

Deaths rise in good economic times: Evidence from the OECD

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Abstract:

This study uses aggregate data for 23 Organization for Economic Cooperation and Development (OECD) countries over the 1960–1997 period to examine the relationship between macroeconomic conditions and deaths. The main finding is that total mortality and deaths from several common causes rise when labor markets strengthen. For instance, controlling for year effects, location fixed-effects (FE), country-specific time trends and demographic characteristics, a 1% point decrease in the national unemployment rate is associated with growth of 0.4% in total mortality and the following increases in cause-specific mortality: 0.4% for cardiovascular disease, 1.1% for influenza/pneumonia, 1.8% for liver disease, 2.1% for motor vehicle deaths, and 0.8% for other accidents. These effects are particularly pronounced for countries with weak social insurance systems, as proxied by public social expenditure as a share of GDP. The findings are consistent with evidence provided by other recent research and cast doubt on the hypothesis that economic downturns have negative effects on physical health.

Keywords: Business cycles; Mortality; Health

Article:

1. INTRODUCTION

Widely cited analyses of aggregate time-series data by Harvey Brenner (1973, 1975, 1979) reveal a countercyclical variation in admissions to mental hospitals, infant mortality rates, and deaths due to cardiovascular disease, cirrhosis, suicide, and homicide.¹ However, this research suffers from serious technical flaws (Gravelle et al., 1981; Stern, 1983; Wagstaff, 1985; Cook and Zarkin, 1986) and studies correcting the problems (Forbes and McGregor, 1984; McAviney, 1988; Joyce and Mocan, 1993) fail to uncover a consistent relationship between the macroeconomy and health.² Instead, the results are sensitive to the choice of countries, time periods, and outcomes, with falling unemployment frequently being correlated with worse rather than better health. This lack of robustness is not surprising since any lengthy time-series may contain confounding factors that are spuriously correlated with economic conditions.³

1. An outcome is countercyclical (procyclical) if it decreases (increases) when the economy strengthens.

2. Criticisms of Brenner's research include his method of choosing lag lengths, the hypothesized pattern of lag coefficients, choice of covariates, lack of statistical power and unclear presentation of the methods and results.

3. For example, much of the variation in unemployment occurring during the four decades (beginning in the 1930s) covered by Brenner's research resulted from dramatic reductions in unemployment following the great depression. During this same period, health improved due to better nutrition and increased availability of antibiotics. Failure to control for these factors leads to an overstatement of the detrimental health impact of unemployment.

Ruhm (2000) has recently addressed the omitted variables bias issue by estimating fixed-effect (FE) models for a panel of the 50 states and District of Columbia over a 20-year period (1972–1991). These specifications exploit *within-state* changes and so automatically control for time-invariant factors that are spuriously correlated with economic conditions across locations. Evidence is provided that mortality *increases* when labor markets are tight. Unemployment is negatively and significantly related to total mortality and 8 of 10 specific causes of death, with suicides the important exception. For instance, a 1% point fall in the state unemployment rate is associated with 0.5, 3.0, 0.7, and 0.4% increases in deaths from all causes, motor vehicle deaths, influenza/pneumonia, and heart disease.

Using similar methods and data from German states over the 1980–2000 time span, Neumayer (2004) finds that a 1% point decline in unemployment is predicted to raise mortality from all causes by between 0.7 and 1.1%.⁴ Increases in deaths from cardiovascular diseases, pneumonia/influenza and motor vehicle accidents are also obtained and, interestingly, the estimates also suggest a procyclical variation in suicides.

The analysis below extends on the previous research by examining whether deaths rise when labor market conditions improve using information for 23 member nations of the Organization for Economic Cooperation and Development (OECD) over the 1960–1997 period. Specifically, countries are the unit of observation and we investigate how total mortality and nine causes of deaths vary with national unemployment rates (or the percentage of the population employed), after controlling for time-invariant country-specific factors, general time effects, demographic characteristics and (usually) country-specific time trends.

Thus, this research can be viewed as a test of whether the finding that death rates increase when labor markets strengthen, obtained using aggregate national data, is generalizable across industrialized countries that often have quite different economic institutions, lifestyles, and systems of medical care. However, this same heterogeneity may raise concerns if the results may vary with the institutional features of the specific nations. For instance, it seems plausible that the macroeconomic effects differ in countries with strong social insurance systems (e.g. income replacement policies) or labor protection laws (defined by worker termination policies and maximum allowable hours or days per week of work), when compared to those with weaker safety nets or constraints on employers. A full examination of these issues is beyond the scope of the current analysis but we do provide an exploratory investigation of how the results vary with the comprehensiveness of social insurance systems.

Our major finding is that robust economic conditions are associated with increases in total mortality rates and several important sources of death. In the preferred model, a 1% point decrease in the national unemployment rate is estimated to raise total mortality by 0.4% and deaths from cardiovascular disease, influenza/pneumonia, liver disease, motor vehicle deaths and other accidents by 0.4, 1.1, 1.8, 2.1 and 0.8%, respectively. Conversely, deaths from cancer are largely unaffected and there is some evidence that suicides and homicides decline in good economic times. We also uncover evidence of larger procyclical fluctuations in mortality for countries with relatively weak social insurance protections, as proxied by public social spending as a share of GDP, compared to those with more extensive programs.

4. In addition, to the model used in Ruhm (2000), Neumayer also estimates “short-run” and “long-run” dynamic models, resulting in a range of estimates.

