Explaining aggregate health status (mortality). Insights to the possible impact of the economic crisis

Report to the European Commission

September 28, 2009

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Introduction

The most extensive and robust findings in epidemiology of mortality patterns in industrialized countries is that "socioeconomic status" is the single most dominant, pervasive (or powerful) factor that routinely influences comparative length of life among industrialized country populations.

It can be seen that socioeconomic status of individuals, thus defined, is based on, firstly, investments in education (and other human capital including occupational training and skill). This investment in training will be a precondition to employment at different levels of occupational remuneration, including wages/salaries and benefits. Many of the benefits associated with specific wage levels will include elements of social protection that are based on both state and private sources of material welfare. This type of social protection will include various forms of social insurance i.e. unemployment insurance, involvement in active labor market policy initiatives, health and disability insurance, and payments and pensions.

Thus it can be seen that the national income and wealth of a society, i.e., real GDP per capita, is the foundation of much of individual material welfare that is described in the concept of socioeconomic status. Beyond those sources of investment in socioeconomic status are societal investments in a variety of public health and safety measures to insure social protection. These include health care sciences and technology, health and safety regulations in the workplace, environmental regulations, investment in the epidemiological and clinical sciences that identify risks to population health in terms of the monitoring of food and drug safety, safety of water and sanitation systems, new knowledge of optimal diets and the effects of alcohol and tobacco on health, and transportation safety.

In addition, of course, growth in GDP per capita is almost by definition the antithesis of recession and, therefore, unemployment. It is indeed specified under the "law" proposed by the economist Okun that a specified quantitative increase in potential GDP will reduce the unemployment rate by a specified amount.

Finally, real GDP per capita is also the source of investment in new innovation and new employment, largely through the initiation of new small firms, frequently via self-employment. The strength of self employment, then, in a well developed industrialized society, represents much of the source of innovation that will maintain or advance the rate of economic growth. Equally important, however, self-employment serves as a source of opportunity to avoid unemployment – whether that unemployment originates with economic cycles, technical and productivity development, globalization or other structural changes in the economy. Self-employment, thus, can provide a "safety catch" by which unemployment is reduced and through the development of small firms, can be an avenue through which active labor market policies can result in successful reemployment.

To exemplify this true set of factors which affect health and social wellbeing both directly and indirectly stemming from GDP growth, a model is presented which encompasses a number of the factors which are related to GDP-based investment and consumption patterns. This is a model which attempts to account for variation among industrialized countries in the age-standardized mortality rate.

The model includes a measure of the rate of productivity, namely GDP per employee. It includes as well, the rate of self-employment and both the unemployment rate for males in relation to population as well as the source of inflation, namely the consumer price index. This model also includes publicly-funded health expenditures which are derived from GDP investments. Finally it controls for a major risk factor that is well-known in the epidemiological literature for its ability to exert a short-term effect of a multiplicity of sources of illness and disability, including cardiovascular diseases, diabetes, work and home accidents and injuries, transportation accidents, suicide and homicide. This factor is alcohol consumption per capita.

Drawing on this logic, we present a second model, which examines the relation of economic change to the suicide rate in industrialized countries. Similar factors, such as GDP, self-employment, the unemployment rate, health services expenditure, as well as lifestyle factors and measures of social integration are able to produce a multi-variable model of coherence and predictability.

In a third approach, time series analyses are presented of some of the policy factors that influence age-standardized mortality in the United Kingdom and United States over the years 1970-2005. Attention is especially given to health care expenditures as a percent of GDP and the unemployment rate. Also examined is the potential effect of the dependency ratio on mortality. A time-series regression analysis is presented as well as a graphic display of the activity of the historical time-series during 1970-2005.

Finally, a concluding section is devoted to a numerical estimation of the impact, on mortality, of potential changes in the health care expenditures and the unemployment rate. Mortality figures are simulated and estimates are given under conditions where there are separate changes in health care expenditures and the unemployment rate. Estimates are also given for scenarios where both factors change simultaneously.

Major Factors in the Prediction of National Life Expectancy

1. *Income*

At the individual level of analysis – i.e., in epidemiological studies – individual income is a standard and fundamental inverse predictor of illness and early mortality (Andersen, Gamborg, Osler, Prescott, Diderichsen, 2005; Ecob, Davey Smith, 1999; Ettner, 1996; Kahn, Wise, Kennedy, Kawachi, 2000; Kivimäki, Shipley, Ferrie et al., 2008; Lynch**,** Smith**,** Kaplan**,** House**,** 2000). In industrialized countries, the higher the level of income of individuals, the lower the illness and mortality rates attributed to the great majority of infections, chronic diseases and mental disturbances. In developing countries similar relations are found, but the impact of income is substantially stronger. Moving from the individual to the national level, however, real GDP per capita indicates the availability of basic goods and services: nutrition, potable water, sanitary engineering, housing and other means of climate control, transportation and primary health care. At the national level, real GDP per capita – especially for industrialized societies also conveys the capacity of the society to invest in the development of science and technology, improved working conditions at higher technological levels of safety and health, financing of education at all levels, stabilization of the income of individuals and small businesses, and the many types of social protection: unemployment insurance; active labor market policies; health insurance; disability insurance; social welfare payments to impoverished, frail populations and children; social security and retirement benefits.

Income, of course, inasmuch as it conveys the purchase of goods and services of different price and quality, also conveys the special 'social status' of the purchaser. Thus, certain aspects of purchases take on the meaning of 'status symbols' by which different levels of social prestige are attributed to the purchasers. Prestige, in turn, is a principal marker of the socioeconomic status of individuals and is understood to convey differential levels of psychological wellbeing (Marmot, 2002; Marmot, Wilkinson, 2001).

