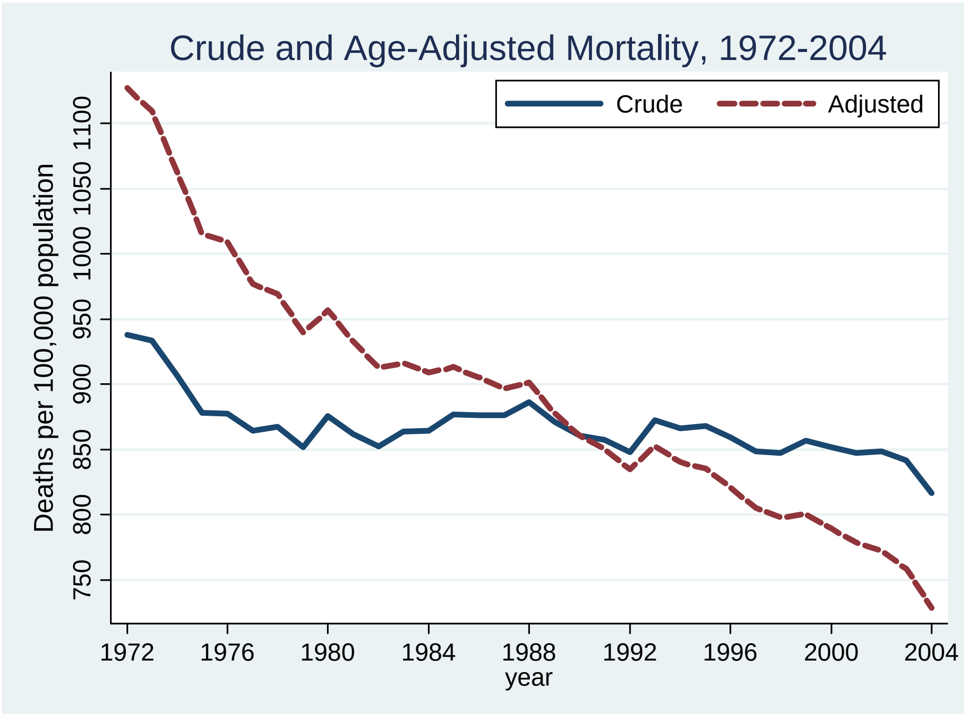


Figure 2

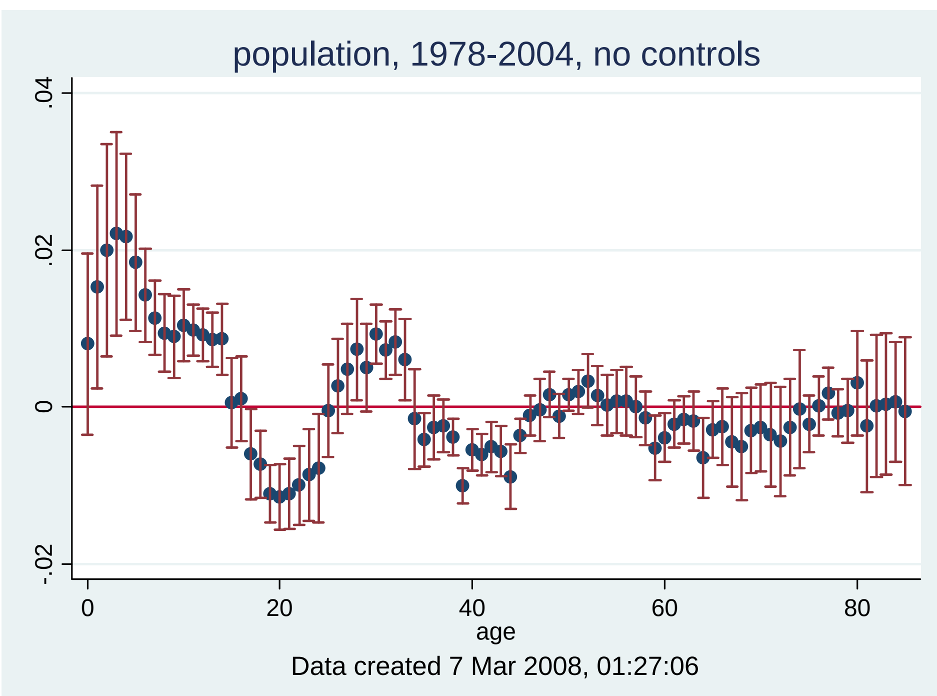
