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ARE RECESSIONS GOOD FOR YOUR HEALTH?*

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This study investigates the relationship between economic conditions and health. Total mortality and eight of the ten sources of fatalities examined are shown to exhibit a procyclical fluctuation, with suicides representing an important exception. The variations are largest for those causes and age groups where behavioral responses are most plausible, and there is some evidence that the unfavorable health effects of temporary upturns are partially or fully offset if the economic growth is long-lasting. An accompanying analysis of microdata indicates that smoking and obesity increase when the economy strengthens, whereas physical activity is reduced and diet becomes less healthy.

This study examines how health responds to transitory changes in economic conditions. Fixed-effect (FE) models are estimated using longitudinal data for the 1972–1991 period, with health proxied by total and age-specific mortality rates and ten particular causes of death. The unit of observation is the state, and most of the analysis focuses on within-state variations in unemployment and personal incomes; limited attention is also paid to the changes in national unemployment rates.[1] In addition, microdata for *1987–1995* from the *Behavioral Risk Factor Surveillance System* (BRFSS) are used to examine how risky behaviors and time-intensive health investments in physical activity, diet, and preventive medical care vary with the status of the economy. State fixed-effects are again controlled for as are a variety of demographic characteristics and general time effects.

The analysis provides strong evidence that health *improves* when the economy temporarily deteriorates. Specifically, state unemployment rates are *negatively* and significantly related to total mortality and eight of the ten specific causes of fatalities, with suicides representing an important exception. The variation in death rates is strongest for those causes and age groups where

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1. Discussions of "cyclical" variations or "macroeconomic" effects below therefore refer mainly to changes occurring within states rather than at the national level. For instance, the term "recession" is used loosely to indicate the effects of increases (decreases) in state unemployment rates (personal incomes), instead of a technical definition based on changes in national GDP.

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fluctuations are most plausible, and there is some evidence that the unfavorable health effects of temporary upturns are partially or fully offset if the economic growth is long-lasting. Consistent with these results, the microdata reveal that higher joblessness is associated with reduced smoking and obesity, increased physical activity, and improved diet.

These results contrast with seminal work by Harvey Brenner [1973, 1975, 1979]. Using aggregate time-series data, he uncovers a countercyclical variation in admissions to mental hospitals, infant mortality rates, and deaths due to cardiovascular disease, cirrhosis, suicide, and homicide. However, other researchers [Gravelle, Hutchinson, and Stern 1981; Stern 1983; Wagstaff 1985; Cook and Zarkin 1986] have pointed out serious flaws in Brenner's analysis and studies correcting these problems (e.g., Forbes and McGregor [1984], McAvinchey [1988], and Joyce and Mocan [1993]) fail to replicate his findings.[2] Significantly, the estimated "effects" are sensitive to the choice of countries and time periods, with elevated unemployment frequently being correlated with better health. This fragility is not surprising since any lengthy time-series is likely to suffer from substantial omitted variables bias.[3]

Previous studies of the relationship between macroeconomic conditions and health have usually focused on psychological determinants, hypothesizing that downturns cause detrimental changes in physical and mental health by increasing stress and risk-taking.[4] By contrast, in economic models health is produced

2. Criticisms include Brenner's method of choosing lag lengths, the hypothesized pattern of lag coefficients, choice of covariates, and the plausibility of his results.

3. Much of the variation in unemployment during the four decades (beginning in the 1930s) covered by Brenner's research resulted from dramatic reductions in joblessness following the great depression. During this period, mortality declined substantially due to improvements in nutrition and increased availability of antibiotics. Cross-sectional data have similar problems. For instance, Junankar's [1991] examination of the mortality and unemployment rates of specific region/occupation subgroups in Britain will yield biased results if joblessness is correlated with unobservables that influence fatalities (e.g., if unskilled blue-collar workers experience both high unemployment and elevated mortality due to lack of education). Alternatively, many researchers contrast the health of unemployed and employed persons (e.g., Moser, Fox, and Jones [1984], and Janlett, Asplund, and Weinehall [1991]). This introduces two other problems. First, economic downturns could affect the health of persons who do not become unemployed (e.g., if jobs become more stressful). Second, poor health may cause rather than be caused by unemployment.

4. For example, Brenner and Mooney [1983, p. 1128] write: "recession increases the probability of a variety of losses and social changes that potentially threaten health in at least three ways: 1) poverty or lack of material resources to meet the ordinary requirements and extraordinary problems of life . . . 2) psycho-

by lifestyle behaviors, human capital investments, and stochastic shocks, and therefore is influenced by factors such as income and the relative price of medical care (e.g., see Grossman [1972]). For instance, assume that individuals maximize a utility function with health and other consumption as arguments subject to budget and time constraints, where health is produced by nonmarket "leisure" time, medical care, baseline status, and health shocks. Utility maximization then implies allocating time and purchased goods to equalize the marginal utility of the last dollar's worth of medical care, other consumption, and leisure.[5]

In such a model, permanently higher incomes will probably be associated with health improvements since the budget constraint is shifted out. However, there are at least four reasons why health might decline during temporary upturns. First, the opportunity cost of time is likely to rise. Second, health could be an input into the production of goods and services. Third, some risky activities may be normal goods. Fourth, in-migration in response to improvements in local economic conditions could have negative effects. These mechanisms are detailed below.

I. Economic Conditions and Health Status

The evidence for developing countries strongly supports the prediction that lasting economic growth leads to better health.[6] However, the relationship is more ambiguous for industrialized nations: some studies [Feinstein 1993; Duleep 1995] indicate that average income is not an important correlate; others [Menchik 1993; Ettner 1996] find a positive relationship; and still others [Waldmann 1992; Kaplan et al. 1996; Kennedy, Kawachi, and Prothrow-Stith 1996] suggest that *inequality,* rather than average income, is of key importance.

Brainerd's [1997] analysis of post-reform Russia is instructive in considering the complicated connections between income and health. The Russian death rate increased by 40 percent between 1990 and 1994. This growth in mortality was accompanied but does not appear to have been caused by sharp declines in

logical stress associated with (the) loss . . . 3) attempts to alleviate psychological distress by medication with alcohol or legal and illegal drugs . . . (which) tend to exacerbate existing morbidity and produce additional health problems."

5. See Ruhm [1996] for details of this model and extensions to it.

6. For instance, the long-run income elasticity of infant and child mortality in developing countries is between −0.2 and −0.4 [Pritchett and Summers 1996].

wages and output.[7] Instead, the higher death rate resulted from rapidly rising alcohol and tobacco consumption, partially due to declining relative prices, combined with a substantial increase in the price of medical care, higher crime rates, and deterioration in the already poor public health infrastructure. These effects were accentuated by the low health stock of the Russian population prior to the reforms.

Even if a permanent rise in income improves health, temporary growth could cause mortality to increase. There are two basic reasons why the long- and short-run effects may differ. First, agents have greater flexibility in making consumption, time allocation, and production decisions to improve health in the long run. Second, even relatively small negative health shocks, associated with transitory upturns, may cause frail individuals to die slightly sooner than they otherwise would, while having little effect on life expectancy or overall population health.[8] Four possible mechanisms through which fatalities could vary procyclically are discussed next.

A. The Opportunity Cost of Time

Leisure time declines during economic upturns, making it more costly to undertake health-producing activities (such as exercise) that are time-intensive. Similarly, the time price of medical care will rise if individuals working more hours find it harder to schedule medical appointments for themselves or their dependents.[9] A testable implication is that lifestyles should become less healthy when the economy temporarily expands.[10]

7. Brainerd points out that deaths increased little or actually declined over the same period in other Eastern European countries, such as Poland and the Slovak Republic, that instituted rapid economic reforms and experienced dramatic increases in unemployment. Within Russia, predicted death rates were *positively* related to region-specific changes in wages in fixed-effect models that controlled for general time effects and various demographic characteristics.

8. This phenomenon is referred to as "harvesting" by epidemiologists. Consistent with this possibility, Graham, Chang, and Evan's [1992] analysis of U. S. time-series data for the 1950–1988 period indicates that mortality rates are negatively (positively) related to permanent (transitory) income as proxied by per capita consumption (the inverse of unemployment).

9. Some empirical evidence supports the possibility that the time costs rise during periods of high employment. For instance, Mwabu [1988] shows that agricultural workers in Kenya see medical providers less often during the busy season than the rest of the year, while Vistnes and Hamilton [1995] demonstrate that ambulatory medical care received by children is negatively correlated with their mothers' work hours.

10. Intertemporal substitution implies that individuals will be more likely to defer time-intensive health investments in response to a temporary than a permanent increase in wages.

Medical care utilization is harder to predict because the higher time costs may be offset by increased availability of health insurance or because health deteriorates when the economy improves.

