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MACROECONOMIC CONDITIONS, HEALTH AND MORTALITY

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ABSTRACT

Although health is conventionally believed to deteriorate during macroeconomic downturns, the empirical evidence supporting this view is quite weak and comes from studies containing methodological shortcomings that are difficult to remedy. Recent research that better controls for many sources of omitted variables bias instead suggests that mortality decreases and physical health improves when the economy temporarily weakens. This partially reflects reductions in external sources of death, such as traffic fatalities and other accidents, but changes in lifestyles and health behaviors are also likely to play a role. This paper summarizes our current understanding of how health is affected by macroeconomic fluctuations and describes potential mechanisms for the effects.

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Macroeconomic Conditions, Health and Mortality

Although health is conventionally believed to deteriorate during macroeconomic downturns, the empirical evidence supporting this view is quite weak and comes from studies containing methodological shortcomings that are difficult to remedy. Recent research that better controls for many sources of omitted variables bias instead suggests that mortality *decreases* and physical health *improves* when the economy temporarily weakens. This partially reflects reductions in external sources of death, such as traffic fatalities and other accidents, but changes in lifestyles and health behaviors are also likely to play a role. This paper summarizes our current understanding of how health is affected by macroeconomic fluctuations and describes potential mechanisms for the effects.

1. Time series analyses for single locations

There has been extensive research examining how the macroeconomy affects health and mortality using time series data aggregated over a single geographic location, such as the United States. Most influential have been a series of studies by Brenner (1971, 1973, 1975, 1979, 1987) arguing that recessions and other sources of economic instability increase overall mortality, infant deaths, and fatalities from cardiovascular disease, cirrhosis, suicide, and homicide as well as morbidities, alcoholism and admissions to mental hospitals.

These findings are controversial. Many researchers (Kasl, 1979; Gravelle, et al., 1981; Stern, 1983; Gravelle, 1984; Wagstaff, 1985; Cook & Zarkin, 1986) point out serious flaws in Brenner's analysis and studies correcting the problems (Forbes & McGregor, 1984; McAvinchey, 1988; Joyce & Mocan, 1993) fail to replicate his findings.[1] The results instead are sensitive to the choice of countries, time periods and proxies for health. With the exception of Brenner's

research, most time series evidence suggests that the contemporaneous effect of economic downturns is to improve health and reduce mortality. Indeed, analyses undertaken as early as the 1920s by Ogburn & Thomas (1922) and Thomas (1927) identify a positive correlation between macroeconomic activity and total mortality as well as deaths from several specific causes (with the exception of suicides). Eyer (1977) obtains a similar finding using U.S. data from 1870-1975. These correlations hint at a procylical variation in mortality, although they are not conclusive since other determinants of health are not controlled for.

Recent time series analyses correct for some problems inherent in earlier studies. McAvinchey (1988), for instance, uses statistical rather than ad-hoc methods to choose the lag length and order of the polynomial lag; Joyce & Mocan (1993) and Laporte (2004) correct for nonstationarity in the time series data; Tapia Granados (2004a) implements spectral analysis and local regression techniques; and Gerdtham & Johannesson (2005) use multiple business cycle indicators with data on individual, rather than aggregate, mortality risk. Despite these innovations, the results remain ambiguous. Most of this research continues to suggest that mortality is procyclical (Laporte, 2004; Tapia Granados, 2004a, forthcoming) but some finds countercyclical effects (Gerdtham & Johannesson, 2005), no impact (Joyce & Mocan, 1993) or variation across countries (McAvinchey, 1988).

Such a lack of robustness should not be surprising since any lengthy time-series may yield biased estimates due to omitted variables that are spuriously correlated with economic conditions and affect health.[2] This problem has long been recognized by at least some

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[1] Criticisms include Brenner's method of choosing lag lengths, the hypothesized pattern of lag coefficients, choice of covariates, use of inconsistent data series, poor data documentation, implausibility of results, and use of different specifications across studies without justification or evidence of the robustness of the findings to such changes.