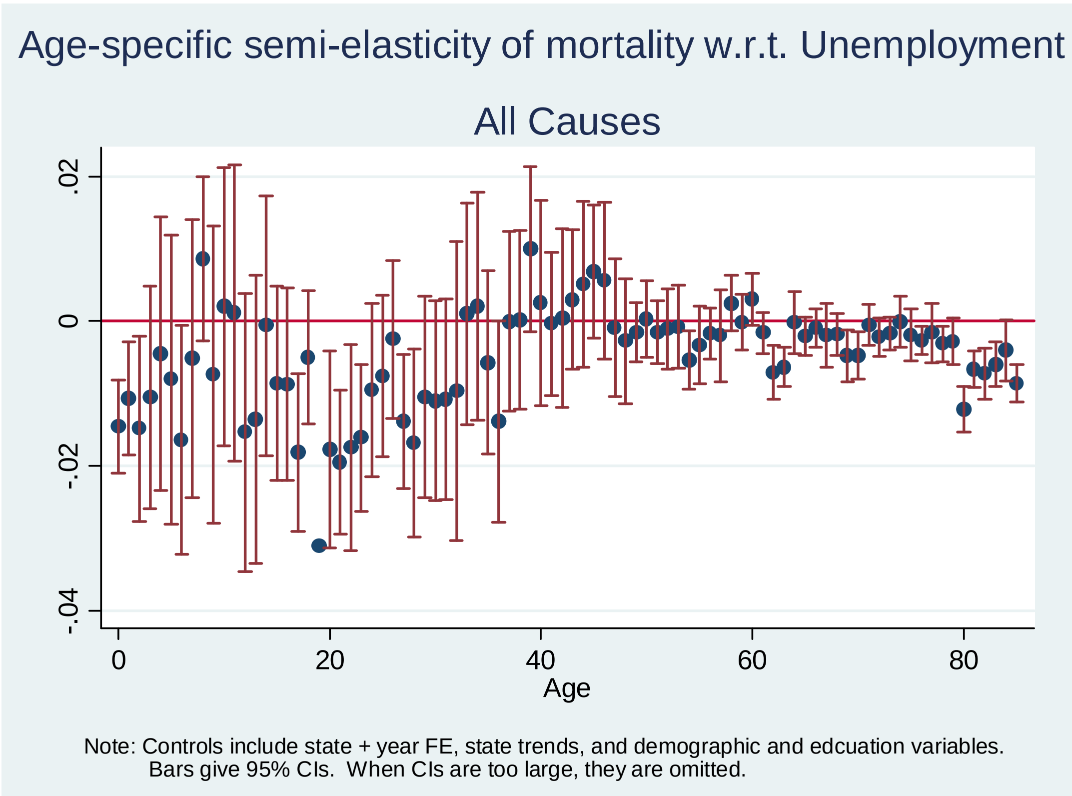
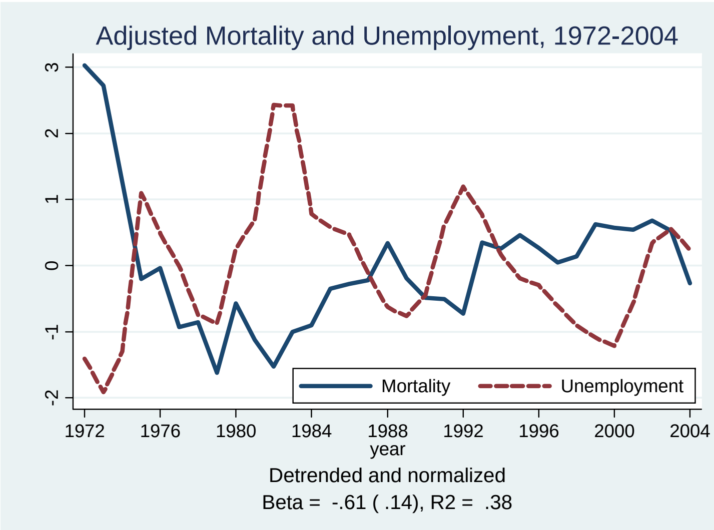
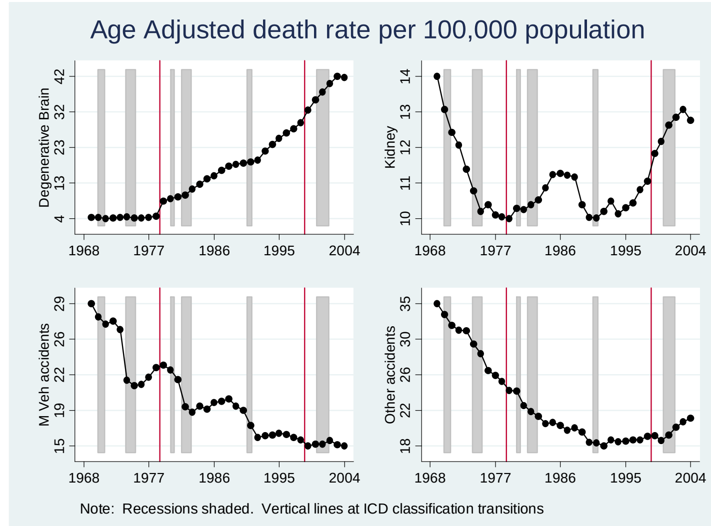