B. Health as an Input into Production

Health may also be an input into the production of goods and services. Most directly, hazardous working conditions, job-related stress, and the physical exertion of employment may have negative effects on health, particularly when job hours are extended during short-lasting economic expansions.[11] These effects will be reinforced since cyclically sensitive sectors, particularly construction, have high accident rates.[12] Finally, some joint products of increased economic activity may present health risks. For instance, Chay and Greenstone [1999] show that localized (county-level) reductions in pollution levels associated with the 1981–1982 recession led to substantial decreases in infant mortality.[13]

C. External Sources of Death

As mentioned, work-related accidents are likely to become more common during temporary expansions. Other types of accidents will probably increase as well. Of particular importance, drinking and driving rise in good times, leading to higher motor vehicle fatality rates [Evans and Graham 1988; Ruhm 1995].[14] The predictions are less obvious for other external sources of death (homicides and suicides). Cook and Zarkin [1985] provide theoretical arguments showing that the business cycle has ambiguous effects on crime.[15] However, a careful analysis by Raphael and Winter-Ebmer [1998] indicates that murders are procyclical.

11. Research on the stressful nature of work includes Karasek and Theorell [1990] or Fenwick and Tausig [1994]. Viscusi [1993] and Tolley, Kenkel, and Fabian [1994] review the vast literature on hazardous working conditions.

12. Construction had a fatal injury rate of fifteen per thousand workers in 1996, compared with one and three per thousand in services and manufacturing [*Statistical Abstract of the United States* 1998].

13. The negative effects of economic growth will again probably be more pronounced in the short run than in the long run, since temporary increases in production usually combine greater use of labor and health inputs with existing technologies, whereas permanent growth results from new technologies that have the potential to ameliorate or eliminate any costs to health.

14. Permanently higher incomes, however, may permit greater investments in road and vehicle safety, possibly ameliorating or reversing this effect in the long run.

15. Both criminal and legitimate opportunities increase in good times, with offsetting effects on crime, while alcohol, drugs, and guns are likely to be normal goods.

Conversely, research dating back to Durkheim [1897] suggests that suicides rise as the economy deteriorates, possibly because of increased stress.[16]

D. Migration Flows

The effects of national business cycles could differ from those of more localized fluctuations. Importantly, migration flows are large in the United States in response to changes in local economic conditions.[17] This mobility has the potential to raise death rates in destination states through increasing crowding, because the new migrants import disease, or if they are unfamiliar with roads or the medical infrastructure.[18] Conversely, since movers tend to be relatively young and (presumably) healthy, migration may induce a spurious negative correlation between economic conditions and mortality rates.

II. Mortality Is Procyclical: Evidence from State Data

The aggregate data cover the 50 states and District of Columbia over the 1972–1991 time period. The outcomes are total mortality rates, fatalities for three age groups (20–44, 45–64, and ≥65 year olds), and deaths due to ten specific causes: 1) malignant neoplasms; 2) major cardiovascular diseases; 3) pneumonia or influenza; 4) chronic liver disease and cirrhosis of the liver; 5) motor vehicle accidents; 6) other accidents and adverse effects; 7) suicide; 8) homicide and legal intervention; 9) infant mortality (deaths within the first year); and 10) neonatal mortality (deaths within the first 28 days).

The ten specific sources account for around 80 percent of all fatalities. Cancer, heart disease, and pneumonia/influenza represent three of the main physical illnesses causing death. Cirrhosis, suicides, and accidents combine the effects of lifestyles and

16. More recent studies include Hamermesh and Soss [1974] or Dooley et al. [1989].

17. Blanchard and Katz [1992] show that the medium-term employment response to labor demand shocks in the United States is entirely accounted for by migration.

18. For example, immigration has been linked to the incidence of tuberculosis [U. S. Department of Health and Human Services 1998], and vehicular safety problems to the unfamiliarity with roads or traffic regulations [National Highway Traffic Safety Administration 1995]. Analysis of traffic fatality data confirms that states with fast population growth experienced relative increases in crash deaths over the 1985–1990 period (the simple correlation of the two growth rates is .19).

physical or mental health problems in various degrees.[19] Homicides provide one indication of the interaction between crime and the economy. Finally, infant and neonatal mortality are partially determined by prenatal and postnatal care. Data on fatalities are from *Vital Statistics of the United States,* published annually by the United States Bureau of the Census.

Using the subscripts j and t to index the state and year, the basic regression equation is

$$H_{jt} = \alpha_t + X_{jt}\beta + E_{jt}\gamma + S_j + \epsilon_{jt}, \tag{1}$$

for H the natural log of the mortality rate, E the proxies for economic conditions, X a vector of supplementary regressors, and ϵ the error term. The fixed-effect S_j controls for time-invariant state characteristics, α_t accounts for nationwide time effects, and γ captures the impact of *within-state* deviations in economic conditions. Observations are weighted by the square root of state populations to account for heteroskedasticity.[20] Limited information on the effects of *national* business cycles is also obtained by estimating

$$H_{jt} = X_{jt}\beta + E_{jt}\gamma + E_t\delta + S_j + \epsilon_{jt}, \tag{2}$$

where E_t indicates national economic conditions and the time effects are excluded.

Unemployment rates are the primary proxy of economic conditions used below. The data are from a consistent (unpublished) series for the noninstitutionalized civilian population aged sixteen and over. (The information is missing for some smaller

19. Empirical evidence confirms that economic factors can have rapid and substantial effects on fatalities resulting from diseases which develop slowly. For instance, Cook and Tauchen [1982] show that cirrhosis mortality responds quickly to changes in alcohol tax rates, and Willich et al. [1994] demonstrate that the heart attacks of working individuals peak on Mondays, suggesting that even extremely short-term changes in employment status can affect health.

20. Cook and Tauchen [1984] show that, for this model, heteroskedasticity takes the form, $\ln(1 + (1 - p)/pN)$, for p the probability of death and N the cell size. Thus, weighting by (the square root of) population size is not correct. However, with small p, the variance of the error term is approximately proportional to the cell size, and the procedure is close to being right. In this case, $1 - p \approx 1$ and, for large N, $\ln(1 + (1 - p)/pN) \approx 1/pN$. I also experimented with a three-stage weighting procedure for the total mortality models. OLS was used in the first stage. The squared residuals were then regressed against a constant and the reciprocal of the state population. The constant term never differed significantly from zero while the population variable was always highly significant, as expected if the heteroskedasticity results from sampling error. The square roots of the inverse of the predicted values from the second-stage regression were then used as weights in a final set of estimates. The resulting coefficients on unemployment rates and personal incomes were virtually identical to those obtained using the more conventional weighting procedure.

states prior to 1976.) As an alternative, I experimented with the employment-to-population (EP) ratio and the level of payroll employment in nonfarm establishments. EP ratios are considered 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. Changes in payroll employment may reflect migration flows in response to local economic conditions. Personal incomes, in 1987 dollars adjusted by the implicit price deflator, are sometimes controlled for.

In addition, the regressions hold constant the percentage of the state population with three levels of educational attainment (high school dropout, some college, college graduate), in two ethnic groups (Black, Hispanic), and two age categories (<5, ≥ 65 years old). Ceteris paribus, mortality rates are expected to be relatively low when the proportions of educated individuals, whites, and young persons are relatively high. Ethnic status and age are measured over the full population; educational attainment refers to persons aged 25 and higher. These variables are constructed using census data for the years 1970, 1980, and 1990. Values for the noncensus years are interpolated by assuming a constant rate of growth between census periods.[21]

A. Descriptive Statistics

Summary statistics, weighted by the total resident population in each state, are displayed in Table I and are largely self-explanatory. The fatality rates refer to deaths per 100,000 persons, except for infant and neonatal mortality, which are per 1000 live births. For cause-specific mortality, the listings in parentheses refer to the Ninth Revision of the International Classification of Diseases (ICD-9 categories).

Total mortality and most specific sources of fatalities declined substantially during the sample period. The overall death rate fell more than 8 percent over the twenty years (decreasing from 943.2 to 860.3 per 100,000 persons), with substantially larger 27 and 36

21. The reporting of education changed between 1980 and 1990. In 1970 and 1980 information on years of college was provided; the 1990 data indicated whether a college degree had been obtained. The "some college" group refers to persons with one to three years of university education in 1970 and 1980 and some college but no bachelor's degree in 1990. The "college graduate" group is those with four or more years of college in the two earlier census years and with a bachelor's degree in the latest one. Many students take more than four years to obtain a degree, so the percentage of college graduates is likely to be moderately overstated prior to 1990.

TABLE I
VARIABLES USED IN ANALYSIS OF STATE AGGREGATE DATA

Variable	Mean	Standard deviation
Death rate per 100,000 population:		
All causes	879.8	106.9
All causes, 20–44 year olds	165.4	32.0
All causes, 45–64 year olds	934.2	141.8
All causes, ≥65 year olds	5240.0	417.7
Malignant neoplasms (140–208)	186.7	29.4
Major cardiovascular diseases (390–448)	423.9	74.5
Pneumonia and influenza (480–487)	27.1	5.9
Chronic liver disease and cirrhosis of the liver (571)	12.6	4.2
Motor vehicle accidents (E810–825)	21.3	5.9
Other accidents, adverse effects (E800–807, E826–949)	22.2	5.4
Suicides (E950–959)	12.4	2.8
Homicides and legal intervention (E960–978)	9.5	4.2
Death rate per 1000 live births:		
Infant: deaths within first year	12.4	3.3
Neonatal: deaths within first 28 days	8.5	2.7
Explanatory variables:		
Civilian unemployment rate in %	6.9	2.1
Per capita personal income (in thousands of 1987 dollars)	14.2	2.4
% of population under 5 years old	7.5	0.8
% of population aged 65 and over	11.5	2.0
High school dropouts (% of persons 25 and over)	33.0	8.6
Some (1–3 years) college (% of persons 25 and over)	25.0	6.9
College graduate (≥4 years of college, % of persons 25 and over)	16.6	4.0
% of population who are black	11.7	8.0
% of population who are Hispanic	6.9	7.8

All variables are weighted by state populations. The unemployment rate refers to civilians aged sixteen and over. For the mortality rates, entries in parentheses refer to category listings from the Ninth Revision of the International Classification of Diseases.