These results suggest that physical health deteriorates when labor market conditions improve and generally accord with the findings of recent research using similar methods and data (e.g. Ruhm, 2000; Tapia Granados, 2004; Neumayer, 2004). The estimated effects of unemployment rates on mortality are of comparable absolute size to previous results based on the U.S. states (Ruhm, 2000); however, the mechanisms for these effects may be complicated and vary across sources of death. For instance, higher incomes are predicted to reduce some but raise other types of deaths, and the dynamics of the adjustment to a sustained change in unemployment differs with the cause of mortality.⁵

Although we use standardized unemployment rates as our main proxy of labor market conditions, it is important to emphasize that reductions in mortality during bad times need not be restricted to or even concentrated among those becoming newly unemployed. To the contrary, job loss could induce stress that counteracts other beneficial effects and thus raise death rates among jobless individuals, even while overall mortality declines.⁶ There is also no reason to believe that all types of health respond in the same way. For instance, increasing stress provides one reason why mental health might deteriorate despite gains in physical well-being.⁷ Similarly, we expect to see larger fluctuations in deaths from sources such as cardiovascular disease that may be strongly and rapidly affected by changes in lifestyles, environmental factors and medical interventions, than from those like cancer that probably are not.

2. WHY MIGHT DEATHS INCREASE IN GOOD ECONOMIC TIMES?

Many researchers hypothesize that cyclical upturns benefit health by reducing the stress associated with economic insecurity (e.g. Brenner and Mooney, 1983; Catalano and Dooley, 1983; Fenwick and Tausig, 1994). However, there are at least three reasons why health might instead worsen. First, non-market “leisure” time decreases, making it more costly for individuals to undertake time-intensive health-producing activities such as exercise. Data from the *Behavioral Risk Factor Surveillance System* (BRFSS) suggests that a strengthening economy is associated with increased smoking and obesity, reduced physical activity, and worse diet (Ruhm, 2005a), which might reflect higher time prices.⁸

5. Ruhm (2006) provides a comprehensive review of this research. Also, see the symposium of papers contained in the December 2005 issue of the International Journal of Epidemiology (e.g. Tapia Granados, 2005) for alternative viewpoints on the relationship between macroeconomic conditions and health.

6. There is no doubt that the non-employed are in worse average health than workers (e.g. Morris et al., 1994; Currie and Madrian, 1999; Ettner, 2000; Gerdtam and Johannesson, 2003). However, since poor health probably reduces employment probabilities, the direction of causation is poorly understood (Bartley, 1996; Goldney, 1997; Smith, 1999). Martikainen and Valkonen (1996) examine this by comparing mortality of persons losing jobs in Finland during times of relatively low and high unemployment. Consistent with the hypothesis of stronger selection during good times, they find that the association between unemployment and subsequent mortality weakens as unemployment rises.

7. Jobless persons are more likely to be mentally ill or commit suicide than employed individuals (Dooley et al., 1988; Catalano, 1991; Lewis and Sloggert, 1998; Mortensen et al., 2000). While it is difficult to infer causation from these studies, a careful investigation by Hamilton et al. (1997) finds a detrimental effect even after accounting for the endogeneity between mental illness and unemployment.

8. The time price of medical care may also increase if persons working more hours find it harder to schedule medical appointments for themselves or their dependents. Consistent with this, Mwabu (1988) and Vistnes and Hamilton (1995) report a negative relationship between employment and the utilization of medical care.

Second, health may be an input into the production of goods and services. Most obviously, hazardous working conditions, the physical exertion of employment, and job-related stress could have negative effects, particularly when job hours are extended during short-lasting economic expansions (Baker, 1985; Karasek and Theorell, 1990; Sokejima and Kagamimori, 1998). Cyclically sensitive sectors, such as construction, also have high accident rates and some joint outcomes of economic activity (like pollution) present health risks.⁹

Third, increases in permanent income are expected to have a positive effect on most aspects of health (Smith, 1999), but income growth – particularly when transitory or occurring in already wealthy countries – may nevertheless be associated with higher risks of some sources of death. For example, individuals drive more when times are good and may be more likely to do so after consuming alcohol, with the result that vehicle fatalities (and possibly other external causes of death) rise when the economy strengthens (Evans and Graham, 1988; Ruhm, 1995; Freeman, 1999).

3. ESTIMATION STRATEGY

We use linear regression to estimate the relationship between labor market conditions and death rates. Using the subscripts j and t to index the country and year, the basic specification is:

$$M_{jt} = \alpha_t + X_{jt}\beta + E_{jt}\gamma + C_j + \varepsilon_{jt} \quad (1)$$

where M is the natural log of the mortality rate, E the unemployment rate, X a vector of regressors controlling for the age and sex distribution of population, α year-specific intercept, C a country fixed-effect, and ε a disturbance term.

The year effect holds constant determinants of health that vary uniformly across countries over time (e.g. the effects of oil shocks) and the fixed-effect accounts for factors that differ across locations but are time-invariant (such as some country-specific institutions). The impact of the macroeconomy is therefore identified by within-country variations in unemployment rates, relative to the changes occurring in other nations.¹⁰ Importantly, these estimates automatically control for cross-country differences in the determinants of health (such as geographic factors and some aspects of lifestyles) that remain constant over time, as well as determinants (like medical technologies) that vary over time but are rapidly diffused across countries.

9. For instance, Chay and Greenstone (2003) show that county-level reductions in pollution associated with the 1981–1982 recession led to substantial decreases in infant mortality. Small negative health shocks associated with transitory upturns might also cause frail individuals to die slightly sooner than they otherwise would, even while having little impact on overall life expectancy. This phenomenon is referred to as “harvesting” by epidemiologists. There is also a large literature documenting a procyclical pattern in workplace absenteeism (e.g. Leigh, 1985; Kaivanto, 1997; Arai and Thoursie, 2001). This is generally believed to result from negative selection into employment during good times (i.e. sicker individuals can more easily find jobs when the economy is robust) or increased shirking due to reduced fear of job loss (Calvo, 1979; Salop, 1979; Shapiro and Stiglitz, 1984). However, such a pattern is also consistent with worsening health when labor markets strengthen.