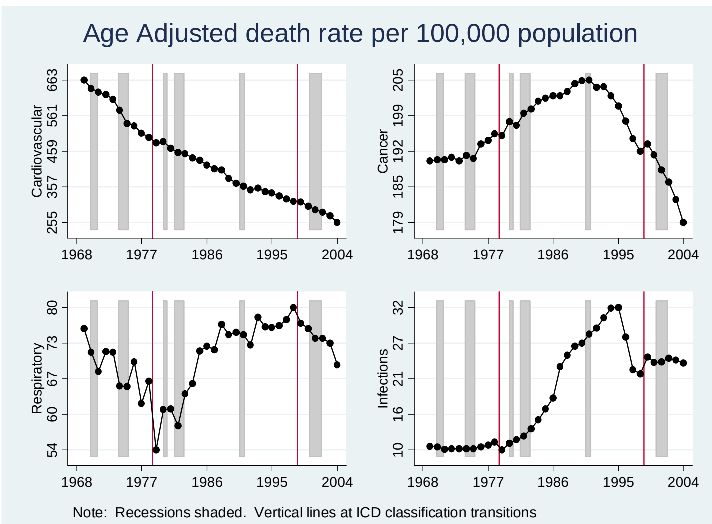
Figure 3

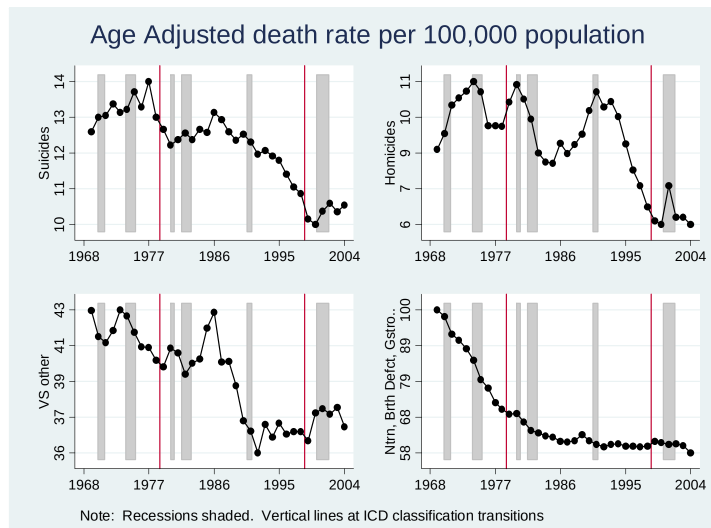

Age-specific semi-elasticity of mortality w.r.t. Unemployment
All Causes
.02
0
-.02
-.04
0
20
40
60
80
Age
Note: Controls include state + year FE, state trends, and demographic and edcuation variables.
Bars give 95% CIs. When CIs are too large, they are omitted.