Data on fatalities are from *Vital Statistics of the United States,* published annually by the United States Bureau of the Census. Those on unemployment rates were provided to me by the Bureau of Labor Statistics. Data on personal incomes are from U. S. Department of Commerce [1989] and various issues of the *Statistical Abstract of the United States.* Variables indicating age, education, and population size are constructed using census data reported in the *Statistical Abstract of the United States* and, for the percentage of Hispanics in 1970, from United States Bureau of the Census [1973].

percent reductions in mortality due to heart disease and vehicle crashes. By contrast, cancer fatalities increased 23 percent, and deaths from influenza/pneumonia, suicides, and homicides also rose (by 3, 2, and 12 percent). Mortality from all of the other specific causes trended downward, as did the death rates of all three age groups.

Figure I displays *national* total mortality and unemployment

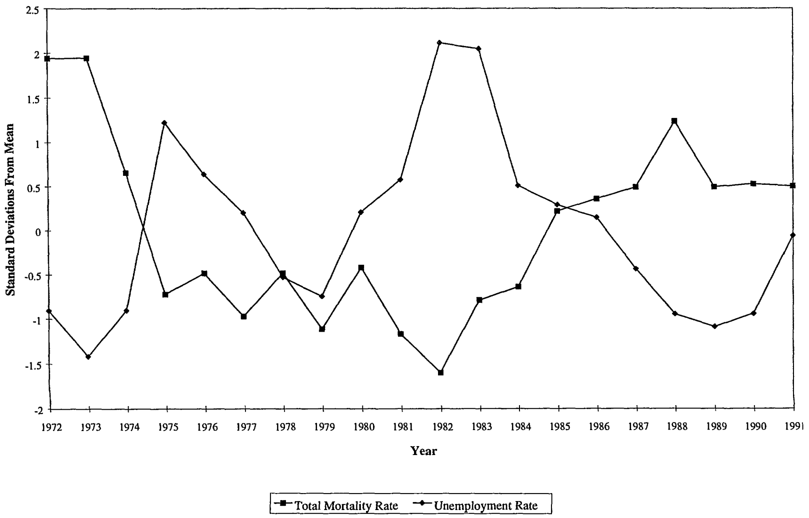

FIGURE I
Total Mortality and Unemployment Rates (Detrended and Normalized)

rates in each year. The variables are detrended, using a linear trend, and normalized by subtracting the mean of the detrended variable and dividing by its standard deviation. Previewing the econometric results to follow, the figure illustrates a strong *inverse* relationship between economic conditions and fatality rates. Deaths declined dramatically during the 1975 and 1982 to 1983 recessions, while increasing throughout much of the recovery of the middle 1980s.[22] Although the national data may suffer from the aforementioned problems of confounding, these findings raise questions about the common belief that health declines during economic contractions.

The fixed-effect estimates exploit within-state variations in economic conditions and have the potential to improve on (aggregate) time-series analyses if there are substantial independent macroeconomic fluctuations across states over time. This condition appears to be met. For example, even accounting for error in the measurement of (annual) state unemployment rates, the

22. Unemployment exhibits virtually no time trend, decreasing by .003 percent per year. Conversely, total mortality declines by 3.1 deaths per 100,000 persons annually. A regression of the natural log of total mortality on unemployment rates and a linear time trend, using national data ($n = 20$), yields an unemployment coefficient of $-.0102$ with a standard error of .0023.

squared-correlation coefficients between these and the national unemployment rate are fairly low—the R^2 exceeds .9 in just three states, is above .75 in only fourteen, and is less than .5 in twenty states. Similarly, state unemployment rankings vary substantially over time. Thus, none of the five states with the highest unemployment in 1976 (the first year the data were universally available) were in the top five in 1991, and just three states ranked in the top ten during both years.

B. Total Mortality Rates

This subsection examines the relationship between economic conditions and total mortality rates. Unless otherwise stated, the dependent variable is the natural logarithm of the death rate (per 100,000 persons). Table II summarizes the results of a variety of specifications, all of which control for state population characteristics (age, education, and ethnic status), state fixed-effects, and use state or national unemployment rates to proxy macroeconomic conditions. Most specifications also include year dummy variables, and some hold constant personal incomes, state-specific (linear) time trends, or both.

Joblessness is always *negatively* and statistically significantly correlated with total mortality. For the full sample (shown in the top panel), a one percentage point increase in the state unemployment rate decreases the predicted death rate by approximately 0.5 percent. This estimate is insensitive to the inclusion of state-specific time trends.[23] When measured in levels, rather than logs, the one point increase in joblessness is expected to reduce fatalities by 4.6 per 100,000; this is also equivalent to a 0.5 percent decline from its base of 879.8 per 100,000 (see the last two columns of the table).[24] Personal income is positively related to mortality—a $1000 increase is associated with a 0.4 to 0.6 percent

23. The demographic coefficients conform to our expectations. Mortality increases with age, graduation from college is predicted to modestly reduce deaths, and blacks have higher fatality rates than whites. The unemployment coefficient is roughly one-third larger in models without controls for population characteristics, with the entire difference caused by the exclusion of age.

24. Fatalities also always exhibit a substantial procyclical variation in specifications controlling for EP ratios or nonagricultural payroll employment, rather than unemployment rates, or the natural log rather than the level of personal incomes. For instance, a one percentage point increase in the EP ratio raises the predicted death rate 0.3 to 0.5 percent, with the smaller magnitude of the effect consistent with the larger cyclical fluctuation of EP ratios than unemployment rates. Similarly, in models with state time trends, a 1 percent increase in payroll employment reduces expected mortality by approximately 0.2 percent. Details on some of these estimates are provided in Ruhm [1996].

TABLE II
FIXED-EFFECT ESTIMATES OF THE DETERMINANTS OF TOTAL MORTALITY RATES

	Basic specification					With state-specific time trends					Deaths in levels	
Full sample estimates	(a)	(b)	(c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)	(a)	(b)
State unemployment rate	−.0052	−.0044	−.0065		−.0069	−.0054	−.0041	−.0068		−.0069	−4.574	−4.224
	(.0005)	(.0006)	(.0004)		(.0006)	(.0004)	(.0006)	(.0003)		(.0005)	(0.429)	(0.527)
U. S. unemployment rate				−.0067	.0006				−.0070	.0002		
				(.0005)	(.0008)				(.0005)	(.0007)		
Personal income		.0037					.0060					−1.572
		(.0016)					(.0017)					(1.378)
Year effects	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	Yes

	1971–1982		1983–1991		10 largest states		Fast growing states		Slow growing states	
Split-sample estimates	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
State unemployment rate	−.0045	−.0034	−.0061	−.0047	−.0057	−.0035	−.0080	−.0076	−.0057	−.0078
	(.0007)	(.0008)	(.0007)	(.0008)	(.0009)	(.0012)	(.0009)	(.0013)	(.0010)	(.0013)
Personal income		.0076		.0077		.0077		.0013		−.0123
		(.0026)		(.0023)		(.0030)		(.0027)		(.0046)

The dependent variable is the natural logarithm of the total mortality rate per 100,000 population, except in the last two columns of the top panel, where it is measured in levels. Observations are weighted by the square root of the state population. All specifications also include vectors of state dummy variables and controls for the percentage of the state population who are black and Hispanic, in two age categories (<5 and ≥65 years old), and three education groups (high school dropout, some college, college graduate). Year dummy variables are also controlled for, except models (c) and (e) in the top panel. Standard errors are in parentheses. The sample in the top panel includes annual observations for the 50 states and the District of Columbia covering the period 1972–1991. Missing data on unemployment rates for some states prior to 1976 reduce the sample size to 930. The ten largest states refer to rankings in 1991 and include, in descending order of size, California, New York, Texas, Florida, Pennsylvania, Illinois, Ohio, Michigan, New Jersey, and North Carolina. Fast and slow growing states refer to those with the largest population growth rates between 1980 and 1990. The former include Nevada, Alaska, Arizona, Florida, California, New Hampshire, Texas, Georgia, Utah, and Washington. The latter include West Virginia, Indiana, North Dakota, Wyoming, Pennsylvania, Louisiana, Michigan, Nebraska, Ohio, and Kentucky. Sample sizes are 471 and 459 for the 1972–1982 and 1983–1991 time periods and 200, 180, and 180 for the largest, fastest growing, and slowest growing states.

rise in fatalities—but controlling for it only modestly decreases the unemployment coefficient and the estimated income effect is reversed when the dependent variable is measured in levels instead of natural logs.