10. The correlation coefficient between national and OECD unemployment rates is less than 0.7 for 12 of the 23 countries and below 0.5 for six. This indicates that labor market conditions exhibit considerable independent variation across OECD countries over time, which is a necessary condition for the usefulness of the fixed-effect methods employed in this analysis.

Most models also include a vector of country-specific linear time trends ($C_j \times T$), to account for factors that vary over time within nations (for example, the level of education), implying the regression equation:

$$M_{jt} = \alpha_t + X_{jt}\beta + E_{jt}\gamma + C_j + C_j \times T + \varepsilon_{jt} \quad (2)$$

We also display the results of models that incorporate controls for the OECD-wide unemployment rate or national per capita incomes (to examine whether the macroeconomic fluctuations in mortality partially reflect changes in incomes) and conducted extensive sensitivity testing that is summarized below.

The regressions are usually estimated by weighted least squares (with observations weighted by the square root of the national population) to account for heteroscedasticity. We also examine whether the results are robust to using unweighted data or allowing for first-order autocorrelation, with country-specific AR(1) coefficients.

4. DATA

Annual information on death rates, country characteristics, and per capita disposable income are obtained for 23 OECD countries over the 1960–1997 period from the *OECD Health Data 2000* (OECD, 2000).¹¹ The outcomes examined are the total mortality rate and deaths from nine leading causes: malignant neoplasms (cancer), major cardiovascular (heart) disease, influenza/pneumonia, liver disease and cirrhosis, motor vehicle accidents, other accidents, suicides, homicides, and infant deaths.¹²

Standardized unemployment rates are our primary proxy of labor market conditions, with information supplied from two sources. Rates for 10 countries (Australia, Canada, France, Germany, Italy, Japan, The Netherlands, Sweden, United Kingdom, and the United States) come from a consistent series developed by the U.S. Bureau of Labor Statistics, with data available starting in the first year of our analysis for all nations except The Netherlands, where the series begins in 1973.¹³ Standardized rates for 13 additional countries (Austria, Belgium, The Czech Republic, Denmark, Finland, Ireland, Luxembourg, New Zealand, Norway, Poland, Portugal, Spain, and Switzerland) are obtained from several issues of the *OECD Employment Outlook* and start in various years.¹⁴

The regressions also control for the percentage of the population that is male and in three age ranges (15–64, 65–74, and >75), since these characteristics may independently affect death rates. Country fixed-effects, general time effects, and (usually) country-specific time trends are

11. See www.oecd.org/health for details and documentation.

12. The nine causes account for approximately 80% of all deaths.

13. The data were obtained from: www.bls.gov/fls/flslforc.pdf. Information for Germany refers to West Germany, with analysis limited to the 1960–1990 (prior to unification), to avoid problems of comparability.

14. Starting years are 1973 for Norway and Spain, 1980 for Belgium and Finland, 1982 for Denmark, Ireland, Luxembourg, and New Zealand, 1983 for Portugal, 1991 for Switzerland, 1992 for Hungary, and 1993 for The Czech Republic and Poland.

Table 1
Descriptive information on variables used in analysis

Variable	Mean	Standard deviation	Number of observations
Dependent variables: mortality rates			
All causes	907.0	164.8	525
Malignant neoplasms (140–208)	191.3	41.6	495
Major cardiovascular diseases (390–459)	403.6	103.0	495
Pneumonia and influenza (480–487)	35.2	19.3	525
Liver diseases, cirrhosis (571)	15.0	8.0	525
Motor vehicle accidents (E810–825)	18.1	5.6	525
Other accidents (E800–809; E826–949; 979–999)	23.4	8.3	313
Suicides (E950–959)	13.3	4.6	525
Homicide (E960–978)	4.1	3.9	313
Infant deaths	13.7	7.4	525
Explanatory variables			
Civilian unemployment rate in percentage	5.6	3.6	525
Per capita income (thousands)	14.3	4.8	525
Percentage male of population	48.9	0.5	525
Percentage of population 15–64 years	65.4	2.6	525
Percentage of population 65–74 years	7.1	1.3	525
Percentage of population aged 75 and over	4.6	1.3	525

Note: All variables are weighted by country population. The data are for 23 OECD countries over the 1960–1997 period. Mortality rates refer to deaths per 100,000 population, except for infant mortality, which is measured as deaths per 100,000 live births. ICD-9 codes are shown in parentheses. Income refers to net national disposable income per capita in thousands of the U.S.\$ PPP (1990). Unemployment rates are standardized to the U.S. or OECD definitions, as discussed in the text.

included. Finally, some models hold constant net national disposable income per capita, in thousands of 1990 dollars measured at purchasing power parities and converted to constant dollars using the U.S. GDP price deflator.¹⁵

Table 1 provides summary statistics. The panel contains 525 country-year observations, or an average of 23 observations per country (ranging from 4 to 38). Missing data reduce sample sizes slightly for cancer and heart disease and considerably more for homicides and non-vehicle accidents. Deaths from most sources have trended downwards. For instance, the total mortality rate fell 8% (from 944 to 873 deaths per 100,000 population) between 1960 and 1995, death rates from cardiovascular disease and vehicle accidents declined 22 and 27%, respectively, and infant mortality decreased 78%.¹⁶ Conversely, death rates from cancer increased 43%, which may reflect aging of the population.

15. We use purchasing power parities instead of conventional market exchange rates because the latter overstate (understate) real income in high (low) income countries (Kravis et al., 1978).

