Commentary: Mortality increases during economic upturns

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The conventional wisdom is that mortality falls when the economy temporarily improves and increases when it weakens. This strong apriori belief has engendered substantial attention to be paid to analyses indicating a countercyclical variation in deaths and excessive scepticism to countervailing evidence. However, this view is beginning to change as recent research, often using more sophisticated methodological designs than earlier studies, commonly finds that fatalities rise during economic upturns. 'Increasing Mortality During Expansions of the US Economy, 1900–1996' by José Tapia Granados[1] contributes to this new understanding by showing that the secular decline in US mortality accelerates during economic recessions and slows or reverses in expansions. His analysis utilizes time-series data on total deaths, as well as age-specific and cause-specific mortality.

The use of time series data for a single geographic location is traditional in this research. The next section discusses how the resulting literature has obtained ambiguous results, in part because of difficulties in adequately controlling for confounding factors that are spuriously correlated with macroeconomic conditions. This is followed by a description of a relatively new approach using panel data for multiple time periods and geographic areas. Longitudinal information allows for estimation methods that exploit within-location changes in economic conditions. Since local economies evolve somewhat independently over time, these variations are less likely to be correlated with changes in omitted determinants of death that have similar effects across areas (such as many technological innovations). Most estimates using these techniques indicate a procyclical variation in mortality.

Time series analyses

Most of the extensive research examining how mortality varies with macroeconomic conditions uses time series data aggregated over a single geographic location (such as the US). Particularly influential have been a series of studies conducted by M Harvey Brenner[2–5] suggesting that overall mortality, infant deaths and fatalities from cardiovascular disease, cirrhosis, suicide and homicide increase during recessions and periods of economic instability.

These findings are controversial. Researchers have pointed out serious technical flaws in Brenner's analyses including: choice of lag lengths and covariates, hypothesized pattern of lag

coefficients, use of inconsistent or poorly documented data, and changes in specifications within and across analyses.[6–11] Studies correcting the problems often fail to replicate his findings.[11–14] With the exception of Brenner's work, most (but not all) of the time series evidence suggests that economic downturns reduce mortality. Research undertaken as early as the 1920s by Ogburn and Thomas[15] and Thomas,[16] using US and UK data from the late 19th and early 20th century, identifies a positive correlation between macroeconomic activity and total mortality, as well as deaths from several specific causes (with suicides the exception). Eyer obtains a similar finding using US data from 1870 to 1975.[17] Though not conclusive, these analyses present a serious challenge to Brenner's hypothesis and even he has noted that mortality tends to decrease in periods of rising unemployment (p. 232).[18]

It is presumably for these reasons that Brenner's[18] later research postulates that the negative health effects occur 2 or 3 years after the economy declines and then persist for a lengthy period. However, his analyses rarely provide sufficient information on the lag structure to verify the hypothesized pattern and other researchers find little support for it.[7,13] Moreover, since business cycles typically last ~4 years, a 2 to 3 year lag implies that mortality is at its highest level around the time the economy peaks.

Recent time series analyses correct many problems in earlier studies. McAvinchey,[13] for instance, employs statistical rather than *ad hoc* methods to choose the length and order of the polynomial lag; Joyce and Mocan[14] and Laporte[19] allow for nonstationarity of the data; Tapia Granados[20] implements spectral analysis and local regression techniques; and Gerdtham and Johannesson[21] experiment with multiple business cycle indicators using individual, rather than aggregate, data. Despite these innovations, the results remain ambiguous. Most recent research suggests that mortality is procyclical;[1,19,20] however, some studies find countercyclical effects,[21] no impact[14] or variation across countries.[13]

This lack of robustness should not be surprising since in any lengthy time-series there may be confounding factors that are spuriously correlated with economic conditions and have a causal effect on mortality. Consider estimates of:

$$M_t = \alpha + X_t\beta + E_t\gamma + \varepsilon_{t'} \quad (1)$$

where M measures mortality at time t, E indicates macroeconomic conditions, X is a vector of covariates and * is an error term. The coefficient of key interest ($\hat{\gamma}$) will be biased if cov (E_t' ε_t) $\neq$0 which occurs if there are uncontrolled determinants of mortality that are correlated with but not caused by the fluctuations in the macroeconomy. For instance, dramatic reductions in joblessness at the end of the great depression were accompanied by spuriously correlated improvements in health owing to better nutrition and increased availability of antibiotics.