2. *Education*

As in the case of income, educational level attained is strongly associated with lower illness and mortality rates in industrialized country populations. Educational level attained by individuals is almost universally associated with lower morbidity and mortality rates in epidemiological studies (Leigh, 1983; Ross, Mirowsky, 1999; Ross, Wu, 1995). This relationship is consistent with the more generally cited relationship – perhaps the single strongest empirical relationship in all of epidemiology – that overall socioeconomic status is a predictor of lower morbidity and mortality for nearly all diagnoses, at all ages, both sexes and populations of different ethnicity and immigration status (Smith, Hart, Hole, et al., 1998; Winkleby, Jatulis, Frank, Fortmann, 1992). The explanation of the positive relationship between educational status and health clearly involves multiple mechanisms. The most common understanding is that education itself, meaning the attainment of knowledge enables the comprehension of the most widely recognized health risks (dealing e.g., with matters of diet, environment, working conditions, stress and addictions) and the ability to secure the most timely and effective health care. Even more generally, education is the basis for adaptation to opportunities and challenges in economic and social areas of life.

Education is, of course, the most important prerequisite of higher skill and managerial levels of employment, and is virtually essential to employment in professional and administrative positions in larger economic and political organizations. Educational attainment level is, therefore, a strong factor in personal income and the maintenance and advancement of careers in technological societies. In this era of rapid technological change and globalization – leading to frequent restructuring of private firms and government organizations – relatively high education levels permit more rapid transition to new jobs and the resumption of careers. This often avoids

the substantial losses in permanent earnings that accrue to individuals who experience structural unemployment or downsizing of firms.

It should be kept in mind that educational level, a standard measure of 'human capital', has long been understood as a significant source of economic growth. Of course, the extent of education in a population is also financed from the wealth developed as a result of economic growth. This close linkage of education to the economic growth process often means that once GDP per capita is used as a variable to account for increases in life expectancy, no additional variables measuring the extent of education in a society is usually needed, even though the level of education in a population may well make a substantial contribution to a population's health. This will be especially true in comparative (i.e., cross-sectional) analyses of industrialized countries. Nevertheless, a variable that deals more directly with the extent to which the working population is highly educated can often make an additional contribution to the explanation of life expectation among industrialized societies. Such a variable, for example, is the proportion of the employed population who have achieved tertiary education.

3. Unemployment

The unemployment rate is well established as a risk factor for elevated illness and mortality rates in epidemiological studies performed since the early 1980's. In addition to influences on mental disorder, suicide and alcohol abuse and alcoholism, unemployment is also an important risk factor in cardiovascular disease and overall decreases in life expectancy (Linn, Sandifer, Stein, 1985; Morris, Cook, Shaper, 1994; Jin, Shah, Svopoda, 1995; Martikainen, Ma, Ja, 2007; Virtanen, Vahtera, Kivimäki, et al., 2005; Bambra, Elkemo, 2008; Catalano, 1991; Catalano, Dooley, Novaco, Wilson, Hough, 1993; Dooley, Catalano, Wilson, 1994; Kasl, Jones, 2002; Tausky, Piedmont, 1967).The relationship between increased unemployment and increases in mental disorder and cardiovascular illness was first observed at the macro (national) level using historical time-series analysis in United States, British and Scandinavian populations (Brenner, 1971, 1973, 1976, 1979a, 1979b, 1982, 1985, 1887). This work was further advanced under the sponsorship of the European Commission, where the interest was in the implications of unemployment and employment policies which could promote health (Brenner, 2000, 2002).

Several mechanisms are understood to operate in the relationship between unemployment and damage to health. One of these concerns the psychological stresses of loss and mental depression that separates the individual from his/her place in economic organizations – a position in which the content of work and social relations give meaning and direction to life. A second mechanism involves the loss of social relationships at work, which often constitute the major social networks and friendship patterns for many individuals as well as a definition of their position in society. Thirdly, and over the longer term, there is the problem of loss of income – which could be transitory or relatively permanent. In the case of transitory income loss, the period of unemployment may be relatively short, and new employment will restore previous wage and salary levels. More common, as with lengthy recessions and structural unemployment, is the inability of the unemployed individual to find reemployment in the same industry and/or at the same level of seniority (Podgursky, Swaim, 1987a, 1987b). In that case the unemployed person may find subsequent work in a different firm, or different industry altogether, in which the starting position will be at a very junior level. It may then take many years – if ever – f or the previously unemployed person to resume the level of income that prevailed prior to the unemployment. A far more serious situation occurs when the unemployed person becomes discouraged from seeking new work which would make use of the individual's skills and length of experience (Moore, Ranjan, 2005; Wilson, 1990; Blank, Blinde, 1985). In that case, the individual may leave the labor force entirely (or retire), and the likelihood of considerable loss of permanent income is relatively high (Uchitelle, Kleinfield, 1996). Finally, as

we have seen in the case of loss of income – indicating permanent loss of socioeconomic status – there is then a significantly increased risk of illness and early mortality.