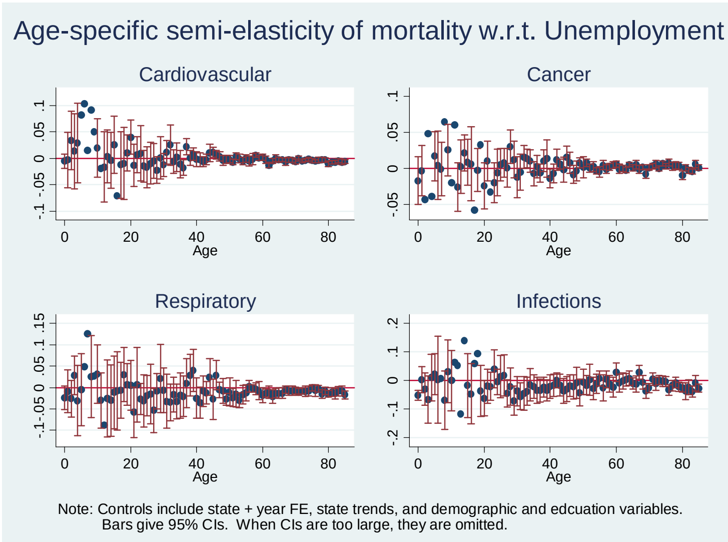
Figures not yet referenced in the text

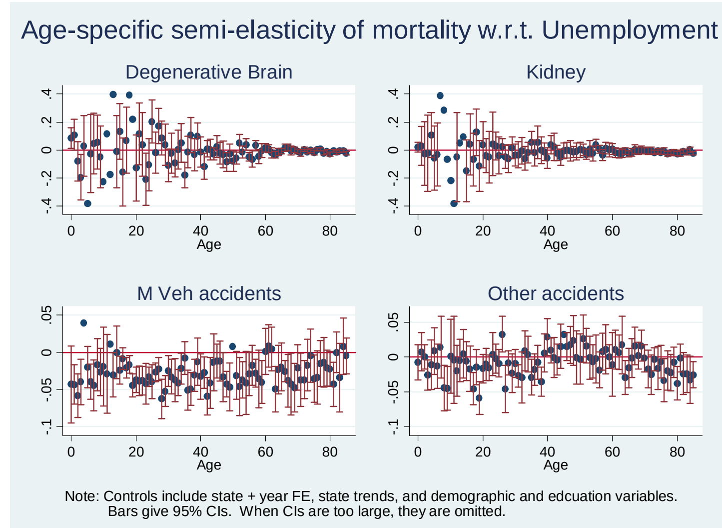


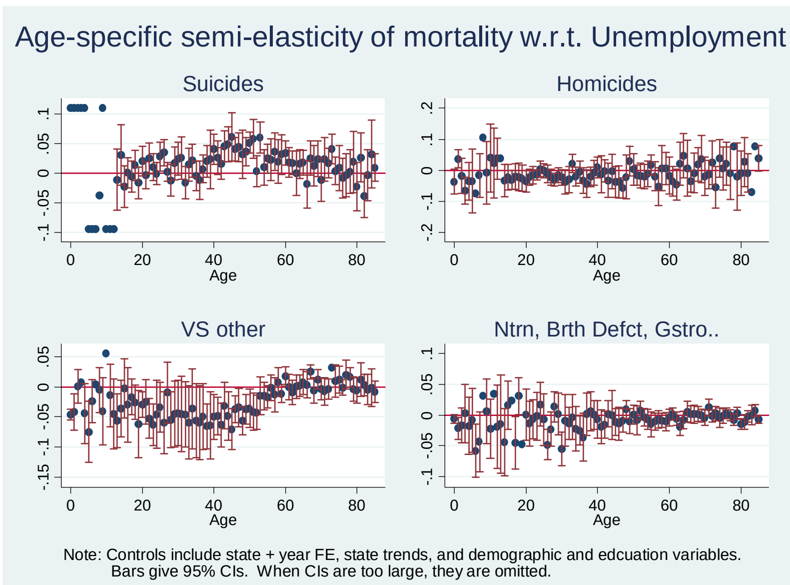







Age-specific semi-elasticity of mortality w.r.t. Unemployment
Cardiovascular
Cancer
Respiratory
Infections
Age
Note: Controls include state + year FE, state trends, and demographic and edcuation variables.
Bars give 95% CIs. When CIs are too large, they are omitted.


Age-specific semi-elasticity of mortality w.r.t. Unemployment
Degenerative Brain
Kidney
M Veh accidents
Other accidents
Age
Note: Controls include state + year FE, state trends, and demographic and edcuation variables.
Bars give 95% CIs. When CIs are too large, they are omitted.


Age-specific semi-elasticity of mortality w.r.t. Unemployment
Suicides
Homicides
VS other
Ntrn, Brth Defct, Gstro..
Age
Note: Controls include state + year FE, state trends, and demographic and edcuation variables.
Bars give 95% CIs. When CIs are too large, they are omitted.

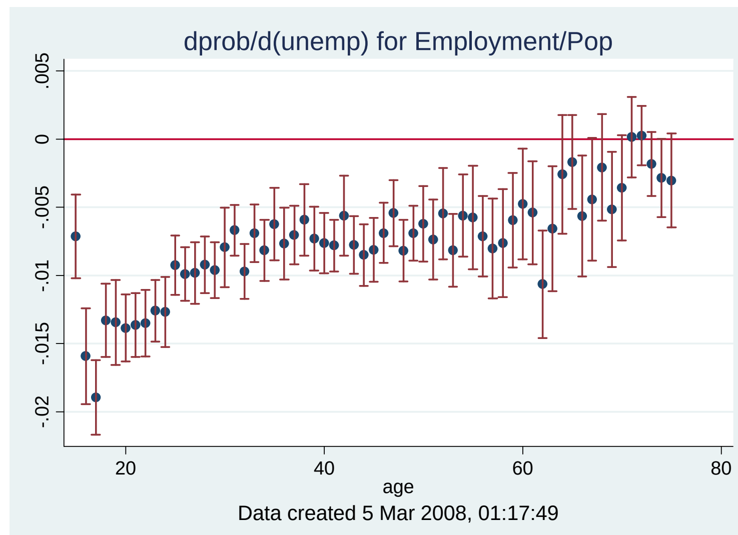

dprob/d(unemp) for Employment/Pop
age
Data created 5 Mar 2008, 01:17:49

Table 1

Replication of Ruhm estimates, different specifications and years

year	Ruhm- all 1972-1991	Ruhm - all 78-91	Ruhm rhs Our mortality 78-91	Our rhs Our mortality 78-91	Our rhs Our mortality 78-04	Age-adjusted mortality 78-04	Poisson model
weight by pop							
coeff	-0.0054	-0.0048	-0.0038	-0.004	-0.0026	-0.0042	-0.0044
se	(0.0010)	(0.0010)	(0.0007)	(0.0008)	(0.0009)	(0.0009)	(0.0010)
no weights							
coeff	-0.0056	-0.0053	-0.004	-0.0052	-0.0033	-0.0042	-0.0042
se	(0.0009)	(0.0010)	(0.0008)	(0.0010)	(0.0008)	(0.0007)	(0.0008)

Notes: Parameters are estimated Mortality semi-elasticity with respect to the state-year unemployment rate. Controls include State and Year Fixed effects, State-specific trends, demographic and education controls. Standard errors clustered at the state level. Estimates weighed by population.