There has been some testing of whether the observed macroeconomic 'effects' result from omitted factors. One useful strategy, adopted by Tapia Granados[1] and others (e.g. Gravelle *et al.*[7]), is to examine whether the parameter estimates are stable across periods. Many potential confounding variables will be spuriously correlated with the macroeconomy at one time but not others. Thus, stable coefficients suggest causal effects, whereas substantial fluctuations (or sign reversals) hint at the possible impact of confounding factors. Specification checks can also be employed. For example, Joyce and Mocan[14] include two such tests when analysing how cyclical

and structural unemployment are related to the frequency of low birth weight. The first examines whether lagged birth weights predict current unemployment rates; the second investigates if future unemployment predicts current rates of low birth weight. Evidence of either would raise concern about reverse causation or endogeneity.

Pooled data with location-specific fixed effects

Even the improvements just discussed do not eliminate the inherent limitations using time series data from a single location to examine how macroeconomic conditions affect mortality. This issue has long been recognized by at least some researchers. A potential solution proposed by Kasl[6] (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.' In a similar vein, Stern[8] (p. 69) points to the promise of using differencing techniques with panel data to remove the bias associated with area-specific fixed effects.

Following this advice, several studies have recently estimated models using a panel containing information for multiple geographic locations at several points in time. Analyses of mortality typically use aggregated data, whereas studies of morbidity or health behaviours sometimes utilize individual- level information.

The methodological approach is to estimate some variant of:

$$M_{jt} = \alpha_j + X_{jt}\beta + E_{jt}\gamma + \lambda_t + \varepsilon_{jt'} \quad (2)$$

where M_{jt} is mortality (or another health outcome) for location j at time t, E proxies macroeconomic conditions, X is a vector of covariates, * is location-specific fixed-effect, λa general time effect, and * is the regression error term. Unemployment rates are the most common indicator of macroeconomic conditions, although measures such as employment-to-population ratios or GDP growth are occasionally used. National or personal incomes are sometimes also held constant and the supplementary regressors may include individual or location-specific 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, consider annual mortality rates for a panel of states estimated using Equation (2). The general year effects hold constant determinants of death that vary uniformly across states over time (such as many medical innovations), the state fixed-effects account for differences across locations that are time-invariant (like lifestyle differences between residents of Nevada and Utah), and the consequences of macroeconomic conditions are identified from within-state variations relative to the changes in other states. Equation (2) does not account for factors varying within states over time but this can often be substantially rectified by including a vector of location-specific time trends.

Non-employed individuals are typically less healthy than workers[22–24] (although the direction of causation is not well understood[25–27]). It is therefore important to note that using unemployment rates, or similar labour market measures, to proxy economic conditions does not imply that the macroeconomic effects are restricted to or concentrated among those changing employment status. For instance, negative health effects of job loss could be more than offset by

improvements for workers whose employment hours or job-related pressures are reduced during downturns.

One restriction of these procedures is that the general time effects absorb the impact of national business cycles. The measured macroeconomic consequences therefore refer to changes in local economic conditions, which could be different from those occurring at the national level. This provides one reason why these strategies should be viewed as complementary to rather than as substitutes for the time series estimates of Tapia Granados[1] and others.