4. Public Expenditure on Health

It is assumed by some health policy experts that health services expenditures, as a proportion of GDP, should bear some relation to the intensity, and the technological sophistication, of the health care utilized by a population (Musgrove, Zeramdini, Carrin, 2002; Comaish, Holdstock, 1983; Gerdtham, Jonsson, 1994; Gerdtham, Jonsson, 1992; Gerdtham, Jonsson, 1991; Gerdtham, Søgaard, Andersson, Jönsson, 1992; Gerdtham, 1993). The further assumption would be that the intensity and sophistication of health care should, in principle, be associated with decreased mortality rates (other things equal) (Getzen, 2000; Gerdtham, 1993; Murray, Govindaraj, Musgrove, 1994). There is an equally vocal group of health policy specialists who contend that health care expenditures need bear no relationship to improved health. This latter group feels that (1) much of the truly effective care occurs at the primary level which is not expensive and carries a minimum of expenditure of total health care in industrialized societies; (2) there has been little progress in improving mortality due to chronic common degenerative diseases – except perhaps in the case of cardiovascular disease; (3) health care expenditures heavily reflect administrative and management costs rather than actual performance of medicine and surgery; (4) the price of the same pharmaceuticals varies considerably among industrialized countries. Especially intense are critiques from United States health policy specialists who contend that, in the case of privately funded health care typically involving profit-making insurance companies, the cost of care bears little relation to its quality or intensity, since much of private health care expenditure is either medically unnecessary or occurs too late in life to significantly influence life expectancy (Bitton and Kahn, 2003; Woolhandler, Himmelstein, 1997; 2002a; 2002b).

There is some degree of consensus on the part of European and North American health economists that, for publicly funded care there are national criteria that roughly link personal health care procedures to their expenditures (Musgrove, Zeramdini, Karrin, 2002; Murray, Govindaraj, Musgrove, 1994). There is even greater consensus that publically funded health expenditure provides greater coverage to populations at higher morbidity levels – namely, the lowest socioeconomic groups (Ham, 1997; Hurst, 1991; Hurley, 2001) Publically financed expenditures also appear to provide some positive redistributive effects and less differential treatment (Doorslaer, Wagstaff, van der Burg, et al., 1999) There then seem to be some grounds for comparing health outcomes among industrialized countries, in relation to public expenditures on health care as a proportion of their real GDP (Clemente J, Marcuello C, Montañés A, Pueyo, F. 2004). Once this is done, controlling for other factors which measure economic growth and stability as well as lifestyle and environmental risk factors, we do observe a robust positive relationship between public health care expenditures and life expectancy. The more important observation, however, is that we can for the first time actually estimate the effect of health care expenditures on mortality reduction (Mackenbach, 1991). This conclusion takes on added plausibility when one recognizes that nearly all industrialized countries, apart from the United States, have the greatest proportion of their health care expenditure arising from public or not-for-profit sources.

5. Quality of Work/Working Conditions

Quality of working life or, more generally, “working conditions”, have been traditionally known to influence health. In the oldest epidemiological literature, going back to Great Britain in the 1840’s, one observes a powerful relationship between differential occupations, as identified by occupational skill level, and mortality rates at virtually all ages and for occupational, infectious and chronic diseases. Overall, the lower the occupational skill level of a worker, the higher the probability of premature mortality (Susser, Adelstein, 1975; Office of Population Censuses and Surveys Her Majesty’s Stationary Office, 1986). Prior to the advent of

quantitative epidemiology, it was commonplace in clinical studies to demonstrate that the lowest-skilled workers (semi-skilled, unskilled) had the highest illness and mortality rates due to deficiencies of occupational safety. The principal problems in occupational safety and health are (1) physical, including toxic emissions, synthetic organic chemicals, carcinogens and ergonomic problems; and (2) psychological, especially including the lack of worker autonomy, stressful work (high demands), monotonous work and underemployment, insecure and unstable work and under-compensation in wages and benefits (Karasek, Theorell, 1990; Kuper, Singh-Manoux, Siegrist, Marmot, 2002; Lynch, Krause, Kaplan, Tuomilehto, Salonen, 1997; Lynch, Krause, Kaplan, Salonen, Salonen, 1997; Marmot, Bosma, Hemingway, Brunner, Stansfeld, 1997).

In cross-sectional analysis comparing countries, or historical time-series analysis, examining the experience of one country through time, it is difficult to identify precise markers of high or poor quality working conditions. However, in the industrialized country setting, it is well known that employment in the "shadow economy" generally offers working conditions of comparatively low quality. The shadow economy, in fact, involves illegal economic activity in that employers and employees do not pay government taxes (Frey, Weck, 1982; Eilat, Zinnes, 2002; Torgler, Schneider, 2009; Buhn, Karmann, Schneider, 2007; Hughes, 2000; Kyle, Warner, Dimitrov, et al., 2001; Chaudhuri, Schneider, Chattopadhyay, 2006; Boeri T, Garibaldi, 2005, 2007. This means, as well, that firms operating in the shadow economy are not subject to the payment of standard wages and do not offer the general benefits of insurance, including unemployment, health, disability, social welfare and pensions. Equally important, firms in the shadow economy often operate at long hours, with minimal health and safety rules and without time off (Centeno, Portes, 2006). In addition, workers in the shadow economy are subject to minimal autonomy and have higher stress levels due to the length of working hours, job instability and minimal wages and benefits.

Perhaps the single most important factor promoting the existence of firms in the shadow economy is either the lack of economic growth and development or the decline of the firm due to industrial restructuring, globalization or national recession (Boeri, Garibaldi, Salasco, Gobbi, 2002; Dell'Anno, Gomez-Antonio, Pardo, 2007). These phenomena reduce the capacity of the firm to pay taxes and to finance the modern technology needed to avoid problems of occupational safety and health, environmental toxins, ergonomically sophisticated work places, stable working conditions and minimally standard wages and benefits. Thus, for industrialized countries, we can conclude that firms in the shadow economy generally have considerably poorer working conditions, and that such conditions are risk factors for occupational safety and health problems, psychological stress and chronic degenerative diseases (Frey, Weck, Pommerehne, 1982; Chaudhuri, Schneider, Chattopadhyay, 2006; Boeri, Garibaldi, 2005, 2007; Bajada, Schneider, 2005).