Table 2
Estimated Relationship between Unemployment and Age-Specific Mortality - All Causes

	All			Males			Females		
Age	Beta	Predicted Additional Deaths	Total Deaths 2004	Beta	Predicted Additional Deaths	Total Deaths 2004	Beta	Predicted Additional Deaths	Total Deaths 2004
0-85	-0.0038	-8975	2397269	-0.0025	-2595	1181394	-0.0048	-5886	1215875
0-0	-0.0144	-403	27936	-0.0155	-244	15718	-0.013	-159	12218
1-17	-0.0092	-167	18068	-0.0115	-127	11003	-0.0054	-37	7065
18-24	-0.0158	-427	26972	-0.0165	-334	20232	-0.0104	-71	6740
25-34	-0.0093	-371	40868	-0.0132	-368	28359	0.0022	29	12509
35-44	-0.0028	-203	85362	-0.0043	-203	53677	0.0002	10	31685
45-54	-0.0015	-268	177697	-0.0009	-101	111163	-0.0024	-150	66534
55-64	-0.0017	-444	264697	-0.0016	-230	158032	-0.0015	-168	106665
65-69	-0.0024	-418	171984	-0.0014	-141	98455	-0.0036	-260	73529
70-74	-0.0035	-791	227682	-0.0011	-129	124436	-0.0064	-661	103246
75-79	-0.0027	-825	310746	-0.0005	-93	160308	-0.0044	-646	150438
80-84	-0.0056	-2075	373484	-0.004	-671	173361	-0.0061	-1222	200123
85-85	-0.0038	-2584	671773	0.0002	46	226650	-0.0057	-2551	445123

(Note that Ruhm age groups are 20-44, 45-64, 65+)

Table 3

Estimated Relationship between Unemployment and Cause-Specific Mortality

	All			Males			Females		
Cause of Death	Beta	Predicted Additional Deaths	Total Deaths 2004	Beta	Predicted Additional Deaths	Total Deaths 2004	Beta	Predicted Additional Deaths	Total Deaths 2004
All Causes	-0.0038	-8975	2397615	-0.0025	-2595	1181668	-0.0048	-5886	1215947
Cardiovascular	-0.0034	-2828	865863	-0.0021	-757	408541	-0.0042	-1899	457322
Cancer	0.0023	1432	567468	0.0035	1066	293594	0.0015	487	273874
Respiratory	-0.0105	-2419	229076	-0.0054	-579	109486	-0.0155	-1857	119590
Infections & immune deficiency	-0.0214	-1592	79608	-0.023	-900	39285	-0.0125	-461	40323
Degenerative Brain	-0.0091	-1629	161340	-0.0008	-77	56148	-0.0145	-1587	105192
Kidney	-0.0076	-340	43803	-0.0081	-169	20917	-0.0076	-175	22886
Nutrition related	-0.003	-256	90849	-0.0015	-40	43423	-0.0036	-177	47426
Motor Vehicle Accidents	-0.0262	-1141	44933	-0.0292	-860	30837	-0.0175	-247	14096
Other Accidents	-0.0078	-425	67079	-0.0056	-162	41213	-0.0119	-265	25866
Suicide	0.0183	684	32439	0.0139	424	25566	0.0337	228	6873
Homicide	-0.0168	-299	17729	-0.0165	-231	13941	-0.0175	-68	3788
VS other	-0.0157	-840	60522	-0.0186	-496	28297	-0.0131	-363	32225
Misc categories	-0.0039	-500	136906	-0.0034	-218	70420	-0.0042	-269	66486
All non-Motor Vehicle Accident	-0.0035	-8047	2352682	-0.0019	-1898	1150831	-0.0047	-5678	1201851

Note: "Misc categories" includes XXX.

TABLE 4

Dependent Variable: Log of Age-adjusted Death Rate Per 100,000

Subsample	all_bridg	all	25_29	30_34	35_39	40_44	45_49	50_54	55_59	60_64	65_69	70_74	75_79	80_84	85+
	(1)	(2)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
state urate (BLS)	-0.0044***	-0.0051***	-0.0115**	-0.0072	-0.0051	-0.0010	-0.0010	-0.0025	-0.0008	-0.0031***	-0.0022***	-0.0020**	-0.0020**	-0.0076***	-0.0091***
	(0.0010)	(0.0009)	(0.0049)	(0.0077)	(0.0061)	(0.0048)	(0.0031)	(0.0017)	(0.0014)	(0.0011)	(0.0006)	(0.0008)	(0.0009)	(0.0010)	(0.0014)
---------------------------															
state e/pop	0.0027***	0.0029***	0.0092**	0.0032	0.0044	0.0003	-0.0019	0.0015	-0.0003	0.0017**	0.0016**	0.0013*	0.0007	0.0033***	0.0048***
	(0.0007)	(0.0007)	(0.0036)	(0.0052)	(0.0047)	(0.0028)	(0.0021)	(0.0012)	(0.0011)	(0.0008)	(0.0007)	(0.0007)	(0.0010)	(0.0009)	(0.0013)
---------------------------															
group urate			0.0040	0.0011	-0.0007	0.0063*	0.0028*	-0.0012	0.0021**	-0.0008	0.0000	-0.0002	0.0004***	0.0000	0.0001
			(0.0041)	(0.0047)	(0.0047)	(0.0033)	(0.0016)	(0.0014)	(0.0009)	(0.0006)	(0.0005)	(0.0003)	(0.0002)	(0.0001)	(0.0001)
state urate			-0.0160**	-0.0082	-0.0046	-0.0059	-0.0032	-0.0017	-0.0024	-0.0026**	-0.0022***	-0.0019**	-0.0019**	-0.0076***	-0.0088***
			(0.0076)	(0.0089)	(0.0085)	(0.0056)	(0.0033)	(0.0020)	(0.0016)	(0.0012)	(0.0007)	(0.0008)	(0.0009)	(0.0010)	(0.0014)
---------------------------															
group e/pop			-0.0002	-0.0030	-0.0032	-0.0015	-0.0008	0.0003	0.0002	-0.0001	-0.0002	-0.0005	0.0000	0.0001	0.0005
			(0.0019)	(0.0021)	(0.0021)	(0.0021)	(0.0011)	(0.0006)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0006)	(0.0007)	(0.0005)
state e/pop			0.0094**	0.0054	0.0066	0.0012	-0.0013	0.0013	-0.0004	0.0018**	0.0017**	0.0015**	0.0007	0.0033***	0.0044***
			(0.0042)	(0.0057)	(0.0049)	(0.0033)	(0.0024)	(0.0012)	(0.0011)	(0.0007)	(0.0008)	(0.0007)	(0.0010)	(0.0009)	(0.0013)