16. To avoid changes in sample composition, these calculations are performed using information for the eight countries (Australia, Canada, France, Italy, Japan, Sweden, United Kingdom, and the United States) on which mortality and unemployment data are available throughout the 35-year period. Similar trends are obtained using an unbalanced panel of nations with information available in the two end years.

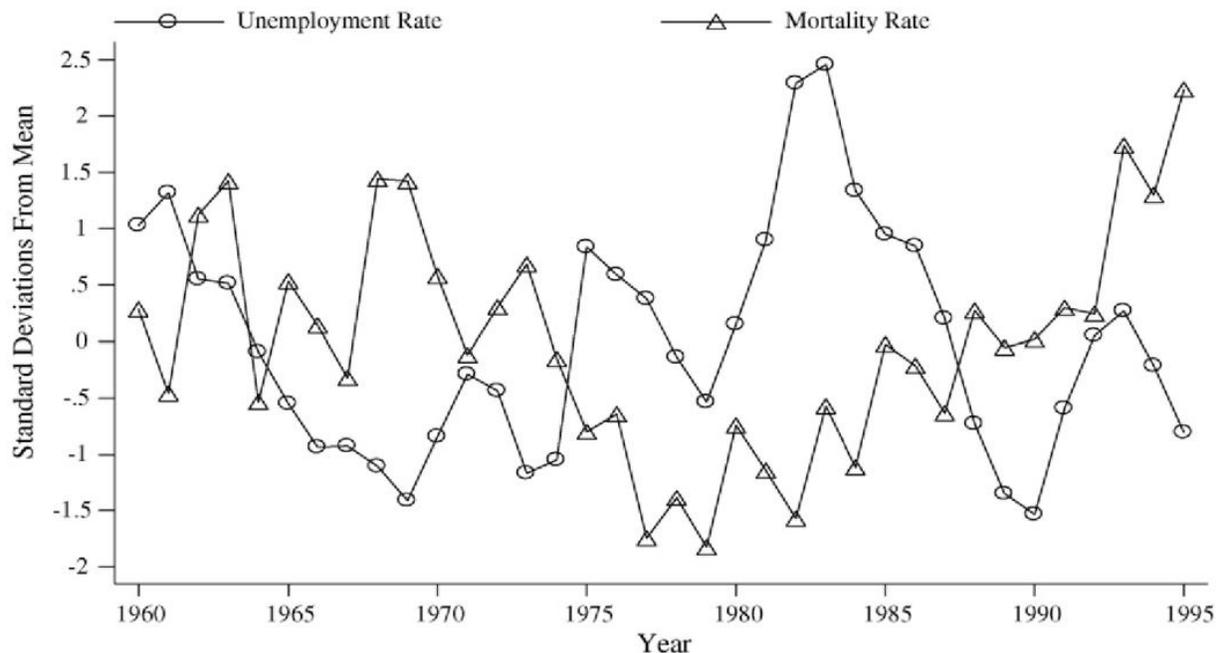


Fig. 1. Total mortality and unemployment rates (detrended and normalized).

A first indication of the relationship between deaths and macroeconomic conditions is provided in Fig. 1, which displays (population-weighted) OECD total mortality and unemployment rates from 1960 to 1995. For ease of interpretation, these variables have been detrended and normalized to have a mean of zero and a standard deviation of one.¹⁷ Previewing the econometric results, the figure suggests a fairly strong *inverse* relationship between labor market conditions and deaths.¹⁸ Although the OECD-wide aggregates may suffer from the aforementioned problems of confounding, implying the need for a careful multivariate analysis, these findings suggest the possibility that deaths increase when the macroeconomy improves.

5. MORTALITY RISES IN GOOD TIMES

Table 2 summarizes the results of a variety of econometric models, all showing that deaths rise when labor markets are strong. Here and below, the tables display the estimated effect of a 1% point increase in the standardized unemployment rate. Specification (a) shows the results of regressing the natural log of the total death rate on unemployment, country demographic characteristics (sex and age), fixed-effects, year effects, and country-specific linear time trends. The statistically significant coefficient of $-.0040$ implies that a 1% point fall in unemployment is estimated to raise mortality by 0.4%.¹⁹ Since unemployment averages 5.6%, the one point

17. The detrended variables are residuals from regressions of aggregated values on linear time trends. Unemployment trends upwards by 0.14% points per year and total mortality downwards by 3.0 deaths per 100,000 persons annually. This analysis is restricted to the same eight countries as in the previous paragraph, although substantially similar findings are again obtained using an unbalanced panel of nations.

18. Regressing the natural log of total mortality on unemployment rates (using the detrended data) yields an unemployment coefficient of -0.409 with a standard error of 0.159.

19. A one standard deviation (3.62%) decline in unemployment is associated with a 1.5% rise in mortality.

Table 2

Econometric estimates of the determinants of total mortality rates

Repressor	Specification					
	(a)	(b)	(c)	(d)	(e)	(f)
Country						
unemployment rate	-.0040* (.0009)	-.0067* (.0010)	-.0026* (.0007)	-.0050* (.0009)		-.0043* (.0011)
OECD					-.0045* (.0011)	-.0015 (.0014)
unemployment rate						
Natural log of income		-.1660* (.0290)				
Year effects	Yes	Yes	Yes	No	No	No
Country-specific trends	Yes	Yes	No	Yes	Yes	Yes

Note: The analysis includes 23 OECD countries for the 1960–1997 time period. The dependent variable is the natural logarithm of the total mortality rate. The number of observations is 525. Observations are weighted by the square root of the country population. All specifications also include vectors of country dummy variables and controls for the percentage of the country population who are: men, 15–64 years old, 65–74 years old, and 75 years and over. Year dummy variables and country-specific time trends are also controlled for, except where noted. Income refers to net national disposable income per capita in thousands of the U.S.\$ PPP (1990). Standard errors are in parentheses ($p < 0.05$).