[2] For example, the variation in unemployment occurring during the four decades (beginning in the 1930s) covered by much of Brenner's research is dominated by dramatic reductions in joblessness following the great depression. During this same period, mortality declined due to improved nutrition and increased availability of antibiotics.

researchers. A solution proposed by Kasl (1979, p. 787) is to conduct "a more refined ecological analysis … taking advantage of local and regional variations in the business cycle as well as in disease rates." Stern (1983, p. 69) similarly points to the promise of using differencing techniques with panel data.[3] Research using these strategies has become increasingly common in the last five years and is the focus of the remainder of this chapter.

2. Estimates using pooled data with location-specific fixed effects

A number of recent studies address the omitted variables bias issue by estimating models using panel data for multiple geographic locations at several points in time. Some analyses (including most examining mortality outcomes) use geographically aggregated variables; others (such as those focusing on morbidities or lifestyles) typically utilize individual level information but with the key macroeconomic determinants measured over larger areas.

Studies based on aggregate data usually estimate some variant of:

$$Y_{jt} = \alpha_j + X_{jt}\beta + E_{jt}\gamma + \lambda_t + \varepsilon_{jt}, \quad (1)$$

where Y_{jt} is a health outcome or input in location j at time t, E measures macroeconomic conditions, X is a vector of covariates, α is a location-specific fixed-effect, λ a general time effect, and ε is the regression error term. The corresponding equation with microdata is:

$$Y_{ijt} = \alpha_j + X_{ijt}\beta + E_{jt}\gamma + \lambda_t + \varepsilon_{ijt}, \quad (2)$$

where i indexes the individual, with the macroeconomic and fixed effects referring to the geographic area.

Unemployment rates are the most common primary proxy for macroeconomic conditions but other variables (e.g. the employment-to-population ratios or growth in real GDP) are

[3] Methods of testing for potential omitted variables bias when using time series data include examining whether the model estimates are structurally stable over time (Gravelle et al., 1981) and controlling for future values of the macroeconomic variables as an informal test of reverse causality (Joyce & Mocan, 1993).

sometimes used. Interpretation of the results in models that also control for incomes is more complicated since, as discussed below, permanent growth may improve health but transitory increases need not. Moreover, since incomes fall during temporary downturns, their inclusion is likely to absorb and possibly explain a portion of the macroeconomic effect. Supplementary regressors vary but often include measures of age, education and race/ethnicity. Some analyses add lags of the macroeconomic variables or use other methods to capture dynamics of the adjustment process.

To illustrate the econometric strategy, consider annual mortality rates for a panel of states estimated using equation (1). The year effects (λ_t) hold constant determinants of death that vary uniformly across states over time, the fixed-effects (α_j) account for those that differ across locations but are time-invariant, and the impact of the macroeconomy is identified from within-state variations relative to the changes in other states. The state and year effects control for a wide variety of determinants of health – such as lifestyle differences between residents of Nevada and Utah or advances in widely used medical technologies. The model does *not* account for factors varying within states over time, but including a vector of state-specific time trends can often substantially rectify this.[4]

Unemployment rates are often used to *proxy* macroeconomic conditions but the effects need not be restricted to or concentrated among those changing employment status. For instance,

[4] The impact of national business cycles, which could differ from more localized fluctuations, is absorbed by the time effects. Discussions of "cyclical" variations or "macroeconomic" effects therefore refer to changes within locations rather than at the national level and terms like "recessions" are used loosely to indicate deterioration in local conditions, rather than reflecting official technical definitions. Migration flows mitigate against finding a countercyclical variation in health if movers are relatively healthy and relocate into areas with robust economies.

the stress of job loss could have a negative impact on health that is more than offset by improvements for workers whose hours or job-related pressures are reduced.[5]

3. Adult mortality

Death rates are the most common dependent variables in research using the methods just described. Mortality is useful to study because it represents the most severe negative health outcome, is objective and well measured, and diagnosis generally does not depend on access to the medical system (in contrast to many morbidities).[6] Table 1 documents widespread evidence of a procyclical fluctuation in total mortality and some specific sources of death, which is obtained despite substantial differences in samples and time periods, and some variation in model specifications,

A one percentage point increase in the unemployment rate is typically associated with a 0.3 to 0.5 percent reduction in total mortality, corresponding to an elasticity of -.02 to -.05 (Ruhm, 2000, 2004a; Johansson, 2003; Gerdtham & Ruhm, 2004; Tapia Granados, 2004b). Using German data, Neumayer (2004) estimates a significantly larger 1.1 percent decrease.[7] Some reasons why mortality falls are obvious. Individuals drive fewer miles and so motor vehicle fatalities decrease – a one point increase in unemployment is predicted to reduce traffic deaths by between one and three percent (Ruhm, 2000; Neumayer; 2004; Gerdtham & Ruhm, 2004; Tapia Granados, 2004b). Other sources of accidental deaths probably also decrease.