An even stronger negative relationship between unemployment and death rates is observed when year dummy variables are excluded. A one percentage point rise is associated with a 0.6 to 0.7 percent decline in mortality and the parameter estimate is virtually identical when either the state or the national unemployment rate is controlled for. However, when both the state and national rate are included in the same model, there is no independent impact of the latter (see specification e), suggesting that national business cycles affect health entirely through the resulting changes in state economic conditions.

The bottom panel of Table II presents separate estimates for the 1972–1982 and 1983–1991 periods, the ten largest states (based on 1991 population), and the ten states with the fastest and slowest rates of population growth during the 1980s. Splitting the sample into shorter time periods is likely to reduce the influence of within-state changes in omitted factors that are correlated with unemployment rates, since the size of the trend component is decreased relative to any fluctuations around the trend. The rationale for limiting the sample to large states is that measurement-error problems may be less severe for them. If the negative health effects of economic expansions result from migration, a stronger negative correlation between unemployment and mortality would be expected in fast than in slow growing states.

Mortality exhibits a procyclical variation for all of the subsamples. Restricting the analysis to large states has virtually no effect on the unemployment coefficient. The cyclical fluctuation is smaller prior to 1983 than subsequently but, even in the earlier period, a one percentage point increase in unemployment reduces the predicted death rate by a statistically significant 0.5 percent. The negative relationship between unemployment and mortality is relatively strong in fast growing states—a one point increase in joblessness is predicted to reduce fatalities by around 0.8 percent—but there is also a strong response in states with stagnant populations, thus providing mixed evidence on the hypothesis that migration flows cause poor health outcomes. The coefficient on personal incomes varies by sample, with a positive parameter estimate for both time periods and the ten largest states but a negative sign for the slow growing states. These ambiguous income effects receive further attention below.

C. Age- and Cause-Specific Death Rates

Most deaths involve the elderly. In 1990, 72 percent of fatalities occurred to persons aged 65 and older, as did over 80 percent of mortality from heart disease and almost 90 percent of deaths from influenza or pneumonia [*Vital Statistics of the United States* 1990]. However, individuals younger than 45 accounted for large shares of fatal vehicle crashes (69 percent), other deadly accidents (42 percent), suicides (56 percent), and homicides (83 percent), while 45–64 year olds disproportionately died from cancer (27 percent) and liver disease (42 percent).

Since young adults have the highest rates of labor force participation and are most affected by economic conditions, cyclical fluctuations in fatalities are anticipated to be largest for them.[25] The top panel of Table III verifies this expectation. A one percentage point rise in state unemployment lowers the predicted death rate of 20–44 year olds by 2.0 percent, has no effect on persons aged 45–64, and reduces the expected fatalities of senior citizens by less than 0.3 percent.[26] One reason macroeconomic conditions have such different effects across age groups is that state mean personal income is strongly *positively* correlated with the expected mortality of 20–44 year olds—an extra $1000 increases predicted fatalities by 5.2 percent—but not for the two older groups. Nevertheless, holding income constant, a one percentage point increase in joblessness is associated with a 0.3 percent reduction in the death rates of both 45–64 and ≥65 year olds, which is only one-fourth the estimated effect for those aged 25–44.

To put these macroeconomic fluctuations in perspective, more than 1.5 million senior citizens died in 1990, versus only 145,000 25–44 year olds. However, a one percentage point rise in unemployment would have decreased the predicted number of deaths involving the latter group by more than 2900, compared with a

25. In 1994, 83 percent of 20–44 year olds were in the labor force, compared with 72 percent of 45–64 year olds, and 12 percent of those ≥65; unemployment rates for the three groups were 6.1, 4.0, and 4.0 percent [U. S. Department of Labor 1995]. Business cycle effects need not be restricted to young adults, however, since government-funding for medical programs might vary with economic conditions, as could the ability of working-age adults to take their children or parents to receive medical care.

26. The greater cyclical fluctuation for senior citizens than for 45–64 year olds may result because the latter group disproportionately dies from cancer, whose progression is unlikely to be much affected by the state of the macroeconomy.

TABLE III
FIXED-EFFECT ESTIMATES OF AGE-SPECIFIC AND CAUSE-SPECIFIC MORTALITY EQUATIONS

	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
	20–44 year olds			45–64 year olds			≥65 year olds		
State unemployment	−.0203	−.0098	−.0193	.0003	−.0025	.0002	−.0032	−.0026	−.0043
rate	(.0016)	(.0018)	(.0019)	(.0009)	(.0010)	(.0009)	(.0005)	(.0006)	(.0007)
U. S. unemployment			−.0001			−.0017			−.0005
rate			(.0026)			(.0023)			(.0009)
Personal income		.0508			−.0134			.0028	
		(.0048)			(.0028)			(.0016)	
	Heart disease			Cancer			Flu/pneumonia		
State unemployment	−.0046	−.0052	−.0071	.0004	.0000	.0002	−.0066	−.0060	−.0084
rate	(.0008)	(.0010)	(.0010)	(.0006)	(.0008)	(.0006)	(.0023)	(.0029)	(.0032)
U. S. unemployment			.0038			−.0005			−.0138
rate			(.0013)			(.0009)			(.0045)
Personal income		−.0025			−.0017			.0027	
		(.0026)			(.0020)			(.0075)	
	Liver disease			Vehicle accidents			Other accidents		
State unemployment	−.0039	−.0060	−.0075	−.0302	−.0180	−.0319	−.0166	−.0185	−.0200
rate	(.0023)	(.0029)	(.0024)	(.0022)	(.0026)	(.0024)	(.0020)	(.0025)	(.0022)
U. S. unemployment			−.0010			−.0137			.0116
rate			(.0034)			(.0034)			(.0030)
Personal income		−.0095			.0544			−.0085	
		(.0076)			(.0067)			(.0065)	
	Suicide			Homicide					
State unemployment	.0127	.0116	.0110	−.0189	−.0153	−.0221			
rate	(.0022)	(.0027)	(.0022)	(.0035)	(.0043)	(.0041)			
U. S. unemployment			−.0084			.0073			
rate			(.0030)			(.0057)			
Personal income		−.0048			.0163				
		(.0070)			(.0112)				
	Infant mortality			Neonatal mortality					
State unemployment	−.0062	−.0086	−.0097	−.0063	−.0075	−.0122			
rate	(.0016)	(.0011)	(.0016)	(.0021)	(.0026)	(.0022)			
U. S. unemployment			.0051			.0101			
rate			(.0023)			(.0032)			
Personal income		−.0109			−.0051				
		(.0050)			(.0068)				

See note to Table II. All equations include state dummy variables and demographic characteristics. Specifications (a) and (b) also include year dummy variables. The dependent variables are natural logs of mortality rates per 100,000 population, except infant and neonatal mortality which are per 1000 live births. Sample sizes are 930 for death rates other than homicides, where missing values reduce the sample size to 922.

reduction of around 4900 for the former. Thus, young adults accounted for fewer than one-tenth as many deaths as those 65 and over, but the change in fatalities associated with higher joblessness is around three-fifths as large.

State unemployment rates are also negatively and significantly related to eight of the ten specific causes of death (see the bottom four panels of Table III), confirming that many aspects of health deteriorate when the economy improves. Moreover, the fatalities disproportionately experienced by young adults exhibit greater variation than those concentrated among older persons. A one point increase in unemployment reduces predicted mortality from motor vehicle crashes, other accidents, and homicides by 3.0, 1.6, and 1.9 percent, respectively, whereas deaths from cardiovascular disease and influenza/pneumonia are expected to fall just 0.5 and 0.7 percent.[27] The findings are also consistent with patterns of disease progression. For instance, it would be surprising to observe significant variation in cancer fatalities, since deaths from this source are unlikely to respond much to short-term changes in medical care or lifestyles. The lack of any effect for cancer therefore serves as an internal check of the validity of the results.[28]

Personal incomes have a small and statistically insignificant effect on most causes of death, and their inclusion generally has little impact on the unemployment coefficients.[29] However, income is positively correlated with vehicle fatalities and homicides. Since young adults frequently die from these causes, this helps to explain why incomes are strongly related to the deaths of 20–44

27. The differential effects could occur for reasons unrelated to age. For example, vehicle fatalities might vary because persons *of all ages* drink and drive less during recessions, rather than because young adults are most affected by downturns. However, the evidence suggests that the procyclical variation in traffic fatalities is stronger for young adults than for those who are older [Evans and Graham 1988; Ruhm 1995].

28. Evidence that infant and neonatal mortality decline when the economy falters is consistent with Joyce and Mocan's [1993] analysis of Tennessee data indicating that low weight births are negatively (although insignificantly) related to unemployment rates.

29. Additional information was obtained by estimating models that controlled for personal incomes but not unemployment (to allow for the possibility that including the latter absorbs a portion of the short-run income effect) and from specifications that included various measures of inequality (i.e., the state poverty rate or the ratio of incomes of the ninetieth versus the tenth, the ninetieth versus fiftieth, or the seventy-fifth versus twenty-fifth percentile of households). There was never a consistent relationship between incomes and mortality, with positive correlations obtained for the majority of causes of death. The income coefficients were also never much affected by including the inequality variables, while results for the latter were mixed and usually statistically insignificant.

year olds but with no observed association for persons ≥65 and a negative correlation for 45–64 year olds.