Estimated effects on mortality and morbidity

Ruhm[28] conducted the first comprehensive investigation using the procedures just described. He analysed state level mortality in the US using data for 1972–91. Unemployment rates were the primary macroeconomic proxy and the models controlled for state and year effects, population characteristics and (sometimes) state-specific time trends. The results, summarized in Table 1, indicate that most types of death decline when the economy weakens. A 1% point increase in the state unemployment rate is anticipated to decrease the total mortality rate by 0.5%, with particularly large reductions in traffic deaths and other accidental causes of fatalities. Substantial decreases are also predicted for deaths due to heart disease, influenza/pneumonia, and infant mortality. However, cancer fatalities are unrelated to macroeconomic conditions and suicides vary countercyclically.

Table 1 Predicted effect of a 1% point increase in state unemployment rate on mortality

Cause of death	Predicted effect (%)
All deaths	–0.5 (0.1)
Heart disease	–0.5 (0.1)
Cancer	0.0 (0.1)
Flu/pneumonia	–0.7 (0.2)
Liver disease	–0.4 (0.2)
Infant deaths	–0.6 (0.2)
Neonatal mortality	–0.6 (0.2)
Vehicle accidents	–3.0 (0.2)
Other accidents	–1.7 (0.2)
Suicide	1.3 (0.2)
Homicide	–1.9 (0.4)

Source: Ruhm.[28] Estimates obtained from US vital statistics data covering the period 1972–91, with additional controls for state and year effects and state demographic characteristics (age, race/ethnicity, and education). Standard errors are shown in parentheses.

Subsequent research using similar methods, but different samples or time periods, generally verifies these findings. A one point increase in unemployment is associated with a 0.3–1.1% reduction in all-cause mortality using data from OECD countries, Germany and Spain.[29–32] Motor vehicle fatalities are predicted to decline by a highly significant 1.3–2.1%, with reductions also anticipated for other types of accidental deaths.[30–32]

The results are more mixed when considering mortality due to specific medical conditions. Neumayer[30] and Gerdtham and Ruhm[31] show that cardiovascular deaths are procyclical, and Ruhm[33] uncovers particularly strong fluctuations for fatalities from ischemic heart disease (especially acute myocardial infarction). This is of interest since ischemic heart disease is likely to be responsive to short-term changes in modifiable health behaviours and environmental risk factors. A fairly strong (but not always significant) procyclical variation in influenza/pneumonia deaths is also generally observed. Conversely, cancer mortality is unrelated to macroeconomic conditions, which makes sense since even a substantial behavioural response is unlikely to quickly reduce deaths from this source by very much. The evidence is less consistent for liver disease, homicide or suicide. For instance, Gerdtham and Ruhm[30] and Tapia Granados[32] obtain weaker countercyclical variations in suicides than those indicated by Ruhm,[28] while Neumayer[31] uncovers a procyclical fluctuation. One possibility is that the effects differ across countries or institutional arrangements. Consistent with this, Gerdtham and Ruhm show that the procyclical fluctuation in mortality is most pronounced in nations with weak social safety nets.[30]

Ruhm's[28] finding of a decline in infant mortality in the US during periods of economic weakness is confirmed in a careful study by Dehejia and Lleras-Muney,[34] who further examine how fertility selection and changes in pregnancy behaviours contribute to the overall effect. However, infant mortality is shown to be unrelated to economic conditions in Germany or OECD countries.[30,31] Since infant health may be strongly affected by lifestyle behaviours and the structure of medical or social supports, this again points to the possibility of differing impacts across institutional environments.

Severe data restrictions have limited analysis of health outcomes other than mortality. One study that does so is by Ruhm.[35] He uses US data from the 1972–81 National Health Interview Survey to investigate macroeconomic fluctuations in morbidity, other health indicators and the use of medical care. Table 2 summarizes selected results from this analysis. A key finding is that a 1% point increase in unemployment cuts the fraction of adults (≥30 years) predicted to have one or more medical conditions by 1.5%, with decreases in acute (rather than chronic) ailments accounting for most of the decline. The point estimates also suggest reductions in restricted-activity and bed-days, as well as substantial (but not always significant) declines in some chronic conditions (like ischaemic heart disease and intervertebral disk problems). Conversely, cancer is much less responsive and the countercyclical variation in non-psychotic mental disorders (when combined with a similar pattern for suicides) points to possible differences in how the macroeconomy affects mental, as compared with physical, health.