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[5] The nonemployed are in worse average health than workers (e.g. Morris, et al., 1994; Ettner, 2000; Gerdtham & Johannesson, 2003). However, since poor health reduces employment probabilities, the direction of causation is not well understood (Bartley, 1996; Goldney, 1997; Stewart, 2001).

[6] However, fatalities may not capture changes in non-life threatening conditions. Also, small negative shocks might cause frail individuals to die sooner, while having little effect on overall population health.

[7] Evidence of a countercyclical variation in total mortality and many specific sources of death is provided by Economou et al. (2004). However, their specifications control for smoking, drinking, caloric intake, hospitalization and (sometimes) pollution levels that, as shown below, are directly affected by macroeconomic conditions and so provide potential mechanisms for the fluctuations in health. As a result, the unemployment coefficients do not capture the full macroeconomic effect and are difficult to interpret.

The results are more mixed for deaths from specific medical conditions. Cardiovascular fatalities are procyclical, with variations of similar or larger magnitude (in percentage terms) than for total mortality (Ruhm, 2000; Neumayer, 2004; Gerdtham & Ruhm 2004). Particularly strong fluctuations are observed for deaths due to ischemic heart disease and especially acute myocardial infarction (Ruhm, 2004a), that are likely to be responsive to short-term changes in modifiable health behaviors and environmental risk factors. A procyclical variation in influenza/pneumonia fatalities is also generally obtained. Conversely, cancer mortality is not related to the macroeconomy, which makes sense since a short-run impact of even substantial changes in behavior seems unlikely for this cause of death. Fatalities from most other sources may increase when the economy improves but with less consistency across studies. For instance, a procyclical variations in fatalities from liver disease is obtained by Ruhm (2000) and Gerdtham & Ruhm (2004) but not Neumayer (2004).

Diverse findings are obtained for suicides. Ruhm (2000) uncovers a strong countercyclical variation, but with weaker effects by Gerdtham & Ruhm (2004) or Tapia Granados (2004b), and a strong procyclical pattern by Neumayer (2004). There is a similar variation for homicides, pointing to possible differences in the macroeconomic determinants across countries or institutional arrangements. This is particularly salient given evidence by Gerdtham & Ruhm (2004) showing relatively weak procyclical fluctuations in mortality for countries with strong social safety nets.

Infant mortality in the United States also declines when the economy weakens. Ruhm (2000) estimates that a one point rise in unemployment decreases infant and neonatal death rates by 0.6 percent, while Dehejia & Lleras-Muney (2004) predict 0.5, 0.3 and 0.9 percent reductions in infant, neonatal and postneonatal mortality. Conversely, no relationship is obtained for

Germany by Neumayer (2004) or OECD countries by Gerdtham & Ruhm (2004), again suggesting variation across institutional environments.

Due to severe data restrictions, few analyses examine how macroeconomic conditions affect morbidity. One that does is Ruhm (2003). He estimates that a one point increase in unemployment reduces the fraction of adults (30 and over) with one or more medical conditions by 1.5 percent, which largely reflects a 3.9 percent decrease in the prevalence of acute problems. The probability of restricted-activity and bed-days (during a two week period) similarly falls 1.2 and 1.6 percent. Finally, 4.3 and 8.7 percent reductions in the predicted prevalence of ischemic heart disease and intervertebral disk problems contrast with a 7.2 percent increase in non-psychotic mental disorders.