Suicides are predicted to *rise* 1.3 percent for each one percentage point increase in state unemployment rates. This divergent result is particularly interesting because many of the other outcomes primarily proxy physical health or nondisease sources of death, whereas suicides are among the most widely studied indicators of mental health. It therefore raises the possibility that worsening economic conditions have negative effects on some facets of mental health, while improving physical well-being. Equally important, the finding suggests that previous analyses of suicides provide little indication of the effects of the macroeconomy on other aspects of health.

Column (c) of Table III, shows results for models that include both national and state unemployment rates (but exclude year dummy variables). The parameter estimate on the national rate is small and insignificant for the three age groups and several causes of death. However, positive coefficients are obtained for heart disease, nonmotor vehicle accidents, homicides, and infant/neonatal mortality, while negative effects are predicted for motor vehicle fatalities and deaths due to flu or pneumonia. These mixed findings fail to provide a strong indication that the national economy has an independent impact on health, after controlling for local economic conditions, but further study of this issue is obviously needed.[30]

D. Dynamics

Economic conditions have been assumed to have only a contemporaneous impact on mortality up to this point. To provide information on dynamics of the adjustment process, mortality equations were estimated with the inclusion of four-year lags of state unemployment rates and (in some specifications) personal

30. I also estimated models that included interactions between the national and state unemployment rate. The interaction coefficients were positive for some types of death but negative for others. In addition, I replicated Table III for specifications that included state-specific time trends. The results were generally close to those presented, with no clear pattern of differences. The most important changes were that the coefficient on state unemployment shrunk for infant and neonatal mortality; that on the national unemployment rate became significantly negative (positive) for deaths involving 20–44 year olds (due to homicides) and insignificant for heart disease, flu/pneumonia, and infant or neonatal mortality, and the income effect was significantly negative (positive) for heart disease and flu/pneumonia (homicides).

TABLE IV
PREDICTED EFFECT OF A SUSTAINED ONE PERCENTAGE POINT INCREASE IN STATE UNEMPLOYMENT RATE BEGINNING IN YEAR t

Type of mortality	Personal income not controlled for:			Personal income controlled for:		
	t	$t+2$	$t+4$	t	$t+2$	$t+4$
Total	−0.6%	−0.6%	−0.4%	−0.3%	−0.2%	[−0.0%]
20–44 year olds	−1.7%	−2.6%	−2.9%	−0.9%	−1.0%	−0.9%
45–64 year olds	−0.4%	[0.0%]	0.8%	[−0.2%]	[0.1%]	0.6%
≥65 year olds	−0.2%	−0.4%	−0.3%	[−0.1%]	−0.3%	[−0.1%]
Heart disease	−0.6%	−0.5%	−0.3%	[−0.2%]	[−0.2%]	[−0.0%]
Cancer	[−0.0%]	[0.0%]	0.3%	[0.1%]	[0.2%]	0.4%
Flu/pneumonia	[−0.4%]	−1.4%	[0.5%]	[−0.6%]	−1.6%	0.8%
Liver disease	[−0.6%]	[−0.4%]	[0.5%]	[−0.1%]	[0.1%]	[0.5%]
Vehicle accidents	−2.7%	−4.0%	−3.2%	−1.8%	−2.0%	[−0.7%]
Other accidents	−1.5%	−2.2%	−2.2%	−0.9%	−1.3%	−1.9%
Suicide	1.1%	1.4%	1.4%	1.3%	1.6%	1.8%
Homicide	−2.4%	−3.3%	−2.2%	−2.1%	−3.3%	−2.1%
Infant	−0.6%	−0.8%	−0.7%	−0.7%	−0.8%	−1.0%
Neonatal	[−0.4%]	−0.8%	−1.1%	[−0.5%]	−0.7%	−1.2%

See note to Table II. Entries show the predicted effects of a one percentage point increase in the state unemployment rate beginning in year t and continuing through year $t + 4$. These predictions are made using the results of regressions that control for state and year effects, demographic characteristics, and four years of lagged unemployment rates (n = 726). The last three columns show results for models that also include current and four years of lagged values of personal incomes. Unbracketed entries differ significantly from zero at the .05 level, except for neonatal mortality at year $t + 2$ and deaths due to flu/pneumonia at $t + 4$, in the model with personal incomes controlled for, which are both significant at the .10 level. Bracketed entries are not statistically significant at the .15 level, except for deaths due to liver disease at t and because of flu/pneumonia at $t + 4$, without personal income controlled for, and heart disease at t and cancer at $t + 2$, with personal income controlled for, which are all significant at the .14 level.

incomes.[31] Table IV uses the resulting estimates to summarize the predicted impact of a one percentage point rise in unemployment that begins in year t and continues through $t + 4$. The full adjustment path for selected types of fatalities from models without controls for personal incomes is provided in Figure II.[32]

31. A four-year lag was chosen, somewhat arbitrarily, because the coefficient on the fifth lag in the total mortality equation had a p-value greater than .5. Similar results were obtained when more or fewer lags were included or when the lag length was varied by type of death.

32. The negative correlation between unemployment and mortality is less pronounced in specifications without state fixed-effects, indicating that locations with high average joblessness tend to have elevated mortality. These findings are

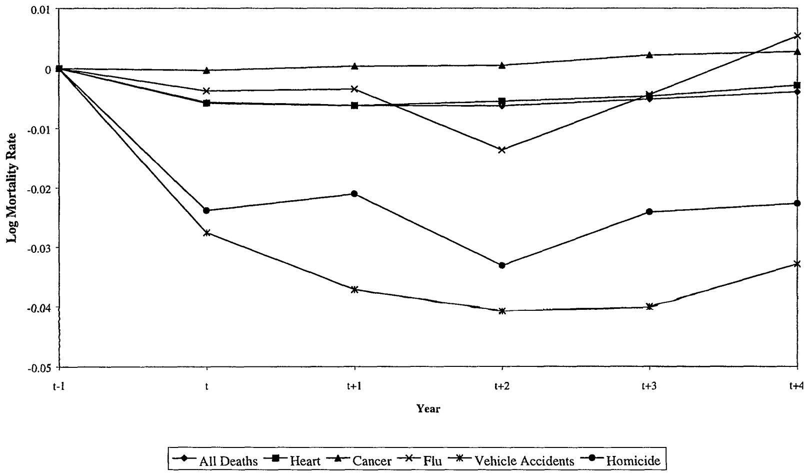

FIGURE II
Effect of a Sustained One Percentage Point Rise in State Unemployment Rates on Selected Causes of Death

Although the time profile varies with the source of death, a sustained deterioration in state economic conditions is frequently associated with larger short-run than permanent reductions in mortality. Persistently higher unemployment raises predicted deaths from some causes (e.g., cancer) and age groups (45–64 year olds) by the end of the four years. Expected mortality from other sources (heart disease, homicides, or motor vehicle accidents) remains lower at $t + 4$ than before the rise in joblessness but with the initial effect being substantially offset.[33] For example, a one percentage point increase in the state unemployment rate reduces predicted fatalities from cardiovascular disease by 0.6 percent at $t + 1$ but by just 0.3 percent in year $t + 4$.[34]

consistent with the possibility that temporary improvements in the economy are bad for health, whereas longer-lasting gains are not.

33. Lagged unemployment is predicted to have little impact on infant or neonatal mortality, presumably because pre- and postnatal care are provided over a relatively short period of time.

34. The same equations, when used to calculate the effect of a temporary increase in unemployment, generally predict a strong but highly transitory reduction in fatalities. For example, a one percentage point rise at time t, which is reversed by $t + 1$, is expected to reduce total mortality rates by 0.6 percent at t, with no effect at $t + 2$, and a statistically insignificant 0.1 percent increase at $t + 4$. The corresponding predicted reductions are 1.7, 0.7, and 0.3 percent for deaths of 20–44 year olds and 2.7, 0.4, and -0.7 percent for motor vehicle fatalities.

The inclusion of controls for personal incomes frequently attenuates the estimated unemployment effect. For instance, a sustained one percentage point rise in joblessness is predicted to decrease total fatalities at $t + 2$ by 0.2 percent and deaths due to heart disease or vehicle accidents by 0.2, and 2.0 percent, when personal incomes are held constant, as compared with 0.6, 0.5, and 4.0 percent when they are not. This suggests that cyclical fluctuations affect health partly through changes in incomes.

III. Why Is Mortality Procyclical? Evidence from Microdata

The preceding analysis documents a procyclical variation in mortality. I next consider why health worsens when the economy improves. Microdata from the *Behavioral Risk Factor Surveillance System* are used below to show that individuals change their lifestyles in ways consistent with the fluctuations in health. The following section then decomposes the variation in total mortality into several components, some likely to be sensitive to behavioral responses and others that are not.

The BRFSS is an annual survey, administered by the Centers for Disease Control and Prevention, that collects comparable information across states and time periods for repeated cross sections of individuals. The sample is designed to be representative of the civilian noninstitutionalized adult population. The survey was initiated in 1984 but only fifteen states took part in that year. This analysis uses data for the 1987–1995 period. In 1987, 34 states participated, and over 50,000 individuals were interviewed. By 1995 all 50 states and the District of Columbia were included, and the sample size approached 114,000.[35] The data source has many advantages. Most importantly, it contains information on lifestyle behaviors and preventive medical care for a large sample of respondents and is designed to measure progress toward meeting the *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* (hereafter abbreviated as *Healthy People 2000*).