It is important to bear in mind, however, that the shadow economy is most heavily represented in counties at comparatively low levels of economic development. Thus, one might argue that there is some redundancy in placing GDP per capita and the proportion of GDP that represents the shadow economy as independent variables in a single model by which one wishes to account for changes in life expectancy. In general, this would be true where one was comparing countries in a very large sample that included geographic areas dominated by relatively impoverished developing countries. However, this would not be the case where the comparison is among advanced industrialized societies at comparatively high per capita income levels. In the latter case, the presence of a substantial "shadow economy" tends to connote relatively underdeveloped sectors of the economy or an economy that is undergoing economic distress or extensive restructuring.

Self-employment is another important structural feature of working conditions. The self-employment rate is intended, in this analysis as a measure of entrepreneurship in small and medium-size enterprises (SME's). In traditional economic thinking entrepreneurship is the "fourth" factor of production and is essential to innovation and risk-taking in market economies. It is theoretically the source of continuous renewal of the technology and

structure of the economy and thus at least part of the basis for continuous long-term growth. The self-employment rate in SME's is also the source of a relatively high rate of job creation. And it is a traditional source of absorption into employment of persons unemployed as a result of recession, globalization and economic restructuring (including 'downsizing', 'offshoring', 'delocalization' and 'outsourcing'). Thus, self-employment is a traditional safety net for professional, managerial, skilled and unskilled workers who have lost employment.

There is also considerable theory that contrasts the SME with the large bureaucratic work organization, with its intensely hierarchical and impersonal employment structure. – i.e., the antithesis of "social capital" (Islam, Merlo, Kawachi, Lindstrom, Gerdtham, 2006; Kawachi, 1999; Lochner, Kawachi, Kennedy, 1999; Altschuler, Somkin, Adler, 2004). The hierarchical component itself is a source of enlarged socioeconomic (SES) inequalities within the firm's internal labor market. There is evidence that larger SES inequalities are an important factor in premature mortality (Kahn, Wise, Kennedy, Kawachi,. 2000; Lynch**,** Smith**,** Kaplan**,** House, 2000; Steptoe, Kunz-Ebrecht, Owen, et al., 2003). Scholars also point to the importance of the exceptional autonomy of the self-employed, obviously involving control (a risk factor in cardiovascular disease) over the extent of work demands as well as the pace, scheduling and intensity of work (Karasek and Theorell 1990). All of these factors lead to the inference that the rate of self-employment is important to economic growth and renewal, economic survival of the unemployed, and social capital – and for these reasons would provide important sources of societal coping with economic shocks.

6. Lifestyles

The primary variables we wish to investigate in relation to mortality concern factors intrinsic to the economy or to economic and social policy. However, in order to appropriately assess the impact of those factors on mortality, we also need to be sure that we have included in our model other risk factors to health that are well established influences on the mortality rate. Failure to include such variables, such as 'lifestyle' factors, may result in an over- or underestimate of the primary relation between the economic or social variables and health. One of these 'lifestyle' factors is high alcohol consumption per capita, which has a wide range of influences on illness including heart disease, stroke, kidney disease, specific malignancies, accidents, suicide, homicide and cirrhosis of the liver (Jernigan, Monteiro, Room, Saxena, 2000; Room, Babor, Rehm, 2005; San Jose, Van De Mheen, Van Oers, Mackenbach, Garretsen, 1999). Alcohol consumption per capita can be seen to positively influence the age-adjusted mortality rates in our cross-sectional studies since we examine the effect of such a factor on mortality within the same year. Other high risk behaviors, such as tobacco (Bartecchi, MacKenzie, Schrier, 1994; Brownson, Eriksen, Davis, Warner, 1997), carbohydrate and animal fat consumption, are also known to influence mortality due to cardiovascular diseases and malignancies, but were not tested in the present model.

Economy, Social Policy and Mortality Among Industrialized Countries

Figure 1 shows age standardized mortality rates for 40 industrialized countries predicted by three types of variables: (1) economic factors, including GDP per employee, size of the "shadow" economy, the male unemployment rate and self-employment as a proportion of the labor force; (2) health expenditures funded by public sources as a proportion of the total GDP; and (3) alcohol consumption per capita, as representing a high-risk "lifestyle" factor harmful to health.

It can be seen that the mortality rate is distributed across the 40 countries largely in accordance with their income and wealth per capita as represented by the GDP per employee. As discussed above the GDP per capita is also strongly inversely related to the size of the shadow economy and the unemployment rate, while self-employment as a percentage of total employment is a measure of the economic health and density of entrepreneurship in the small and medium enterprises (SMEs).

The countries with the lowest mortality rates are among those with the highest GDP per capita, and the smallest shadow economy and unemployment rates. These relatively high income countries are those of Western Europe, North American and the Pacific. Western European countries include: Switzerland, Italy, Sweden, France, Spain, Norway, Austria, Greece, Germany, Finland, Netherlands, Ireland, United Kingdom, Belgium, Portugal and Denmark (in order of increasing mortality rates). The North American countries are Canada and the United States, while the Pacific countries are Japan, Australia, New Zealand and Korea.