4. Health behaviors and medical care

One reason individuals become healthier during economic downturns is because of changes in behaviors and lifestyles. Alcohol use has been most widely studied. Drinking and alcohol-involved vehicle mortality vary procyclically (O'Neill, 1984; Evans & Graham, 1988; Wagenaar & Streff, 1989; Ruhm, 1995; Freeman, 1999), with evidence from individual level data suggesting that the reductions during bad times are dominated by a decline in heavy use (Ruhm & Black, 2002) rather than in light drinking, which is sometimes linked to health benefits (e.g. Gaziano, et al., 1993; Thun, et al., 1997).[8]

The healthier lifestyles are not restricted to decreases in problem drinking. Ruhm (forthcoming) finds that severe obesity, smoking and physical inactivity decline, with larger

[8] Two earlier investigations used microdata. Ettner (1997) concluded that alcohol consumption and dependence were procyclical but with mixed effects of involuntary unemployment. Dee (2001) obtained the contradictory result that economic downturns reduced overall and heavy drinking but increased binge drinking.

(percentage) reductions in multiple risk factors.[9] Ruhm (2000) shows that the consumption of dietary fat falls while the intake of fruits and vegetables rises. Dehejia & Lleras-Muney (2004) indicate that pregnant mothers consume less alcohol, with mixed effects for smoking. Dustmann & Windmeijer (2004) find that temporary wage reductions in Germany are associated with increases in physical exercise. However, Böckerman et al. (2004) sometimes obtain a countercyclical variation in obesity for Finnish adults (with no relationship in other models).

The improvements in health occur despite reductions in the use of medical care: the frequency of routine checkups, screening tests, doctor visits and hospital episodes all fall during downturns (Ruhm, 2000; 2003). However, other research indicates a negative relationship between employment and the utilization of medical care (Mwabu, 1988; Vistnes & Hamilton, 1995) and pregnant women obtain earlier and more extensive prenatal care during times of high unemployment (Dehejia & Lleras-Muney, 2004).

5. Income effects and dynamics

Worse health during *temporary* expansions need not imply negative effects of *permanent* economic progress. Transitory increases in output usually require more intensive use of labor and health inputs with existing technologies. Permanent growth, conversely, results from technological innovations or expansions in the capital stock that potentially ameliorate any costs to health. Individuals are also more likely to defer health investments in response to a temporary rather than lasting rise in work hours.[10]

This distinction is not hypothetical, as there is evidence of sharp differences in the effects of temporary and permanent income changes. Graham et al. (1992) find that permanent

[9] DiSimone (2004) provides evidence of a countercyclical variation in obesity for high school aged boys (but not girls) that partly reflects changes in physical activity.

increases are associated with reduced mortality in the U.S., whereas temporary growth correlates with increased fatalities. Dustmann & Windmeijer (2004) show that higher wealth profiles in Germany predict improved health, whereas status worsens when wages temporarily rise.

Mixed and inconsistent results are obtained when income is included as an additional covariate in the research using the specifications focused on in this chapter. In these studies, income is sometimes positively and other times negatively correlated mortality (see Table 1), while a fairly uniform protective effect is obtained for morbidities and functional limitations (Ruhm, 2003). These are accompanied by reductions in risky behaviors such as smoking and physical inactivity (Ruhm, forthcoming) but with increases in obesity, alcohol use and heavy drinking (Freeman, 1999; Ruhm, 2000; Ruhm, forthcoming).

A number of the studies examine the dynamics of adjustment to fluctuations in the macroeconomy. The results, while not completely consistent, generally suggest that the impact of sustained changes accumulates for a period of time – at least one or two years – with subsequent attenuation observed in some studies (e.g. Ruhm, 2000) but not others (e.g. Neumayer, 2004; Gerdtham & Ruhm, 2004). These findings are generally consistent with Grossman's (1972) health capital model, where investments flows gradually affect the stock of health, leading to effects that increase over time.

6. Why does health worsen when the economy temporarily improves?

As mentioned, health could be countercyclical because it is an input into short-run increases in the production of goods and services. Moreover, hazardous working conditions, the physical exertion of employment and job-related stress could have negative effects, particularly when job hours are extended during economic expansions (Baker, 1985; Karasek & Theorell,

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[10] There is strong evidence that increases in permanent income improve health in developing countries but with a more ambiguous relationship observed for industrialized nations. Useful discussions of this voluminous literature

1990; Sokejima and Kagamimori, 1998; Kivimäki, et al., 2002, Liu et al., 2002). Extra work hours also lead to reductions in sleep (Biddle & Hamermesh, 1990) which are linked to increased stress, decreased alertness and greater injury risk, and higher rates of obesity and physiological or psychological symptoms (Maruyama et al., 1995; Sparks & Cooper, 1997; Gangwisch & Heymsfield, 2004). Cyclically sensitive sectors, such as construction and manufacturing, have high accident rates, which may be exacerbated when the economy temporarily improves by increased hiring of inexperienced workers and speedups in production (Catalano, 1979; Robinson, 1988; Brooker et al., 1997).