The outcomes examined include the following: tobacco use and drinking, height-adjusted weight, physical activity, diet, and preventive medical care. Smoking is the most important prevent-

35. Sample sizes increase monotonically over time but are smaller for some outcomes, primarily because many questions are contained in optional modules included by some but not all states. Further information on the BRFSS is available at the website http://www.cdc.gov/nccdphp/brfss.

able cause of death and disease in the United States [Report of the U. S. Preventive Services Taskforce 1996]. Since tobacco is a normal good, smoking is likely to be procyclical, which may explain a portion of the observed variation in mortality. Similarly, heavy drinking is a significant risk factor, and alcohol-involved driving currently accounts for around one-third of all traffic fatalities [Lane, Stinson, and Bertolucci 1997]. However, whereas the risks of smoking increase monotonically with use, "light" drinking probably has little negative effect on health, and there is even some evidence of benefits (e.g. see Gazaino et al. [1993], and Thun et al. [1997]).

Obesity is the second leading cause of preventable death in the United States and a major risk factor for many sources of morbidity [National Heart, Lung, and Blood Institute 1998]. Thus, death rates might fall as the economy weakens because individuals have more time to exercise or consume healthy diets, reducing the probability of being overweight. Physical activity and diet may also directly affect health, beyond any impact on obesity.[36]

Health could also improve during downturns because individuals have more time to invest in preventive medical care. However, the lower time prices could be offset by reductions in incomes or health insurance coverage or because improved health decreases the incentives to obtain such care. Also, some types of prevention (e.g., pap smears) may occur during the visits treating acute medical problems, so that sicker persons receive more preventive care.

A. Variables and Descriptive Statistics

Tobacco use is analyzed using a dummy variable indicating whether the respondent has smoked in the last month and, for current smokers, a continuous measure of average daily use. Similarly, drinking is proxied by a dichotomous indicator of use during the past month and, conditional on use, a variable specifying the number of alcoholic beverages consumed. Height-adjusted weight is measured by the body mass index (BMI), defined as weight in kilograms divided by height in meters

36. Exercise is associated with better mental health, reductions in osteoporosis, and decreased risk of colon cancer [The President's Council on Physical Fitness and Sports 1996]. Foods high in dietary fat have been linked to cancers of the breast, colon, prostate, and lung [Report of the U. S. Preventive Services Task Force 1996].

squared, and dichotomous variables classifying females (males) with BMI exceeding 27.3 (27.8) as "overweight," those with BMI greater than 30 as "obese," and persons with BMI below 19 as "underweight."[37]

Exercise is captured by two dichotomous variables. Respondents engage in some leisure time physical activity if they affirmatively respond to the question "During the past month, did you participate in any physical activities or exercises (other than your regular job duties) such as running, calisthenics, golf, gardening, or walking for exercise?" Individuals are classified as partaking in "regular" physical activity if they engaged in any activity or pair of activities for at least twenty minutes three or more times per week. Diet is proxied by two variables. The first indicates the average daily number of servings of fruits and vegetables; the second is an index of grams of dietary fat consumed per day.

Dichotomous variables are constructed for four types of preventive medical care. The first shows whether the respondent visited the doctor for a routine medical checkup during the past year. The next three indicate receipt of a pap smear, mammogram, or digital rectal exam (DRE) over the same period. Routine checkups are included as a general preventive measure for all respondents. Pap smears are designed to screen for cervical cancer, which kills 4800 women in the United States annually. Mammography is an important method of testing for breast cancer, which causes the deaths of almost 50,000 American females per year. DRE is used to screen for prostate cancer, which kills over 40,000 U. S. men, and colorectal cancer, which results in 55,000 fatalities annually. The samples for these tests are limited to the age-sex groups for whom the procedures are generally recommended. This includes all adult women in the case of pap smears and women (men) aged 40 and over for mammography (DRE).[38]

37. BMI is a favored method of assessing excess weight because it is simple, rapid, and inexpensive to calculate. The criteria for classifying individuals as "overweight" or "obese" are widely used. The National Institute of Health recently released guidelines lowering to 25 the BMI threshold for defining persons as overweight; however, preliminary analysis revealed no cyclical variation in the probability of being overweight using this standard. There is no generally accepted cutoff point for defining individuals as "underweight," but the threshold of 19 is consistent with evidence that maximum health is achieved when BMI ranges between 20 and 25. National Heart, Lung, and Blood Institute [1998] discusses these issues in detail.

38. A consensus recommendation that all (ever sexually active) women aged eighteen and over should have annual pap smears has been adopted by the

Economic conditions are proxied by the average unemployment rate in the state during the year ending with the survey month. The median calendar year family income of four-person families in the state (in $1987) is also sometimes controlled for. Demographic characteristics include a quadratic in years of age and dummy variables indicating educational attainment (high school dropout, some college, college graduate), race (black, other nonwhite), Hispanic origin, sex, and marital status. The reference group consists of unmarried white non-Hispanic male high school graduates.

Variable definitions and summary statistics are displayed in Table V. The sample sizes differ by outcome. Data on BMI, medical checkups, and smoking are available for every interview year and almost all respondents. Information on drinking and physical activity is also provided in all years, but since the questions are contained in optional modules in 1994 for alcohol and 1993 and 1995 for exercise, the samples are slightly smaller. Questions on diet or medical screening tests are included more sporadically. Information on the consumption of fruits and vegetables (dietary fat) is available for at least some states from 1990–1995 (1990–1994). Data on mammography are available for all sample years, those for pap smears and DRE starting in 1988. The reduced sample sizes for these variables reflect the restriction of the analysis to specified age-sex groups and the inclusion of the questions in optional modules in some years (1988 for mammograms, 1988–1992 for pap smears, and 1988–1992 and 1994 for DRE).

Approximately 1 percent of respondents (7922 individuals) fail to provide information on at least one demographic characteristic. To avoid excluding these persons, the relevant regressors were set to zero and a dummy variable created denoting the presence of a missing value. For instance, for persons not reporting years of schooling, the three education covariates were given a value of zero and a "missing education" variable was set to one.

American Cancer Society (ACS), National Cancer Institute, American College of Obstetricians and Gynecologists (ACOG), and the American Medical Association (AMA), among others. The ACS, AMA and ACOG recommend routine mammograms every one to two years for women after age 40. The ACS recommends that men receive an annual DRE for prostate and colorectal cancer starting at 40. The efficacy of DRE for men and routine mammography for women younger than 50 remains controversial. See Report of the U. S. Preventive Services Task Force [1996] for a comprehensive discussion of these screening tests and the related recommendations.

TABLE V
VARIABLES USED IN ANALYSIS OF INDIVIDUAL DATA

Variable	Sample size	Mean	Std. dev.
Outcomes:			
Current smoker (%)	751,505	22.7	41.9
Number of cigarettes smoked per day (current smokers only)	170,751	18.9	12.3
Current drinker (%)	668,176	51.1	50.0
Number of drinks in last month (current drinkers only)	323,843	22.0	35.0
Body mass index (weight in kgs/height in meters^2)	737,065	25.2	4.6
% underweight (BMI < 19)	737,065	4.5	20.6
% overweight (females with BMI > 27.3, males with BMI > 27.8)	737,065	24.4	43.0
% obese (BMI > 30)	737,065	12.4	33.0
Some leisure time physical activity in last month (%)	584,054	70.3	45.7
Regular physical activity (>20 minutes, ≥3 times/week in %)	584,054	41.9	49.3
Daily servings of fruits and vegetables	229,207	3.9	2.1
Grams of fat consumed daily	85,075	36.4	24.6
Visited doctor for routine checkup in last year (%)	754,930	68.7	46.4
Had mammogram in last year (% of women ≥40)	236,752	48.3	50.0
Had pap smear in last year (% of women)	341,953	65.8	47.5
Had digital rectal exam in last year (% of men ≥40)	59,087	42.5	49.4
State economic conditions:			
Unemployment rate (average for past 12 months in percent)	761,060	6.3	1.4
Median income (4-person families, thousands of $1987)	761,060	36.4	4.0
Individual characteristics:			
Age (in years)	758,253	43.8	17.7
High school dropout (%)	759,268	16.1	36.7
Some college (%)	759,268	24.9	43.3
College graduate (%)	759,268	25.4	43.5
Black	759,857	9.5	29.4
Other nonwhite	759,857	5.4	22.6
Hispanic	759,010	8.2	27.4
Female	761,060	52.1	50.0
Married	759,518	63.1	48.3

Data are for noninstitutionalized adults from the *Behavioral Risk Factor Surveillance System* and cover the period 1987–1995. Information on state unemployment rates is from the Bureau of Labor Statistics *Local Area Unemployment Statistics* database (http:/www.bls.gov/laugeo.htm). Data on family incomes are from the March Current Population Survey (http:/www.census.gov/hhes/income/4person.html). BRFSS Sample weights are used in calculating the mean and standard deviation.