Table 2 Predicted effect of a 1% point increase in state unemployment rate on health conditions and medical care utilization

Health outcome	**Predicted effect (%)**

≥1 medical condition	–1.5 (0.7)
≥1 acute condition	–3.9 (1.2)
≥1 chronic condition	–1.1 (0.9)
≥1 restricted-activity day	–1.2 (1.0)
≥1 bed-day	–1.6 (1.1)
≥1 hospital episode	–0.9 (0.9)
≥1 doctor visit	–0.4 (0.3)
Heart disease	–0.5 (1.3)
Ischaemic heart disease	–4.3 (3.5)
Intervertebral disk disorders	–8.7 (2.3)
Malignant neoplasms	–1.9 (3.5)
Non-psychotic mental disorders	7.2 (3.7)

Source: Ruhm.[35] Estimates obtained using data from the 1972–81 years of the US National Health Interview Survey and refer to persons aged ≥30 years living in one of 31 large SMSAs. The models contain additional controls for state and year effects, state-specific time trends and individual demographic characteristics (age, sex, race/ethnicity, education, veteran and marital status and residence in a central city). Robust standard errors are shown in parentheses. Medical conditions refer to status at the survey date, bed and restricted-activity days to the preceding 2 weeks, and medical care utilization to the prior year.

Why does mortality rise during economic upturns?

Some reasons why mortality grows when the economy temporarily strengthens are obvious. Individuals drive more miles, raising motor vehicle fatalities, and health may be an input into short-run increases in the production of goods and services. Thus, hazardous working conditions, the physical exertion of employment, and job-related stress are likely to have negative effects when work hours are extended.[36–40] Additional hours also lead to reductions in sleep,[41] which may raise stress, decrease alertness, and elevate injury risk, obesity and physiological or psychological symptoms.[42–44] The already high accident rates in cyclically sensitive sectors, like construction and manufacturing, may be exacerbated by increased hiring of inexperienced workers and speedups in production.[45–47] Some joint products of economic activity, such as pollution and traffic congestion, present health risks, with particularly negative consequences likely for infants and senior citizens who do not participate in the labour force.[48–50] Growth in migration could increase social isolation, with especially adverse effects for the old and young.[17,20]

Deaths may also rise because individuals adopt less healthy lifestyles. Table 3 summarizes results obtained using data from the US Behavioral Risk Factor Surveillance System by Ruhm and Black[51] and Ruhm.[52] Previous research had uncovered a procyclical pattern of alcohol

sales[53,54] but the effects on mortality were not entirely clear since light or moderate alcohol use is linked to health benefits.[55,56] Given this, Ruhm and Black's most noteworthy finding is that increased overall alcohol use during expansions results from a growth in heavy drinking (which is certainly unhealthy). Ettner[57] and Dee[58] obtain similar but somewhat less consistent results. For instance, Dee indicates that total and heavy alcohol use rise but 'binge' drinking decreases when the economy expands.

Table 3 Predicted effect of a 1% point increase in state unemployment rate on health behaviours

Health behaviour	Predicted effect (%)
Current alcohol use	–0.4 (0.3)
Heavy drinker	–7.8 (1.5)
Very heavy drinker	–9.7 (2.2)
Current smoker	–0.6 (0.2)
Heavy smoker	–1.0 (0.3)
Very heavy smoker	–1.1 (0.5)
Overweight	0.1 (0.1)
Obese	–0.3 (0.2)
Severely obese	–1.4 (0.5)
Irregular or no leisure-time physical activity	0.7 (0.1)
No leisure-time physical activity	–1.5 (0.3)
Multiple health risks	–1.8 (0.4)

Sources: Ruhm and Black;[51] Ruhm.[52] Estimates obtained using data on adults from the 1987–2000 years (1987–99 for alcohol use) of the US Behavioral Risk Factor Surveillance System. The models contain additional controls for state fixed-effects, age, sex, race/ethnicity, education and marital status. The alcohol models also include state-specific time trends, with general year effects incorporated in all other cases. Heavy (very heavy) drinking refers to alcohol consumption of 60 (100) or more drinks in the last month. Heavy (very heavy) tobacco use refers to smoking 20 (40) or more cigarettes per day. Overweight, obese, and severely obese indicate persons with a body mass index of at least 25, 30, or 35, respectively. Multiple health risks refer to persons with at least two of the characteristics of current smoking, severe obesity or physical inactivity.