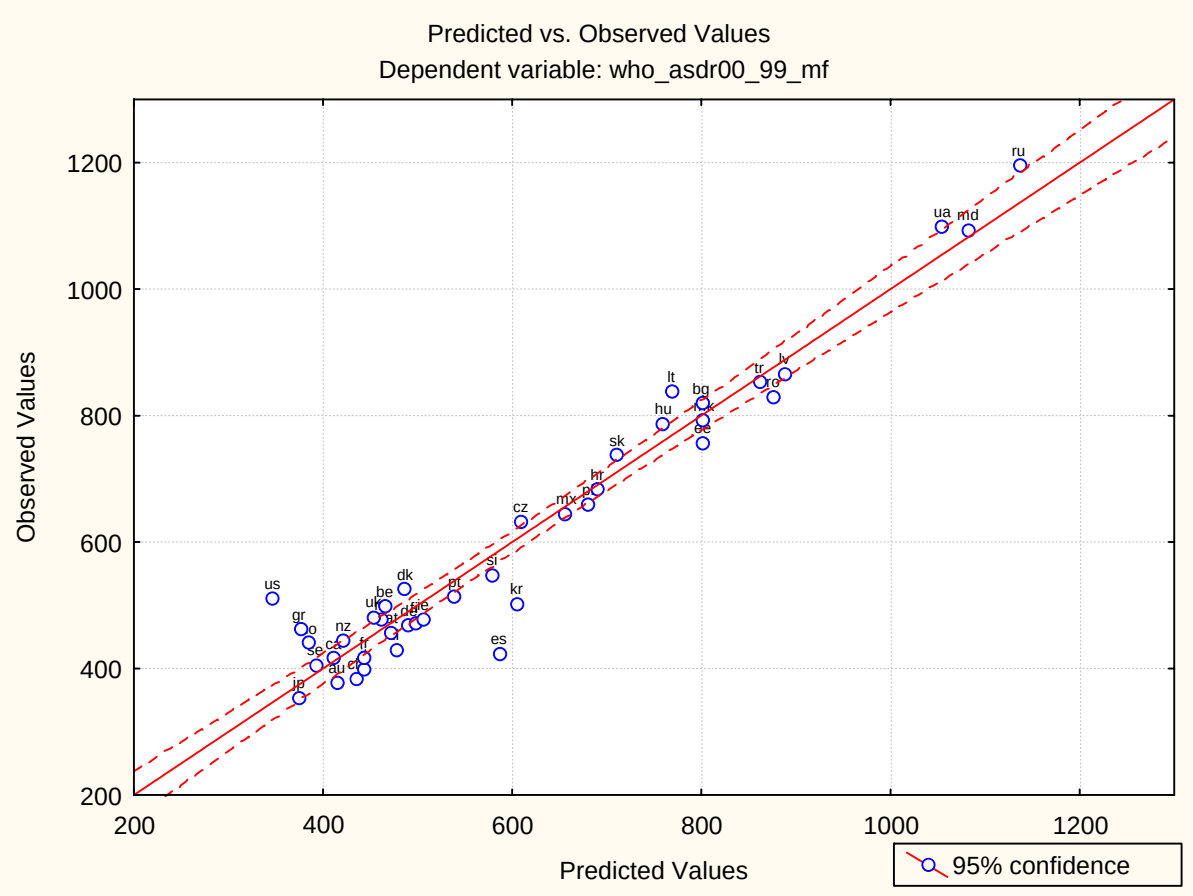
The middle income countries include those of Eastern Europe and, in the Western Hemisphere, Mexico. Eastern European countries in increasing order of mortality include: Slovenia, Czech Republic, Poland, Croatia, Slovakia, Estonia, Hungary, Macedonia, Bulgaria, Romania, Lithuania, Turkey and Latvia. Among the Eastern European countries it is interesting to observe relatively similar age-standardized mortality rates for societies that are geographically proximal and have similar GDP, income and wealth.

The third group of countries with very much higher mortality rates than those of Eastern Europe include: the countries of the Community of Independent States (CIS) including Moldova, Ukraine and the Russian Federation. As a group these countries have a lower GDP per employee than the average in Western or Eastern Europe and have the largest shadow economies among industrialized countries.

Figure 1
Relation of economic variables to age adjusted total mortality 40 European, CIS and OECD Countries, Year 2005

R= .97027845 R^2= .94144027 Adjusted R^2= .92863033
F(7,32)=73.493 p<.00000 Std.Error of estimate: 57.996

N=40	Beta	Std.Err.	B	Std.Err.	t(32)	p-level
Variables			422.1625	113.2121	3.72895	0.000745
GDP per employee (productivity)	-0.275164	0.084246	-0.0038	0.0012	-3.26619	0.002602
Shadow economy as proportion of GDP	0.442261	0.090652	7.8362	1.6062	4.87866	0.000028
Public health expenditure as proportion of GDP	-0.218179	0.062863	-29.1464	8.3978	-3.47072	0.001507
Self employed as proportion of total employment	-0.223634	0.045491	-4.5745	0.9305	-4.91595	0.000025
Unemployment rate, males	0.117708	0.050753	6.9823	3.0106	2.31922	0.026924
Alcohol consumption per capita	0.206031	0.046603	15.4188	3.4876	4.42102	0.000106
Consumer Price Index (Index Year 2000)	0.258445	0.050777	1.3576	0.2667	5.08979	0.000015