Table 5

Dependent Variable: Log of Age-adjusted Death Rate Per 100,000

Subgroup	all	all	all	men	men	men	women	women	women
Age Group	25-44	45-61	62+	25-44	45-61	62+	25-44	45-61	62+
	(2)	(3)	(4)	(6)	(7)	(8)	(10)	(11)	(12)
All Races									
empr_subgrp_25_44	**-0.0040**	-0.0011*	0.0024***	**0.0013**	0.0002	0.0018***	**-0.0029***	-0.0005	0.0012**
	(0.0029)	(0.0007)	(0.0005)	**(0.0025)**	(0.0011)	(0.0003)	**(0.0016)**	(0.0007)	(0.0006)
empr_subgrp_45_61	0.0048**	**0.0002**	0.0010**	0.0035	**-0.0003**	0.0001	-0.0001	**0.0007**	0.0014***
	(0.0019)	**(0.0006)**	(0.0004)	(0.0034)	**(0.0006)**	(0.0003)	(0.0014)	**(0.0005)**	(0.0005)
empr_subgrp_62p	0.0030*	0.0017***	**0.0003**	0.0014	0.0006	**-0.0003**	0.0015	0.0007	**0.0004**
	(0.0017)	(0.0006)	**(0.0003)**	(0.0015)	(0.0006)	**(0.0002)**	(0.0020)	(0.0009)	**(0.0004)**
Whites									
empr_subgrp_wht_25_44	**-0.0050***	-0.0015	0.0023***	**0.0055****	0.0003	0.0020***	**-0.0027**	-0.0004	0.0007
	(0.0028)	(0.0010)	(0.0004)	**(0.0025)**	(0.0010)	(0.0004)	**(0.0018)**	(0.0006)	(0.0004)
empr_subgrp_wht_45_61	0.0070***	**0.0007**	0.0008	0.0032	**-0.0004**	-0.0001	0.0008	**0.0014*****	0.0012**
	(0.0019)	**(0.0005)**	(0.0005)	(0.0028)	**(0.0005)**	(0.0002)	(0.0014)	**(0.0005)**	(0.0005)
empr_subgrp_wht_62p	0.0040**	0.0016***	**0.0001**	0.0025*	0.0008**	**-0.0003**	0.0010	0.0011	**0.0002**
	(0.0017)	(0.0005)	**(0.0003)**	(0.0014)	(0.0004)	**(0.0002)**	(0.0019)	(0.0008)	**(0.0004)**
empr_subgrp_blk_25_44	0.0007	0.0000	0.0005**	-0.0005	0.0000	0.0002**	0.0002	-0.0003	0.0004**
	(0.0007)	(0.0002)	(0.0002)	(0.0006)	(0.0002)	(0.0001)	(0.0005)	(0.0002)	(0.0002)
empr_subgrp_blk_45_61	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	-0.0003	-0.0001	0.0000
	(0.0004)	(0.0001)	(0.0001)	(0.0004)	(0.0001)	(0.0001)	(0.0003)	(0.0001)	(0.0001)
empr_subgrp_blk_62p	0.0003	0.0002	0.0001*	0.0002	0.0000	0.0000	0.0000	0.0000	0.0001
	(0.0004)	(0.0002)	(0.0001)	(0.0002)	(0.0001)	0.0000	(0.0004)	(0.0002)	(0.0001)
Blacks									
empr_subgrp_wht_25_44	-0.0015	0.0018	0.0006	0.0003	0.0015	0.0015*	-0.0018	0.0006	-0.0007
	(0.0046)	(0.0014)	(0.0009)	(0.0042)	(0.0015)	(0.0009)	(0.0022)	(0.0013)	(0.0010)
empr_subgrp_wht_45_61	-0.0013	-0.0027**	0.0023***	0.0007	-0.0003	0.0017**	-0.0028	-0.0035***	0.0018***
	(0.0031)	(0.0013)	(0.0007)	(0.0028)	(0.0010)	(0.0008)	(0.0021)	(0.0012)	(0.0005)
empr_subgrp_wht_62p	0.0023	0.0004	0.0000	-0.0017	-0.0009	-0.0002	0.0060**	0.0012	0.0003
	(0.0035)	(0.0012)	(0.0008)	(0.0021)	(0.0010)	(0.0006)	(0.0029)	(0.0015)	(0.0007)
empr_subgrp_blk_25_44	**-0.0010**	0.0010	-0.0001	**-0.0038*****	-0.0001	-0.0008**	**0.0007**	0.0002	0.0001
	(0.0016)	(0.0008)	(0.0004)	**(0.0014)**	(0.0007)	(0.0004)	**(0.0011)**	(0.0006)	(0.0003)
empr_subgrp_blk_45_61	-0.0009	**-0.0002**	0.0006**	-0.0005	**-0.0001**	0.0005**	-0.0003	**0.0002**	0.0002
	(0.0017)	**(0.0005)**	(0.0002)	(0.0014)	**(0.0004)**	(0.0003)	(0.0010)	**(0.0005)**	(0.0002)
empr_subgrp_blk_62p	0.0002	-0.0004	**-0.0004**	0.0000	0.0001	**0.0000**	-0.0006	-0.0007	**-0.0007***
	(0.0015)	(0.0006)	**(0.0004)**	(0.0013)	(0.0004)	**(0.0003)**	(0.0009)	(0.0006)	**(0.0004)**