B. Econometric Estimates

Econometric estimates of the determinants of smoking, drinking, and height-adjusted weight are summarized in Table VI. The basic econometric specification is

$$H_{ijt} = \alpha_t + X_{ijt}\beta + E_{jt}\gamma + S_j + \epsilon_{ijt}, \tag{3}$$

where i indicates the individual, H the health input, and the other variables are as defined above. All of the models include year and state dummy variables and the aforementioned personal characteristics. Robust standard errors are calculated using the Huber-White sandwich estimator, under the assumption that observations are independent across years and states but not within states in a given year. For ease of interpretation, the results of linear probability models are displayed for the dichotomous outcomes. However, corresponding binary probit models were estimated and always yielded virtually identical results.

Tobacco use exhibits a strong procyclical variation, possibly explaining some of the health improvement that accompanies economic downturns. A one percentage point increase in the state

TABLE VI
FIXED-EFFECT ESTIMATES OF THE DETERMINANTS OF RISKY BEHAVIORS AND HEIGHT-ADJUSTED WEIGHT

	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
	Smoker		Cigarettes per day (smokers only)		Drinker		Drinks per month (drinkers only)	
State unemployment rate	−.0031	−.0030	−.0810	−.0691	.0039	.0035	.2217	.2093
	(.0007)	(.0008)	(.0346)	(.0350)	(.0024)	(.0027)	(.3184)	(.3265)
Family income		.0004		.0386		−.0012		−.0311
		(.0008)		(.0287)		(.0019)		(.0800)
	Body mass index		Underweight		Overweight		Obese	
State unemployment rate	−.0161	−.0177	−.0006	−.0005	−.0017	−.0019	−.0021	−.0021
	(.0067)	(.0073)	(.0003)	(.0003)	(.0006)	(.0007)	(.0005)	(.0005)
Family income		−.0050		.0005		−.0006		−.0000
		(.0063)		(.0002)		(.0008)		(.0004)

All specifications include vectors of year and state dummy variables and control for education (high school dropout, some college, college graduate, education not reported), age (years of age, age squared, age not reported), race (black, other nonwhite, race not reported), ethnicity (Hispanic origin, ethnicity not reported), marital status, and sex. Robust standard errors, estimated assuming observations are independent across years and states but not within states in a given year, are displayed in parentheses. Individuals are defined to be underweight if BMI is less than 19, overweight if BMI exceeds 27.3 for females or 27.8 for males, and obese if BMI is over 30. Linear probability models are estimated when the dependent variable is dichotomous (smoker, drinker, underweight, overweight, and obese). Data are from the BRFSS for the years 1987–1995, with additional information on state economic conditions merged in from other sources. Appendix 1 provides additional results for selected specifications.

unemployment rate reduces the predicted number of current smokers by 0.3 percentage points. Since roughly one-quarter of the sample smokes, this represents a drop of over 1 percent (see the upper panel of Table VI). Conditional on smoking, consumption is predicted to fall by around one-tenth of a cigarette per day, a decline of roughly 0.4 percent at the sample average.

By contrast, the unemployment coefficient is positive for alcohol use. This is surprising since previous research (e.g., Ruhm [1995]) documents a procyclical variation in state alcohol sales and motor vehicle fatalities. Several explanations are possible. First, since the estimate is never statistically significant, this may reflect chance variation. Second, recreational drinking could rise during downturns, whereas problem alcohol use (e.g., binge drinking or drunk-driving) declines. Third, drinking patterns among the BRFSS sample (noninstitutionalized adults contacted by telephone) could differ from those of other adults or youths. Fourth, drinking patterns may have changed over time as information on the possible health benefits of moderate consumption has accumulated. Fifth, the analysis does not control for alcohol tax rates, which varied substantially in some states during the period. Further investigation is needed to reconcile these findings with those of earlier studies.

Individuals are more likely to be in the healthiest weight ranges in bad economic times than in good ones (see the lower panel of Table VI). A one percentage point increase in unemployment is associated with a statistically significant .016 reduction in average BMI, corresponding to a 0.6 percent decline at the sample average. Since one-quarter of respondents are overweight, versus less than 5 percent underweight, decreased BMI is likely to indicate better health. The dichotomous outcomes verify this. The one point rise in joblessness lowers the expected probabilities of being underweight, overweight, or obese by a statistically significant .06, .17, and .21 percentage points, corresponding to reductions of 1.3, 0.7, and 1.7 percent at the sample means. It is noteworthy that obesity, the extreme indicator of excess weight, is predicted to fall the most and that the likelihood of being underweight also declines, despite a decrease in average BMI. These results suggest that part of the reason health improves when the economy stagnates is that individuals are more likely to be in the desired weight range.

Obesity may decline because people have more time to exercise and prepare healthy meals. The top panel of Table VII

TABLE VII
FIXED-EFFECT ESTIMATES OF THE DETERMINANTS OF EXERCISE, DIET, AND PREVENTIVE MEDICAL CARE

	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
	Any physical activity		Regular physical activity		Daily servings of fruits/vegetables		Daily grams of fat consumed	
State unemployment rate	.0064	.0062	.0050	.0049	.0201	.0178	−.7078	−.6318
	(.0021)	(.0023)	(.0021)	(.0023)	(.0239)	(.0248)	(.3112)	(.3134)
Family income		−.0006		−.0004		−.0050		.1086
		(.0015)		(.0013)		(.0085)		(.1278)
	Routine medical checkup in last year		Mammogram in last year (women ≥40)		Pap smear in last year (women only)		Digital rectal exam in last year (men ≥40)	
State unemployment rate	−.0057	−.0054	−.0008	−.0019	−.0050	−.0054	−.0060	−.0093
	(.0018)	(.0019)	(.0017)	(.0018)	(.0019)	(.0020)	(.0090)	(.0070)
Family income		.0010		−.0038		−.0016		−.0071
		(.0012)		(.0013)		(.0012)		(.0075)

See note to Table VI. All specifications include vectors of year and state dummy variables and control for education (high school dropout, some college, college graduate, education not reported), age (years of age, age squared, age not reported), race (black, other nonwhite, race not reported), ethnicity (Hispanic origin, ethnicity not reported), marital status, and sex. Robust standard errors, estimated assuming observations are independent across years and states but not within states in a given year, are displayed in parentheses. Linear probability models are estimated when the dependent variables are dichotomous (any or regular physical activity, medical checkups, mammograms, pap smears, and digital rectal exams).

confirms that physical activity rises and diet improves when the economy weakens. A one percentage point increase in state unemployment is associated with a statistically significant 0.6 percentage point increase in some exercise and a 0.5 point rise in regular physical activity, corresponding to roughly a 1 percent elevation in each at the sample means. The same growth in joblessness boosts the predicted consumption of fruits and vegetables by a statistically insignificant .02 servings per day and lowers the daily intake of dietary fat by a statistically significant .71 grams. The latter corresponds to a 2 percent decrease.

Conversely, the lower panel of Table VII provides no evidence that preventive medical care becomes more common during downturns. Instead, there is a negative (although often insignificant) relationship between state unemployment rates and routine checkups, pap smears, mammograms, or digital rectal exams. As mentioned, the procyclical variation is not surprising since preventive care reflects a complicated combination of factors including ex ante health status, incomes, insurance coverage, and the receipt of acute care.

Consistent with the preceding analysis of mortality rates, the income parameters seldom approach statistical significance, nor are the unemployment effects sensitive to their inclusion. Results for the personal characteristics are generally consistent with those of prior research. For instance, educated persons have relatively healthy lifestyles while nonwhites smoke and drink less than whites but exercise relatively infrequently, have high rates of obesity, and consume poor diets. Appendix 1 details these results for selected outcomes.

The short time span covered by the BRFSS implies that the findings in this section should be interpreted somewhat cautiously. Of particular importance, after controlling for general time effects, unemployment exhibits a monotonic trend in almost all states during the sample period. As a result, the inclusion of state-specific time trends absorbs most of the remaining within-state variation in joblessness, making it difficult to obtain reliable estimates from models containing both state fixed-effects and time trends.[39]

IV. Decomposing the Cyclical Variation in Total Mortality

The aggregate data indicate that temporary downturns reduce mortality. Analysis of the BRFSS suggests that this is partially due to decreases in smoking and obesity, improved diets, and increased physical activity. Deaths from external sources, particularly motor vehicle fatalities, also decline substantially when the economy weakens. To more sharply illustrate these patterns, Table VIII decomposes total mortality into four components and a residual.

"Preventable" deaths, defined to include fatalities from cardiovascular problems, liver disease, or influenza/pneumonia, are so labeled because the progression of these ailments is likely to respond to short-term changes in lifestyles and health investments. By contrast, cancer mortality is expected to exhibit relatively little behavioral response. Deaths due to vehicle crashes or other external sources, the third and fourth components in the table, are likely to be particularly sensitive to short-term eco-

39. The signs on the unemployment coefficients almost never changed when state time trends were included, but the magnitude of the estimated effects frequently declined, and the standard errors usually increased. The latter result is expected if there is substantial collinearity between the state trends and unemployment rates; the former could reflect a greater role for measurement error in the detrended unemployment rates, particularly after controlling for general time effects.