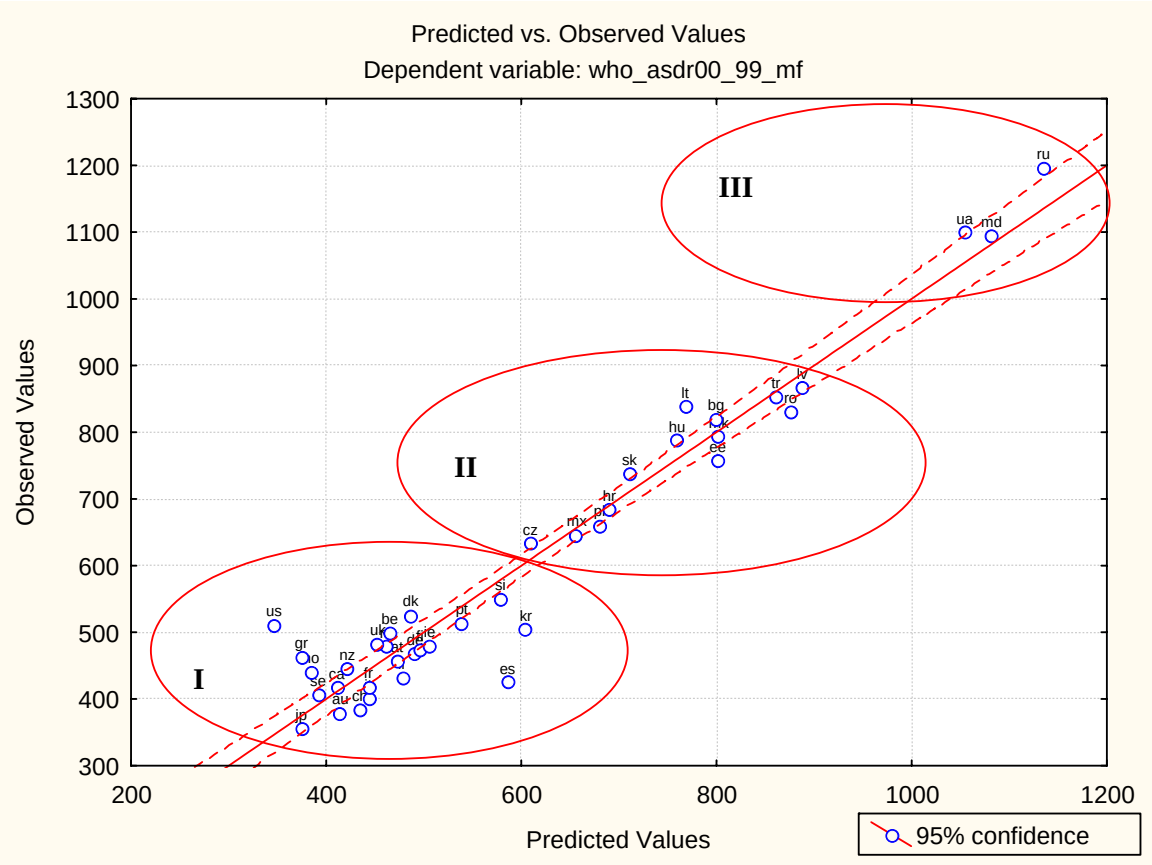


Importance of National Income to National Mortality Rates

The model above uses seven factors to account for the levels of age-standardized mortality rates among 40 industrialized countries. However a fundamental distinction among the 40 countries can be seen by distinguishing these countries by region and by average real GDP per employee. Figure 2 below repeats Figure 1 but groups the countries in terms of major regional classification and average GDP per employee. The first region enclosed in circle I, includes Western Europe, North America (except Mexico) and the highly industrialized Pacific countries of Australia, New Zealand, Japan and Korea with average GDP per employee of $ 45, 766. The second group of countries, in circle II, includes Eastern Europe and Mexico, with average GDP per employee of $20,292. The third group of countries, are within the Community of Independent States (CIS) and include Moldova, the Russia Federation and Ukraine, with average GDP per employee of $8,022.

Thus the basic differentiation among the group of countries is by geography and national income/wealth as well as productivity as measured by real GDP per employee. Within each of the three circles, one can see a relatively straight line representing the extent to which the entire set of seven predictors accounts for variation in age-standardized mortality rates among countries within the three regional groups. While the alignment of the three circles in a upward slope is essentially accounted for by GDP per employee, the variation of mortality among countries within the circles is largely accounted for by the remaining six variables in the model (shadow economy, self-employment, inflation rate, pubic health expenditures, male unemployment rate, and alcohol consumption per capita).

Figure 2
Relation of economic factors to age-standardized mortality rates: countries grouped according to average GDP per employee and geographic region.



	Region	Real GDP per Employee (Average USD)
I.	Western Europe North America Pacific	45,766
II.	Eastern Europe Mexico	20,292
III.	CIS Moldova Russia Federation Ukraine	8,022

Suicide, Economic Growth, Unemployment and Government Expenditure

Suicide is an "external" cause of death which is, at the same time, a principal measure of psychological depression, and is well known to respond to economic crises involving loss and insecurity.

In order to explain (statistically) variation in suicide rates by country, we can investigate several factors which deal with the issue of economic loss and unpredictability. At the individual level, perhaps the most common macroeconomic measure of loss is represented by the unemployment rate. It is also well known that the standard macroeconomic predictor of the unemployment rate is absolute decline and GDP per capita. We would therefore assume that countries with higher levels of GDP per capita, in addition to providing greater income and security, would also show lower suicide rates. Adding to GDP growth as protective against suicide, other major measures of economic development – such as the transformation of economies from domination by agriculture to that of manufacturing and, subsequently, to service industries – should likewise result in greater availability of material goods and services, and thus also reduce the tendency to suicide. However, a direct measure of consumption capacity, especially among the lower income population, is national consumption per capita of food and non-alcoholic beverages. We can compare this variable to expenditures on alcohol and tobacco, where a positive relation to suicide would be expected. Alcohol (and other psychoactive drugs) is known to influence psychological depression. Tobacco, in particular, influences cardiovascular disease and malignancies. The latter two chronic diseases themselves are risk factors to subsequent depression and suicide.