Table 6 - Effects of the business cycle on BRFSS health indicators
1987 - 2006

	All ages		**Ages 25-44**		**Ages 45-61**		**Ages 62+**	
Outcome	Sample mean	Predicted effect	Sample mean	Predicted effect	Sample mean	Predicted effect	Sample mean	Predicted effect
Current smoker	0.2267	-0.1617 **	0.2624	-0.2418 **	0.2365	-0.1999	0.1225	-0.0117
		(0.0780)		(0.0850)		(0.1223)		(0.1036)
Overweight (BMI >= 25)	0.5706	-0.0863	0.5589	0.0259	0.6695	-0.5000 **	0.6053	0.1003
		(0.0992)		(0.1266)		(0.1853)		(0.2102)
Obese (BMI >= 30)	0.2034	-0.0048	0.1984	0.1820	0.2653	-0.3610 **	0.1983	-0.0295
		(0.0888)		(0.1457)		(0.1179)		(0.1410)
Severely obese (BMI >= 35)	0.0648	0.0024	0.06494	0.0918	0.0895	-0.0509	0.0528	-0.0605
		(0.0395)		(0.0705)		(0.0832)		(0.0895)
Physical inactivity	0.2752	-0.4044	0.2465	-0.3469	0.2929	-0.4404	0.3597	-0.4627
		(0.2531)		(0.2665)		(0.2598)		(0.3131)
Multiple health risks	0.1062	-0.1891	0.1097	-0.1280	0.1342	-0.2475 **	0.0845	-0.2030
		(0.1105)		(0.1587)		(0.1076)		(0.1304)
Good health or better	0.8493	0.2633 **	0.9070	0.1674	0.8275	0.2855	0.7189	0.4325 **
		(0.1113)		(0.1321)		(0.1741)		(0.1711)
Fair health or better	0.9597	0.0008	0.9833	-0.0686	0.9463	0.1045	0.9101	-0.0172
		(0.0344)		(0.0360)		0.0819		(0.1173)
Routine checkup in past year	0.6896	-0.4108	0.6152	-0.2653	0.7125	-0.6843	0.8354	-0.2379
		(0.3558)		(0.4864)		(0.3734)		(0.1886)

Note: Micro data from BRFSS. Probit coefficients. (dlm: check)

Table 7
Effects of the business cycle on the fraction of state population in various health occupations

Occupation	Mean	OLS	Poisson
Non-MD	0.02448	0.00007	-0.00329
		(0.00016)	(0.00655)
MD	0.00319	-0.00014	-0.04960
		(0.00005)	(0.01390)
Nurse	0.01317	-0.00009	-0.01479
		(0.00011)	(0.00773)
Health aide	0.00200	-0.00004	-0.04657
		(0.00004)	(0.02094)
Nurse aide	0.00931	0.00019	0.02604
		(0.00008)	(0.00728)

Current Population Survey, 1983-2002
Regression using state and year fixed effects and state trends
N = 1020

Table 8
Effects of the business cycle on education levels for various health occupations

	RN	LPN	Health aide	Nurse aide
HS graduate	-0.00018	0.00168	0.00485	0.00270
	(0.00019)	(0.00105)	(0.00335)	(0.00233)
Some college	-0.00017	0.01377	0.00190	0.00535
	(0.00128)	(0.00733)	(0.00474)	(0.00277)
College graduate	-0.00090	0.00462	0.00215	-0.00012
	(0.00334)	(0.00259)	(0.00286)	(0.00116)
N	250123	57926	53080	238738

Current Population Survey, 1983-2002
Probit regression with state and year fixed effects. Std. errors clustered at state level.