Some joint products of economic activity, such as pollution and traffic congestion, also present health risks (Clancy et al., 2002; Chay & Greenstone, 2003; Peters et al., 2004). These negative consequences may be particularly pronounced for vulnerable sectors of the population – such as infants or senior citizens – who do not participate in the labor force. Economic expansions also induce migration, which could lead to increased social isolation and loss of community support, particularly among the old and young (Eyer, 1977; Tapia Granados, 2004a).

Decreases in non-market "leisure" time make it more costly for individuals to undertake health-producing activities such as exercise and cooking meals at home. Moreover, if health is time-intensive, the demand for both health and the inputs producing it are likely to rise when time prices fall (Grossman, 1972). Evidence that higher time prices correlate with increased obesity has been provided for adults by Chou et al. (2004) and among children by Anderson et al. (2003) and Ruhm (2004b). That said, the direct evidence linking work hours to health outcomes is mixed (e.g. Johansson, 2003; Ruhm, 2004a; Ruhm, forthcoming).

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are contained in Smith (1999), Deaton (2003), or Gerdtham & Johannesson (2004).

7. Concluding thoughts

Recent empirical research suggests that physical health improves and mortality declines when the economy temporarily weakens. Some of this can be easily explained. For example, there is less driving, reducing the risk of traffic fatalities. However, mechanisms for decreases in morbidity and deaths from medical conditions such as cardiovascular disease are less well understood. In particular, it is not yet clear why individuals adopt healthier lifestyles (like reductions in smoking, drinking and physical inactivity). Some risky behaviors (e.g. drinking) decline when incomes fall but most do not. Individuals have more time to undertake health investments such as exercise, when working fewer hours, but the empirical evidence on this is mixed. Conversely, reductions in pollution have clear positive effects on health that are not limited to the working age population.

Future research is needed to confirm the patterns discussed in this chapter and better identify underlying mechanisms for the effects. That said, evidence of a countercyclical variation physical in health suggests that economic progress need not be uniformly beneficial. Health is likely to improve when income permanently increases but the effects of transitory fluctuations may be quite different and, even in the long-run, the uses of the higher incomes may be important (Sen, 2001). These results should obviously not be used to promote recessionary economic policies but they do imply that some previous advocates (e.g. Brenner, 1984) have overly enthusiastically cited an assumed procyclical variation in health as an argument in favor of macroeconomic stabilization policies.

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Table 1:
Macroeconomic Effects on Mortality Estimated Using Pooled Data with Location-Specific Fixed Effects