While the suicide rate is relatively strongly correlated (inversely) with real GDP per capita, it is subject to influences that go well beyond trends and fluctuations in national income and wealth (as measured by the GDP). Epidemiologically, suicide, as a marker for both psychological depression, and for poor mental health in general, is strongly associated in much of the literature over the last 40 years with unemployment experienced by individuals. The individual-level relationship between unemployment and psychological depression is so substantial that it is typically found in epidemiological studies to occur within a few months of the onset of unemployment. Nevertheless, the principal relationship between unemployment and the deterioration in mental health is typically observed over a period of several years. This considerable time lag is based on losses and damage to personal relationships (previously) at work, in the family and among friendship networks. Equally important are the longer term losses in income and economic position that frequently occur, especially among middle aged males, when they become reemployed – usually in a different firm, industry or occupation. In those situations reemployment will often involve starting at a considerably lower level of wage/ salary and job status; this will result in long-term losses in cumulative earnings, personnel benefits and retirement income.

In addition there is substantial evidence that the capacity to recover from crisis of cyclical or structural unemployment is, frequently, based on the extent of self-employment in small and medium enterprises (SMEs). Therefore one would assume that countries with a more viable pattern of self-employment would be (1) more highly productive of new employment, (2) able to generate a greater proportion of new cases of self-employment, and (3) able to absorb a larger number of the unemployed. Thus, the extent of self-employment like GDP per capita, should predict lower rates of suicide.

At the same time, one must consider the extent to which the society provides social protection to individuals in periods of economic crisis. One would expect that countries which traditionally offer stronger social safety nets and, in general, more extensive social welfare systems, would be able to create societies with more stable incomes and employment patterns, as well as higher levels of training for those who have lost jobs or need to restructure their careers, as well as unemployment, disability, health insurance and retirement income. A somewhat crude measure of the tendency of a society to provide such a social protection can be found in the magnitude of government consumption (as compared to private consumption) per capita. With such an

indicator, one would assume that greater levels of social protection and economic security provided by government would minimize economic loss due to economic shocks and structural changes; this would in turn predict lower suicide rates.

Social protection is often thought of, by non-specialists, as essentially referring to insurance systems (especially unemployment, disability and frailty, impoverishment and pensions). However, a major aspect of social protection, during working life and after it, involves expenditure on health care. This needs to be distinguished from government expenditure on overall collective consumption, which will also include education, transportation, national defense etc. We are thus especially interested in the proportion of total government expenditure that represents specific expenditure on health. One may say that this is a measure of the extent to which "governments", or the national polity, place a high priority on population health as a key element of social protection.

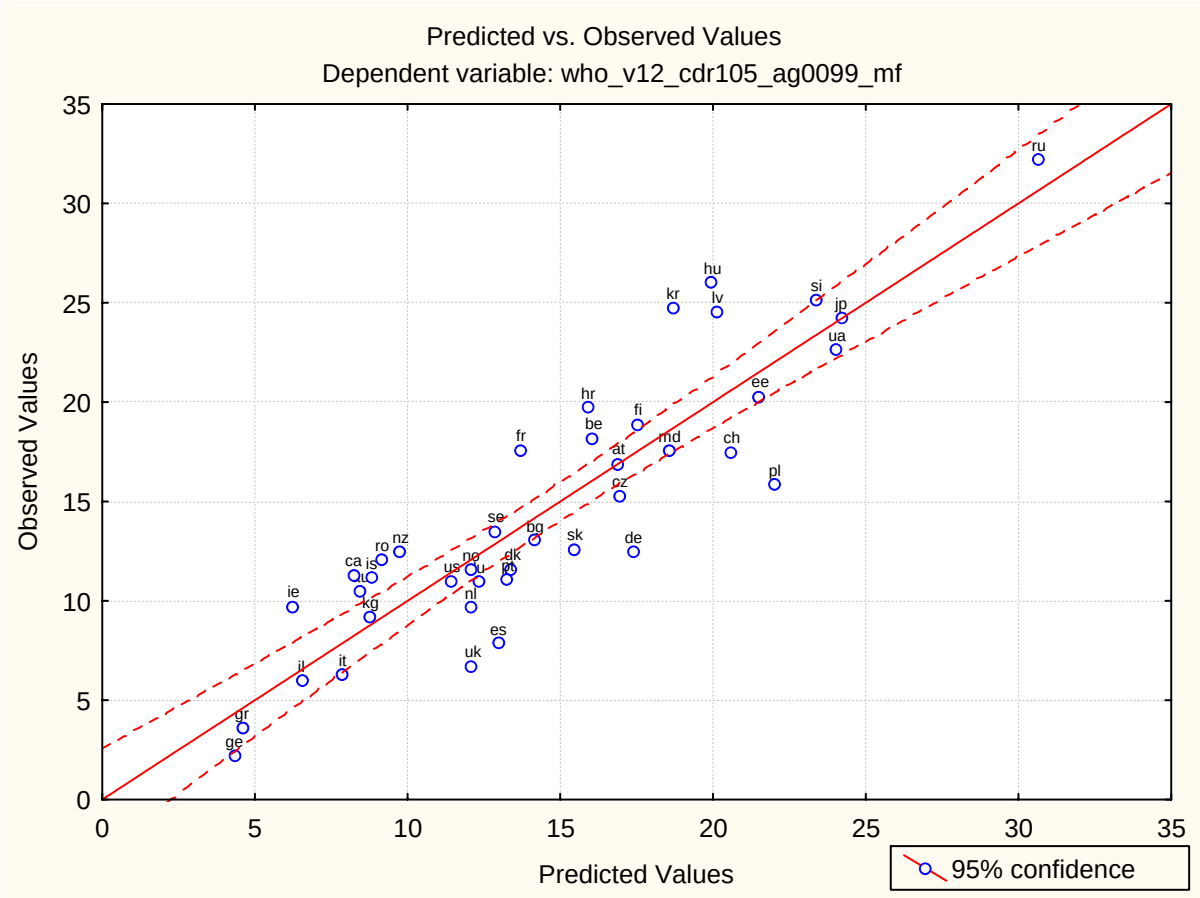
Another position entirely, based on the sociological writings on suicide of Emile Durkheim (1858-1917) puts forward the thesis of social integration as a principal factor militating against high suicide rates. One of Durkheim's key arguments is that a cosmopolitan lifestyle, especially related to urbanization, and incorporating many cultural, religious, political frames of reference and relatively high levels of education, make it difficult for the individual to adopt a coherent system of rational understanding and belief. Such a situation leads to what Durkheim referred to as "anomie" in which the individual becomes relatively "rudderless" and intellectually directionless. This situation, on Durkheim's view, is a primary casual factor in suicide linked to the relative absence of social integration. We could therefore include a measure of such urban cosmopolitanism which would refer to the proportion of the national population that lives in a situation of urban agglomeration. But since Europe is very extensively urbanized, a more penetrating measure of residential agglomeration is the extent of population density among the rural population. Along similar lines of argument, it is also assumed that the divorce rate will predict higher suicide rates.