decrease corresponds to a drop of approximately 18% and the unemployment elasticity of total mortality is around -0.022 .²⁰

Column (b) adds controls for per capita incomes. There is no indication that mortality grows during strong labor markets because incomes increase. Instead, a 10% rise in income is predicted to reduce the death rate by around 1.7%, corresponding to the income elasticity of -0.17 .²¹ Moreover, in absolute size the effect of unemployment is 68% *larger* than in column (a) because of the offsetting benefits of higher incomes. However, we show below that the estimated income elasticities vary substantially across causes of death. Models with controls for incomes are included, here and below, in the interests of completeness and to allow comparison of these results with earlier research using similar specifications. However, in our view, these are likely to indicate only a portion of the total macroeconomic effect, since income generally rises when the economy strengthens. Our “preferred” estimates therefore refer to models that exclude income.

The next four columns investigate the sensitivity of the results to various alternative specifications. Country-specific time trends are omitted in model (c) and year effects are excluded in specification (d). Column (e) substitutes the (population-weighted) mean OECD unemployment rate for the national rates. Specification (f) includes both the OECD and national unemployment rates. Deaths are predicted to increase when labor markets tighten in all of these models. The unemployment coefficient shrinks somewhat when country-specific trends are excluded (model c) and increases in the absence of general time effects (column d). The estimated effects are almost identical when OECD rather than country unemployment rates are controlled for (specification e) but national conditions dominate when including both (model f).

We also estimated models using unweighted data or allowing for autocorrelation of the error term with country-specific AR(1) processes. These results (not shown) again indicated a negative correlation between unemployment rates and total mortality, that occurred despite rather than because of the associated changes in incomes. We included a quadratic of the unemployment rate to test for a non-linear relationship but found no evidence of one.²² Specifications that controlled for the percentage of the 20–64-year-olds employed (rather than the unemployment rate) again predicted increased mortality when labor markets strengthen.²³

20. Deaths are also predicted to increase with the population share of persons aged 65–74 or 75 and above, and to decline with the fraction of persons younger than 15. The percent male has little effect on total mortality.

21. Lutter and Morrall III (1994) estimate an income elasticity of -0.32 using World Bank data for 101 countries over the years 1965–1985. The higher elasticity they obtain is partially due to differences in model specification (e.g. they do not control for unemployment rates or country-specific trends) and may partly reflect their inclusion of developing countries, where the protective effect of income on health is more pronounced.

22. We also estimated models interacting the unemployment rate with five dummy variables indicating ranges of unemployment (with the thresholds chosen to equalize the number of observations in each category). The interaction coefficients were never statistically or economically significant, providing a further indication that the linear unemployment specification is reasonable.

23. Employment-to-population ratios were used because some economists (e.g. Clark and Summers, 1982) argue that they provide a more accurate measure of labor market conditions for groups frequently entering and exiting the labor force.

Table 3

Additional econometric estimates of the determinants of total mortality rates

Regressor	Specification									
	Basic specification		Death in levels		10 Largest countries		1983-1997		Balanced panel 1960-1997	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Country	-0.040* (.0009)	-0.067* (.0010)	-2.944* (.7867)	-4.648* (.8924)	-0.062* (.0084)	-0.067* (.0010)	-0.046* (.0012)	-0.072* (.0013)	-0.050* (.0021)	-0.057* (.0021)
unemployment rate										
Natural log of income		-1.660* (.0290)		-102.6* (25.55)		-0.479 (.0478)		-1.551* (.0364)		-0.829 (.0484)

Note: See note in Table 2. All specifications also include vectors of country and year dummy variables, demographic characteristics, and country-specific time trends ($p < 0.05$). The dependent variable is the natural logarithm of the total mortality rate, except in the third and fourth columns, where it is deaths measured in levels (per 100,000 population). The sample in the fifth and sixth columns is restricted to the 10 countries with the largest population in 1990 (the U.S., Japan, Germany, UK, Italy, France, Spain, Canada, Australia, The Netherlands). The analysis in the seventh and eighth columns is restricted to the 1983-1997 time period. The number of observations is 525 for the full sample, 340 for the subsample of the 10 largest countries and 278 for the 1983-1997 period. The final two columns include a balanced panel regression based on the four countries (Canada, Japan, UK and the U.S.) for which complete data are available for the entire period (1960-1997).

As further tests of robustness, Table 3 summarizes the results obtained using alternative specifications of the dependent variable or subsamples of the data. The first two columns repeat the basic estimates presented in models (a) and (b) of Table 2. The third and fourth use deaths in levels (rather than natural logs) as the outcome and again indicate elevated mortality during strong labor markets, despite a protective effect of income. A one point decline in unemployment is associated with a 2.94 per 100,000 population increase in deaths (see model c), corresponding to a 0.3% growth at the dependent variable mean. An extra \$1000 of income is estimated to reduce deaths by 102.6 per 100,000, or 11.3% (model d). The fifth and sixth columns restrict the analysis to the 10 countries with the largest population (in 1990), since measurement error problems may be least severe for them.²⁴ Doing so somewhat increases the size of the macroeconomic effect—a one point fall in unemployment is estimated to increase the total death rate by 0.5%. The seventh and eighth columns limit analysis to the 1983–1997 period, where standardized unemployment rates are available for almost all countries. The increase in mortality estimated to accompany a drop in unemployment rises considerably when this is done—partly because of the much weaker (protective) income effect. The final two columns restrict the analysis to a balanced panel of the four countries (Canada, Japan, United Kingdom and the United States) with complete data for all variables over the entire period. The estimated coefficients are very similar to the baseline specifications, e.g. a 1% point reduction in unemployment is predicted to lower total mortality by 0.5% in model (a). The results are also robust to additional sensitivity analyses not displayed in the table.²⁵