Appendix Table 1

Estimated Relationship between Unemployment and Mortality by Cause of Death and Age

Estimated Beta

Age	All Causes	Cardiovascular	Cancer	Respiratory	Infections	Deg. Brain	Kidney	Nutrition	Motor Vehicle	Other Accid	Suicide	Homicide	VS Other	Nutrition, Birth Def, Gstro.	All Non-Motor Veh. Acc.
0-85	-0.0038	-0.0034	0.0023	-0.0105	-0.0214	-0.0091	-0.0076	-0.003	-0.0262	-0.0078	0.0183	-0.0168	-0.0157	-0.0039	-0.0035
0-0	-0.0144	-0.0056	-0.0216	-0.0299	-0.0462	0.0312	0.0247	-0.0584	-0.0416	-0.0099		-0.0342	-0.0498	-0.0051	-0.0143
1-17	-0.0092	0.0105	0.0037	-0.0079	-0.0137	0.0223	-0.0102	-0.0327	-0.0163	-0.0122	-0.0125	-0.0132	-0.0554	-0.0055	-0.0074
18-24	-0.0158	0.0033	-0.0046	-0.0098	-0.0078	-0.0216	0.0051	0.0048	-0.0332	-0.0158	0.0084	-0.0165	-0.0663	-0.0113	-0.0091
25-34	-0.0093	-0.0013	0.0085	-0.0209	-0.0351	0.0109	-0.0285	-0.0111	-0.0325	-0.0109	0.0155	-0.019	-0.0755	-0.0139	-0.0059
35-44	-0.0028	-0.0004	0.0008	-0.0073	-0.0282	0.004	-0.0019	-0.0005	-0.0289	-0.0063	0.0217	-0.0182	-0.078	-0.0185	-0.0014
45-54	-0.0015	-0.0004	0.002	-0.0161	-0.0306	-0.0166	-0.0019	-0.0109	-0.0248	0.0123	0.0397	-0.0259	-0.0649	-0.0038	-0.0009
55-64	-0.0017	-0.0017	0.0021	-0.0117	-0.0126	-0.0125	-0.0047	-0.0088	-0.0182	0.0038	0.0231	-0.0096	-0.0031	-0.0056	-0.0015
65-69	-0.0024	-0.003	-0.0003	-0.0077	-0.0132	0.0067	-0.0023	-0.0043	-0.0312	0.0078	0.012	0	0.0139	0.0039	-0.0022
70-74	-0.0035	-0.0045	0.0019	-0.0095	-0.0083	-0.0095	-0.0045	-0.0018	-0.0208	-0.0113	0.0145	-0.0083	0.0086	-0.0008	-0.0034
75-79	-0.0027	-0.0036	0.0045	-0.0075	-0.0159	-0.0072	-0.0122	-0.0029	-0.0223	-0.013	0.0048	0.0193	0.0193	0.0023	-0.0026
80-84	-0.0056	-0.0057	-0.0001	-0.0101	-0.0208	-0.0052	-0.0076	0.0033	-0.0149	-0.0188	0.0029	0.0036	0.0115	-0.0054	-0.0056
85	-0.0038	-0.0029	0.0067	-0.0125	-0.0193	-0.0139	-0.0104	-0.0001	0.0056	-0.0155	0.0216	0.0428	0.0099	0.0001	-0.0039

Appendix Table 2

Estimated Relationship between Unemployment and Mortality by Cause of Death and Age

Predicted Additional Deaths from a 1 percentage point increase in the unemployment rate

Age	All Causes	Cardiovascular	Cancer	Respiratory	Infections	Deg. Brain	Kidney	Nutrition	Motor Vehicle	Other Accid	Suicide	Homicide	VS Other	Nutrition, Birth Def, Gstro.	All Non-Motor Veh. Acc.
0-85	-8975	-2828	1432	-2419	-1592	-1629	-340	-256	-1141	-425	684	-299	-840	-500	-8047
0-0	-403	-3	-3	-19	-26	4	4	-1	-6	-9		-11	-190	-104	-398
1-17	-167	6	8	-6	-5	15	-2	-5	-77	-35	-11	-19	-79	-10	-101
18-24	-427	3	-7	-4	-6	-7	1	2	-280	-56	29	-71	-89	-16	-169
25-34	-371	-6	34	-17	-71	8	-8	-11	-226	-61	78	-87	-170	-42	-189
35-44	-203	-6	14	-18	-203	3	-3	2	-196	-46	162	-54	-319	-154	-79
45-54	-268	-12	102	-118	-320	-52	-3	-84	-152	134	274	-54	-394	-69	-144
55-64	-444	-126	195	-213	-119	-65	-15	-115	-74	22	97	-10	-25	-86	-383
65-69	-418	-164	-23	-129	-60	31	-7	-35	-47	18	13	0	47	31	-379
70-74	-791	-334	148	-247	-50	-78	-19	-20	-29	-33	17	-1	39	-7	-765
75-79	-825	-395	406	-283	-138	-135	-80	-37	-37	-54	6	2	109	26	-794
80-84	-2075	-860	-7	-446	-226	-161	-58	52	-23	-116	2	0	86	-71	-2056
85	-2584	-932	566	-918	-369	-1193	-149	-3	7	-189	17	4	146	3	-2589