Study	Sample	Major Findings	Comments
Ruhm (2000)	50 states and District of Columbia, 1972-91	*Significant Unemployment Effects* ALL: -0.5% [-.04]; 20-44 year olds: -2.0% [-.14]; 65+ year olds: -0.3% [-.02]; CVD: -0.5% [-.03]; FLU: -0.7% [-.05]; VEHICLE: -3.0% [-.21]; EXTERNAL: -1.7% [-.11]; suicide: 1.3% [.09]; homicide: -1.9% [-.13]; INFANT: -0.6% [-.04]; NEONATAL: -0.6% [-.04]. *Insignificant Effects* 45-64 year olds: 0.0%; CANCER: 0.0%; LIVER: -0.4%. Dynamic models generally yield largest effects in medium-run. Mixed and inconsistent income effects.	All models control for percent of state population in specified age, race/ethnicity, education, and marital status groups. Similar results obtained using EP ratio or change in payroll employment as alternative macroeconomic proxies, or when including state-specific time trends.
Johansson (2003)	23 OECD countries, 1960-97	*Significant Unemployment Effects* ALL: -0.4%; -0.3% for observations with information on work hours. Total mortality is negatively associated with per capita incomes and work hours.	Same sample and specification as Gerdtham & Ruhm (2004), except for the addition of work hours in some models.
Neumayer (2004)	16 German states, 1980-2000	*Significant Unemployment Effects* ALL: -1.1%; females: -1.3%; males: -0.9%; 20-45 year olds: -1.1%; 65+ year olds: -1.2%, CVD: -1.8%; FLU: -3.1%; VEHICLE: -1.3%; suicide: -1.4%. *Insignificant Effects* 45-64 year olds: -0.5%; CANCER: -0.1%; LIVER: 0.4%; homicide: 0.3%; EXTERNAL: 1.7%; INFANT: 0.2%; NEONATAL: -1.9%. Dynamic models generally yield larger effects in long-run than initially. Income effects are mixed and inconsistent.	Most specifications correspond to Ruhm (2000). Standard errors corrected for heteroscedasticity and autocorrelation. Models control for personal income, age and percent foreign. Similar results using real GDP growth as macroeconomic proxy.
Econo-mou et al., (2004)	13 EU countries, 1977-96	*Significant Unemployment Effects* ALL: 0.3% [.02]; 45-54 year olds: 0.5% [.04]; 55-64 year olds: 0.5% [.05]; ISCHEMIC; 0.8% [.07]; CANCER: 0.2% (.02); suicide: 0.9% [.08]; homicide: 1.5% [.14]. *Insignificant Effects* Males: 0.2%; females: 0.1%; 25-34 year olds: -0.4%; 35-44 year olds: 0.3%; 65-74 year olds: 0.1%; 75-84 year olds: -0.1%; VEHICLE: 3.0%.	Results difficult to interpret because models control for covariates (smoking, drinking, caloric intake, hospitalization and sometimes pollution levels) that are determined by macroeconomic conditions.
Gerdtham & Ruhm (2004)	23 OECD countries, 1960-97	*Significant Unemployment Effects* ALL: -0.4% [-.02]; CVD: -0.4% [-.02]; LIVER: -1.8% [-0.10];VEHICLE: -2.1% [-.12]; EXTERNAL: -0.8% [-.04]]. *Insignificant Effects* CANCER: 0.1%; FLU: -1.1% [-.05]; suicide: 0.4%; homicide: 1.1%; INFANT: -0.2%. Dynamic models yield larger long-run than initial effects for some outcomes and smaller impacts for others.	Models control for age structure, percent male and include country-specific time trends. Stronger effects are obtained for large countries, nations with weak social safety nets and in more recent years.
Ruhm (2004)	20 largest states, 1978-1997	*Significant Unemployment Effects* ISCHEMIC: -0.8% [-.05] 20-44 year olds: -1.7% [-.11]; 45-54: -1.0 [.07]; 65+ year olds: -0.7% [-.05]. AMI: -1.5% [-.10] 20-44 year olds: -2.3% [-.15]; 45-54: -1.2 [.08]; 65+ year olds: -1.6% [-.10].	Macroeconomic effects similar across sex and race. Mixed effects for income, work hours and long-run versus short-run.
Tapia Granados (2004b)	50 Spanish provinces, 1980-97	*Significant Unemployment Effects* All -0.3% [-.05]; females: -.2% [-.04]; males: -.2% [-.05]; EXTERNAL (includes VEHICLE): -0.7% [-.13]; VEHICLE: -1.9% [-.37] *Insignificant Effects* CVD: -0.1%; CANCER: -0.1%; respiratory disease: 0.0%; infectious disease: -0.6%; suicide: 0.5%; homicide: -0.3%	Models control for age structure and per capita GDP. Similar results obtained using EP ratio as macroeconomic proxy. Inclusion of state-specific trends attenuates effects.

Abbreviations: ALL – total mortality; CVD – cardiovascular disease; ISCHEMIC – ischemic heart disease; AMI – acute myocardial infarction; CANCER – malignant neoplasms; FLU – pneumonia and influenza; LIVER – chronic liver disease; VEHICLE – motor vehicle; EXTERNAL – external causes/accidents other than from motor vehicles; INFANT – infant deaths (in first year); NEONATAL – neonatal deaths (in first 28 days); EP ratio – employment-to-population ratio.

Note: Unemployment effects indicate impact of a one percentage point increase; elasticities are in brackets. All models control for location-specific effects and general time effects. Significant effects refer to rejection of the null at 0.05 level.