6. CAUSE-SPECIFIC MORTALITY

Table 4 demonstrates that deaths from a variety of causes increase when labor markets strengthen. The econometric models again control for location fixed-effects, country-specific time trends, general year effects, national demographic characteristics, and (in specification b) per capita incomes. A one point fall in the standardized unemployment rate is estimated to raise deaths from cardiovascular disease, influenza/pneumonia, or liver disease by a statistically significant 0.4, 1.1, and 1.8%, with small (and insignificant) growth predicted for infant deaths. These results accord with those found for the United States by Ruhm (2000).²⁶

It makes sense that macroeconomic conditions are unrelated to cancer mortality, since deaths from this source may be less affected by short-lasting changes in medical care or lifestyles. The strong procyclical variation in accidental deaths – a one point decline in unemployment is

24. These include the United States, Japan, Germany, United Kingdom, Italy, France, Spain, Canada, Australia, and The Netherlands.

25. For instance, very similar results are obtained for a balanced panel of the seven countries (Canada, Japan, Luxembourg, The Netherlands, Portugal, United Kingdom and the United States) for which all data are available for the 1983–1997 period: the estimated coefficients of unemployment rate —0.0083 and —0.0078, respectively, in the specifications with and without controls for income. We estimated the baseline model for total mortality (specification a) with countries sequentially excluded from the sample, one nation at the time. Our main results are very robust to this exercise. The estimated coefficient of unemployment rate is significant ($p < 0.05$) in each of the 23 regressions, although the magnitude of the unemployment coefficient did occasionally change (e.g. the estimate dropped to —0.0024 when Spain was excluded and rose to —0.0053 with the omission of the United Kingdom).

26. Dehejia and Lleras-Muney (2004) document a procyclical variation in infant mortality in the United States, that is partially due to selection into fertility and partly the result of changes in health behaviors during pregnancy

Table 4

Econometric estimates of the determinants of specific causes of mortality

	Specification		Specification		Specification	
	Heart disease	Cancer	Flu/pneumonia	Liver disease	Vehicle accidents	Other accidents
Country	(a)	(a)	(a)	(a)	(a)	(a)
unemployment rate	-.0036* (.0011)	-.0017 (.0012)	.0009 (.0007)	.0000 (.0008)	-.0110 (.0079)	-.0350* (.0077)
Natural log of income	.1185* (.0359)		-.0556* (.0239)			-1.443* (.2236)
	Specification					
	Liver disease		Vehicle accidents		Other accidents	
Country	(a)	(b)	(a)	(b)	(a)	(b)
unemployment rate	-.0178* (.0032)	-.0161* (.0037)	-.0211* (.0035)	-.0190* (.0040)	-.0080* (.0028)	-.0128* (.0035)
Natural log of income	.1092 (.1068)		.1292 (.1151)			-.3204 (.1712)
	Specification					
	Suicide		Homicide		Infant mortality	
Country	(a)	(b)	(a)	(b)	(a)	(b)
Runemployment rate	.0042 (.0032)	.0044 (.0037)	.0112 (.0065)	.0049 (.0081)	-.0023 (.0023)	-.0119* (.0024)
Natural log of income	-.0138 (.1059)		-.5140 (.3989)			-.5781* (.0695)

Note: See note in Table 2. All equations include country and year dummy variables, demographic characteristics, and country-specific time trends ($p < 0.05$).

predicted to raise vehicle deaths by 2.1% and mortality from other accidental causes by 0.8% – is also consistent with the results of earlier research and seems reasonable, since risky activities such as driving increase in good economic times. Conversely, suicides are estimated to fall by a statistically insignificant 0.4% and homicides by a significant 1.1%.²⁷

The income effects are mixed (see model b). Consistent with the results for total mortality, higher incomes are correlated with significantly lower infant mortality and deaths from cancer and influenza/pneumonia. The coefficients for homicides and non-vehicle accidents are also negative but statistically insignificant. Conversely, rising incomes are linked to increased deaths from heart disease and a statistically insignificant rise in mortality from vehicle accidents and liver ailments. These diverse effects suggest a complicated role for income that deserves further study.²⁸

7. DYNAMICS

Economic conditions have been assumed to have only a contemporaneous impact on mortality until now. Information on the dynamics of the adjustment process was obtained by estimating models that included 4-year lags of the national unemployment rate and calculating the impact of a 1% point rise in unemployment persisting for k years as $\sum_{n=0}^k \widehat{\beta}_{t-n}$, for $\widehat{\beta}_{t-n}$ the regression coefficient on the n -year lag of unemployment.

The adjustment patterns vary substantially across causes of death.²⁹ Falling unemployment is predicted to lead to rapid and sustained increases in total deaths: a lasting 1% point decline in unemployment is estimated to raise overall mortality by 0.5, 0.4, and 0.6% after 0, 2, and 4 years (with standard errors of 0.2% in each case). This reflects deaths from sources such as influenza/pneumonia or liver disease that rise over time. By contrast, the 1.4% initial increase in deaths predicted from cardiovascular disease weakens to 0.2% after 2 years and completely disappears by the end of four. Similarly, traffic deaths are estimated to grow 2.5% in the year unemployment rises but by a smaller 2.3% after 2 years and 1.4% after four.