TABLE VIII
DECOMPOSITION OF THE PREDICTED CYCLICAL FLUCTUATION IN DEATH RATES

Source of death	Percent of deaths	Elasticity (a)	Elasticity (b)	Percent of fluctuation accounted for (a)	Percent of fluctuation accounted for (b)
All sources	100.0	−.039	−.041	100.0	100.0
		(.003)	(.003)		
Preventable	54.0	−.035	−.029	48.0	38.8
		(.006)	(.005)		
Cancer	20.9	.000	−.010	−0.2	5.3
		(.004)	(.004)		
Car accidents	2.7	−.212	−.224	14.5	14.7
		(.016)	(.016)		
Other external	5.2	−.059	−.093	7.8	11.8
		(.011)	(.010)		
Residual	17.2			29.9	29.5
Time trends controlled for		No	Yes	No	Yes

"Preventable" deaths include mortality due to cardiovascular disease, liver disease, and pneumonia or influenza. Deaths from "other external" sources include those due to accidents other than motor vehicle fatalities, suicides, and homicides. The percentage of deaths refers to mortality in 1980. The third and fourth columns display the predicted elasticity of the mortality rate to changes in state unemployment rates, as estimated from double-log models that include controls for state fixed effects, general year effects, and demographic characteristics. Standard errors are shown in parentheses. The estimates in the fourth column also include controls for state-specific time trends. The fifth and sixth columns decompose the predicted fluctuation in the total death rate into the changes predicted for each alternative source, using the elasticity estimates in the previous two columns. Specification (b) again includes controls for state time trends, whereas the estimates in specification (a) do not.

nomic fluctuations, although the countercyclical pattern of suicides partially offsets the procyclical variation in nonvehicle accidents and homicides. The residual, shown in the last row, indicates the proportion of total mortality (or its change) not accounted for by the four components.[40]

Mortality elasticities are estimated by regressing the natural log of the specified death rate on the log of the state unemployment rate, time and state dummy variables, and demographic characteristics. These are shown in the third and fourth columns of Table VIII, with state-specific time trends also held constant in the latter case. The elasticity of total mortality is −.04 and precisely estimated. At the sample means, this implies that a one percentage point increase in joblessness decreases predicted fatalities by roughly 0.6 percent, or around 11,000 deaths annu-

40. The residual includes deaths from a wide variety of diseases, the most important being diabetes and kidney ailments.

ally. The elasticity is marginally lower for preventable deaths, ranging from −.030 to −.035, and for cancer mortality it is close to zero. Conversely, the elasticity is five times as large for motor vehicle fatalities (−.21 to −.22) and 1.5 to 2.3 times as great for other external causes of death (−.06 to −.09).

The estimated elasticities are next used to calculate the share of the predicted cyclical fluctuation in total mortality due to each component. In 1980 preventable sources accounted for over half of all deaths, cancer for one-fifth of fatalities, and car accidents or other external sources for less than 8 percent (see the second column of the table).[41] By comparison, preventable sources were responsible for 39 to 48 percent of the predicted *variation* in death rates, vehicle fatalities for around 15 percent, and other external causes for 8 to 12 percent; cancer accounted for no more than 5 percent of the change in total mortality and 30 percent was not explained by any of these sources (see the last two columns of Table VIII).

The dominance of preventable diseases and motor vehicle accidents in explaining the fluctuation in mortality associated with a temporary change in economic conditions is noteworthy because the sources of the contributions are so different. Vehicle deaths are important because of the large associated elasticity. Conversely, preventable ailments account for a high proportion of deaths in all periods but have more moderate elasticities. These patterns are plausible. Previous researchers (e.g., Wagenaar [1984] and Evans and Graham [1988]) obtain similar estimates of the sensitivity of traffic fatalities to the state of the economy.[42] The smaller elasticities of preventable diseases also make sense. Even though healthy lifestyles substantially reduce mortality risk, business cycle fluctuations can be expected to lead to only modest changes in behavior.[43] As mentioned, the virtual absence of an effect for cancer fatalities is reassuring since even a substantial behavioral response would be unlikely to have much impact on the timing of this source of death.

41. I chose 1980 as the base year in these calculations because it is roughly the midpoint of the sample and preceded the severe 1982–1983 recession.

42. For example, Wagenaar estimates that a one percentage point increase in unemployment results in a 2 to 3 percent reduction in vehicle fatalities.

43. For instance, Stevens et al. [1998] calculate that a one unit fall in BMI (e.g. from 30 to 29) reduces the cardiovascular mortality of 45–54 year olds by around 9 percent. Using this figure, the .016 decrease in BMI estimated, in Section III, to accompany a one percentage point rise in unemployment translates into a 0.2 percent decrease in fatalities from heart disease, or an elasticity of approximately −.01. The full elasticity of preventable deaths will be substantially larger if other changes, such as reductions in smoking, yield health benefits.

V. Conclusion

This study documents a strong inverse relationship between macroeconomic conditions and health. Specifically, a one percentage point rise in the state unemployment rate, relative to its historical average, is associated with a 0.5 to 0.6 percent decrease in total mortality, or a reduction of around 11,000 fatalities annually. A limited analysis suggests that national recessions and more localized downturns have similar effects.

The cyclical fluctuation in deaths is concentrated among young adults and the mortality elasticity is over five (1.5 to 2.3) times as large for motor vehicle fatalities (other external sources) as for all mortality. Smaller, but still substantial, elasticities are predicted for deaths from cardiovascular disease, liver ailments, or flu/pneumonia. These in turn may be explained by the changes in obesity, smoking, diet, and exercise observed in the microdata. By contrast, there is little indication that cancer fluctuates over the cycle, and suicides are predicted to rise with unemployment rates. Finally, there is some evidence that sustained economic growth may improve health, even while short-lasting expansions worsen it.

Are recessions good for your health? Surprisingly, the answer appears to be yes. Further research is needed to better understand why.

Appendix 1: Fixed Effect Estimates for Selected Risky Behaviors and Health Investments

Regressor	Smoker	Drinker	BMI	Exercise	Fruit	Checkup
State unemployment rate	−.0031	.0039	−.0161	.0064	.0201	−.0057
	(.0007)	(.0024)	(.0068)	(.0021)	(.0239)	(.0018)
High school dropout	.0511	−.0921	.6285	−.1015	−.2496	−.0082
	(.0021)	(.0023)	(.0207)	(.0029)	(.1800)	(.0019)
Some college	−.0607	.0654	−.2274	.0911	.2927	.0079
	(.0015)	(.0024)	(.0167)	(.0022)	(.0127)	(.0015)
College graduate	−.1589	.1283	−.8662	.1446	.5030	.0068
	(.0017)	(.0029)	(.0186)	(.0025)	(.0161)	(.0018)
Education: missing value	−.0697	−.1022	−.3433	−.0876	−.5641	.0015
	(.0081)	(.0114)	(.1272)	(.0123)	(.1840)	(.0091)
Age	.0147	.0015	.2904	−.0030	.0011	.0060
	(.0002)	(.0003)	(.0021)	(.0003)	(.0018)	(.0002)
Age squared	−1.8E-4	−6.8E-5	−.0026	−2.9E-6	1.5E-4	9.9E-5
	(1.9E-6)	(2.5E-6)	(2.0E-5)	(2.6E-6)	(1.8E-5)	(2.0E-6)
Age: missing value	.1803	−.2069	5.742	−.1728	.3538	−.0195
	(.0086)	(.0111)	(.0999)	(.0131)	(.0992)	(.0087)

APPENDIX 1: FIXED EFFECT ESTIMATES FOR SELECTED RISKY BEHAVIORS AND HEALTH INVESTMENTS (CONTINUED)

REGRESSOR	SMOKER	DRINKER	BMI	EXERCISE	FRUIT	CHECKUP
BLACK	−.0507	−.1017	1.806	−.0770	−.1516	.1229
	(.0033)	(.0043)	(.0306)	(.0029)	(.0224)	(.0025)
OTHER NONWHITE	−.0198	−.1277	.0001	−.0707	.0478	.0251
	(.0039)	(.0047)	(.0414)	(.0041)	(.0420)	(.0036)
RACE: MISSING VALUE	.0035	−.0524	−.0407	−.0273	−.0644	.0185
	(.0107)	(.0170)	(.1577)	(.0169)	(.1243)	(.0145)
HISPANIC	−.0626	−.0237	.5807	−.0482	.0620	.0299
	(.0045)	(.0051)	(.0436)	(.0061)	(.0329)	(.0036)
HISPANIC: MISSING VALUE	−.0026	−.0295	.0062	−.0054	−.2924	−.0062
	(.0095)	(.0130)	(.1251)	(.0123)	(.0936)	(.0126)
MARRIED	−.0754	−.0380	.0320	.0051	.2318	.0329
	(.0013)	(.0022)	(.0128)	(.0016)	(.0114)	(.0012)
FEMALE	−.0342	−.1436	−1.341	−.0144	.4016	.1561
	(.0013)	(.0019)	(.0167)	(.0019)	(.0127)	(.0019)

See note to Table VI. All models also include vectors of time and year dummy variables. Robust standard errors are shown in parentheses.

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