The macroeconomic variation in other lifestyle behaviours has been less widely studied. Ruhm[52] indicates that severe obesity, smoking, and physical inactivity increase with the state of the economy, with particularly large growth in multiple health risks. As with drinking, these variations appear to be dominated by changes at the intensive rather than extensive margin. Most available evidence supports these conclusions. Ruhm[28] shows that the consumption of dietary fat

(fruits and vegetables) rises (falls) when the economy strengthens. Dehejia and Lleras-Muney[34] find that pregnant mothers consume more alcohol during such periods, with mixed effects for smoking. DiSimone[59] uncovers a procyclical variation in obesity for high school aged boys (but not girls), that is partly due to changes in exercise. Dustmann and Windmeijer[60] indicate that temporary wage increases are associated with lower levels of physical activity in Germany. However, some of Böckerman *et al.*'s[61] specifications point to a countercyclical pattern of obesity among Finnish adults (with no relationship in other models).

Lifestyles may become less healthy when economic conditions improve because increases in non-market 'leisure' time make it more costly for individuals to undertake time-intensive health-producing activities such as exercise and cooking meals at home. More generally, the demand for inputs producing health is likely to fall when time prices rise.[62] This may explain why smoking (which is not time-intensive but is harmful to health) decreases during expansions. Indirect evidence linking time prices to obesity has been obtained[63–65] but direct estimates on the effects of work hours are mixed.[29,33,52]

Higher mortality during temporary expansions need not imply negative effects of permanent growth. The key distinction is that transitory increases in output usually require more intensive use of labour and health inputs with existing technologies, whereas lasting changes result from technological innovations or expansions in the capital stock that have the potential to ameliorate any costs to health. Individuals are also more likely to defer health investments during temporary than permanent increases in work hours and sustained growth permits the purchase of consumption goods (like safer cars) that benefit health.

The data indicate that permanent increases in income improve health in developing countries but with more ambiguous findings for industrialized nations.[66–68] In the latter case, the evidence suggests differences in the effects of transitory and lasting income changes. Graham *et al.*[69] show that rising permanent incomes in the US are associated with reduced mortality, whereas temporary growth has the opposite effect. Dustmann and Windmeijer[60] indicate that higher wealth profiles predict improved health in Germany but transitory wage increases worsen it. On the other hand, mixed and inconsistent results are obtained when income is included as an additional covariate in models with location-specific fixed effects and with unemployment rates used as the primary proxy for macroeconomic conditions.

Conclusion

Most recent research suggests that mortality increases when macroeconomic conditions temporarily improve. Some studies, such as Tapia Granados,[1] reach this conclusion through analysis of aggregate time series data. Others exploit within-location variations in economic conditions using longitudinal data from a panel of states or countries. Both methods contain potential strengths and shortcomings, and so they should be viewed as complementary approaches to examining this issue.

One cause of higher death rates during good economic times may be that individuals adopt less healthy lifestyles. In addition, several joint outputs of temporary expansions, like increases in pollution and driving, have clear negative health effects that are not limited to the working-age population. Future research needs to better identify the underlying mechanisms for the

procyclical variation in mortality, clarify whether macroeconomic conditions differentially affect physical and mental health, and more fully distinguish between the effects of transitory and permanent growth. Additional study should also examine the sensitivity of the results to the use of alternative macroeconomic proxies and under differing institutional environments. These represent exciting avenues for future research.

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