8. DIFFERENCES ACROSS SOCIAL INSURANCE SYSTEMS

The macroeconomic effects could be mitigated or accentuated by institutional factors such as the type and availability of health insurance or, more generally, the comprehensiveness of the social insurance system. Stronger procyclical fluctuations might occur in countries with relatively weak social protections if individuals have incentives to work particularly hard during good economic times to offset the effects of reduced incomes during downturns. Conversely, an employment-based system of health insurance, such as that in the United States, may imply higher rates of coverage during macroeconomic expansions. Labor market protections may also be relatively strong in countries with high levels of social insurance spending. This might mute or reverse the procyclical variation in mortality if individuals in these countries feel less pressure, than their counterparts in nations with weaker labor laws, to increase the intensity or hours of work during good economic times.

27. Ruhm (2000) also finds that suicides are countercyclical but, unlike this analysis, demonstrates that homicides rise in good economic times in the United States.

28. Models that control for the percentage of the population employed, rather than the unemployment rate, yield results that are almost always consistent with those reported in this section.

29. A table showing these results is available upon request for 3 years following the date of publication.

There are many possible methods of measuring the strength of the welfare state (e.g. see Esping-Anderson, 1990; Korpi and Palme, 1998). We explored this issue through a series of estimates on subsamples of nations stratified by the country's average public social expenditure as a percentage of GDP during 1990–1998. Data are from the *OECD Social Expenditure Database* (OECD, 2001).³⁰ Public social expenditure has the advantage of being well measured and closely tied to programmatic assistance related to social insurance.

Our main results are summarized in Table 5. For simplicity, we divided the countries into three groups ranked by social insurance spending. The top category (consisting of Germany, The Netherlands, Austria, Norway, France, Finland, Denmark, Sweden) spent an average of 28.7% of GDP on public social programs; the middle group (containing Spain, New Zealand, Luxembourg, Poland, Italy, United Kingdom, Switzerland, Belgium) devoted 23.5% of GDP to these programs; the bottom category (composed of Japan, the United States, Portugal, Australia, The Czech Republic, Ireland, Canada) spent 18.9%.³¹

The primary finding is that the procyclical fluctuation in mortality is much stronger in countries with weak social insurance programs. Thus, a 1% point decrease in unemployment is predicted to raise total mortality rates by 0.9% for countries in the lowest category, versus 0.5 and 0.3% for nations in the middle and top groups. These results occur despite a protective effect of income that, not surprisingly, is more pronounced in nations with weaker social safety nets: a 10% increase in income is predicted to reduce total mortality by 1.7, 1.4, and 2.6% in the lowest, middle, and highest category. Holding income constant, the one point fall in joblessness would be anticipated to increase deaths by 1.2, 0.7, and 0.6% across the three groups.

Econometric specifications examining specific sources of death (not shown) confirm the general pattern of larger cyclical responsiveness in countries with low rates of social spending. For example, among the bottom third of countries, a one point drop in unemployment is predicted to raise deaths from heart disease, flu/pneumonia, liver disease, vehicle accidents, other accidents, and infant mortality by 1.0, 4.3, 1.5, 4.8, 1.5 and 1.5%, respectively. The corresponding increase for nations in the top social spending category are 0.05, 0.7, 0.4, 2.2, 0.7 and —0.3%.³²

9. DISCUSSION

We provide evidence that deaths increase when labor markets strengthen. In the preferred specification, a 1% point fall in the national unemployment rate is estimated to raise total mortality by 0.4% and deaths due to cardiovascular diseases, influenza/ pneumonia, liver ailments, and vehicle accidents by 0.4, 1.1, 1.8, and 1.9%, respectively. These patterns are similar to, although generally somewhat weaker than, those obtained in Ruhm's (2000) study of the United States using comparable methods and data. If the U.S. is omitted from our analysis, a

30. We choose these years because the social expenditure data was available in of them for all countries in our sample. However, the rankings of countries do not appear to be sensitive to the choice of years.

31. We also experimented with a number of alternative specifications, such as dividing countries into the top and bottom half or interacting social expenditure with unemployment rates and log income (for the full sample). The results are consistent with those reported below.

32. Given the small number of some sources of deaths and the less consistent results obtained above for specific causes, some exceptions to the general pattern are to be expected. For instance, we find a counter cyclical pattern of cancer deaths in the bottom third of social spending.

Table 5

Econometric estimates for total mortality, as a function of public social expenditure as a share of GDP

Specification	Lowest third		Middle third		Highest third	
Country unemployment rate	-.0085* (.0025)	-.0118* (.0028)	-.0046* (.0011)	-.0072* (.0015)	-.0027* (.0015)	-.0065* (.0016)
Natural log of income		-.1747* (.0682)		-.1380* (.0545)		-.2598* (.0621)

Note: See note in Table 2. All equations include country and year dummy variables, demographic characteristics, and country-specific time trends ($p < 0.05$). Countries are ranked according to their average public social expenditure, as a share of GDP, during the 1990–1998 period. The lowest third includes Japan, the United States, Portugal, Australia, the Czech Republic, Ireland, and Canada. The middle third contains Spain, New Zealand, Luxembourg, Poland, Italy, the United Kingdom, Switzerland, and Belgium. The highest third consists of Germany, The Netherlands, Austria, Norway, France, Finland, Denmark, and Sweden.

one point fall in unemployment is estimated to raise total mortality by 0.3%. The smaller magnitude of this estimate may reflect institutional differences, such as shorter working hours and more stringent job safety regulations in many western European nations, compared to the United States. Consistent with this, we found a considerably more pronounced procyclical fluctuation in total deaths (and deaths from most specific sources examined) for countries with stronger social insurance systems, as proxied by the percent of GDP devoted to public social expenditure, than for those with weaker safety nets.

Other recent research also indicates that health deteriorates when the economy temporarily improves. Tapia Granados (2004) and Neumayer (2004) document procyclical variations in mortality using Spanish and German data, while Ruhm (2003) shows that medical conditions in the United States (particularly acute morbidities) become more prevalent when labor markets tighten. An exception is Gerdtham and Johannesson's (2005) evidence of a countercyclical fluctuation in mortality for males (but not females) in Sweden using individual level data and some alternative business cycle indicators (e.g. the notification rate, change in GDP and industry capacity utilization rate). A possible explanation for this difference may be Sweden's strong social insurance system, as discussed above.

It should be emphasized that increased mortality associated with *transitory* strengthening of the labor market does not necessarily imply negative effects of *permanent* economic growth. The key distinction is that agents have greater flexibility in making consumption, production, and time-allocation decisions in the long-run. Thus, temporary increases in output usually involve more intensive use of labor and health inputs with existing technologies, whereas permanent growth results from improvements in technology or expansions in the capital stock that push out the production possibility frontier and so have the potential to ameliorate costs to health. Similarly, individuals may be more likely to defer health investments in response to temporary than permanent increases in work hours and sustained income growth permits purchases of consumption goods (such as vehicle safety) that improve health.³³

That said, our analysis of the dynamics of the effects of sustained changes in economic conditions is too preliminary to determine how long (if ever) an improvement in the macroeconomy must last before yielding improvements in health. Moreover, the results vary across sources of death, suggesting the possibility of a diverse array of mechanisms. For instance, the increase in cardiovascular mortality is estimated to dissipate fairly quickly, as might occur if higher time prices lead to initial reductions in exercise but with individuals gradually making arrangements (such as joining a health club that is close to work) to restore physical activity to previous levels. Conversely, the rise in deaths from liver disease is estimated to grow over time, possibly reflecting the cumulative impact of a sustained increase in alcohol use.³⁴

33. Ettner (1996), Pritchett and Summers (1996), and Gerdtham and Johannesson (2002, 2004) provide examples of research showing a positive relationship between income and health. Graham, Chang, and Evan's (1992) analysis of the U.S. data indicates that mortality rates are negatively related to per capita consumption (a proxy for permanent income) but also to the unemployment rate (which rises when the economy temporarily deteriorates). Conversely, Snyder and Evans (2002) show that reduced incomes of the Social Security "notch" beneficiaries were associated with decreased mortality.

34. See Ruhm (1995) or Ruhm and Black (2002) for evidence of a procyclical variation in drinking.

The role of income is similarly complex. In our estimates, higher incomes are estimated to have a protective effect on overall mortality, once unemployment rates are controlled for, but with substantial variation across causes of death. For example, income growth is associated with increased deaths from heart disease, the single most important cause of mortality, but also with declines in deaths due to cancer or influenza/pneumonia.³⁵

The results may be sensitive to the choice of macroeconomic proxies. We have focused on unemployment rates, which provide a direct indication of labor market conditions and have frequently been used in other research. However, different findings might be obtained using income-based macroeconomic proxies such as changes in GDP or deviations of GDP from its trend.³⁶ It would also be interesting to investigate whether the results differ across population subgroups (such as males and females) that may be differentially affected by macroeconomic conditions, and to examine variations in other outcomes, such as absenteeism, that cause welfare costs and production losses. Finally, additional investigation of individual level (and ideally panel) data might help to explain the underlying mechanisms for the results obtained in this and related research.

Evidence that health deteriorates when the economy improves is *not* an argument for inducing recessions, which have overwhelmingly negative consequences even if worse physical health is not one of them. However, the findings do illustrate that the epidemiological literature emphasizing harmful effects of individual unemployment provides a misleading indication of the overall health consequences of economic downturns.

Interventions designed to ameliorate the health risks of expansions should probably be microeconomic in nature and vary with the specific problem addressed.³⁷ For instance, negative byproducts of growth in output, such as increases in pollution, might be addressed by raising the cost of these activities during robust economic periods. Policies designed to have these effects without the need for specific government intervention may be particularly useful (e.g. allocating traffic enforcement funds as a percentage of government revenues, which rise during expansions).

Economic incentives and public health initiatives might also be employed to decrease the frequency and negative consequences of unhealthy behaviors, for instance by raising taxes on alcohol and tobacco during upturns.³⁸

35. Ruhm (2000) generally obtains much weaker income effects for his analysis of the United States, raising further questions about the relationship between income and health.

36. The notification rate (of plant closings and mass layoffs) as was used by Gerdtham and Johannesson (2005) might also be a useful labor market indicator, since it is typically affected earlier in the business cycle than unemployment. Unfortunately, data on notification rates are not widely available. A rudimentary analysis suggested that the results obtained when regressing mortality rates on deviations of GDP from trend were sensitive to the specific choice of time periods and specifications.

37. This discussion draws heavily on material in Ruhm (2005b), as well as the useful insights of Edwards (2005).

38. If it is politically infeasible to explicitly increase these taxes when the economy improves, a step in this direction might be taken by switching from unit taxes, which are typically specified in nominal terms and so fall during periods of high inflation, to ad valorem taxes which are not.

This could be accompanied by public health campaigns that emphasize the existence, nature and methods of preventing health risks. In countries like the United States, that lack universal health coverage, the eligibility for government-sponsored health insurance programs might be modified to reduce the likelihood that individuals lose coverage when they obtain jobs. There may also be a role for policies designed to promote healthier employment or reduce the stress or physical demands of work (such as incentives for employer-sponsored health promotion activities and employee assistance programs and, possibly, restrictions on the length of the work day, week or year). Obviously, the desirability of any specific policies depends on a fuller accounting of the benefits and costs than has been provided here, as well as a better understanding of the mechanisms by which improvements in macroeconomic conditions lead to worse health.

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