The above potential causal factors lead us to a model of suicide rate variation among industrialized countries. The model consists (1) economic factors [GDP per capita (inverse), male self-employment (inverse), the unemployment rate (positive)], (2) government expenditures on health care as a proportion of total government expenditures (inverse), (3) social integration [rural population density (positive), divorce rate (positive)], (4) 'life-style' risk factors to suicide directly (e.g., alcohol consumption) and to chronic diseases which themselves are risks to suicide (e.g., tobacco). Figure 3 below presents this model. Nearly all variables are statistically significant and the model accounts for 74% of suicide rate variation among industrialized countries.

Figure 3
Regression summary for total suicide mortality rate (CDR per 100,000 of population)
40 European, OECD and CIS countries, year 2005

R= .89499048 R^2= .80100797 Adjusted R^2= .74131036
F(9,30)=13.418 p<.00000 Std.Error of estimate: 3.4128

	Beta	Std.Err.	B	Std.Err.	t(30)	p-level
Intercept			35.73286	8.755259	4.0813	0.000305
GDP per capita, in const. 1990 Geary Khamis $ (Groningen Growth and Development Centre, Total Economy Database, June 2009)	-0.381077	0.189844	-0.00031	0.000153	-2.00732	0.053798
Gen. gover. exp. on health - % of total gov. exp. (WHO Statistical Information System)	-0.382798	0.133949	-0.78077	0.273208	-2.85779	0.007682
Exp. on food and non-alc. bever. - % of total GDP (World Bank, Global PPP indicators 2005)	-0.436559	0.197454	-0.4198	0.189873	-2.21094	0.034806
Exp. on alcohol. bever. and tob- % of total GDP (World Bank, Global PPP indicators 2005)	0.239833	0.139155	1.04157	0.604341	1.72349	0.095094
Gover. exp. on collect. consump. - % of total GDP (World Bank, Global PPP indicators 2005)	-0.349901	0.095794	-1.46623	0.401415	-3.65265	0.000982
Male self-employment - % of tot. male empl-t (ILO, Key Indicators of the Labor Market)	-0.381986	0.139958	-0.28356	0.103897	-2.72929	0.010514
Rural pop. density (per sq. km of arable land (World Bank – World Development Indicators)	0.475674	0.089228	0.01656	0.003106	5.33099	0.000009
Divorces per 1,000 population (United Nations, Statistic Division)	0.437951	0.110286	3.42576	0.862683	3.97105	0.000413
Unemployment rate - % of registered labor force (ILO, Key Indicators of the Labor Market)	0.319163	0.105784	0.48069	0.159319	3.01713	0.005162



Similar policy issues of national health expenditure as a proportion of GDP, and the unemployment rate can be examined over historical time to observe their implications for population health. In this case a model is required that will include these two variables as predictors of mortality in addition to other factors which help to predict the mortality rate. We begin with the observation that models can be developed which can account for mortality changes over time in industrialized countries, but tend to require at least the two variables of real GDP per capita and the unemployment rate. These models have been published for the United States, the United Kingdom and several other countries (Brenner, 1976, 1985, 1979, 1987). In addition there is cross-national and times series evidence for industrialized countries showing that increased health care expenditure as a proportion of the GDP greatly depends on GDP growth (Hitiris, Posnett, 1992). Therefore, on the grounds of substantial correlation among these predictors (i.e., multi-collinearity), it is unwise to include both GDP per capita and health care expenditures in the same predictive model.

At the same time it would be convenient for policy reasons to include in the model a variable that in some significant way dealt with the fact that the material wellbeing of the non-working segments of the population (youth and elderly) depend on the income and working capacity of the working population. One such variable is a purely demographic version of the 'dependency ratio' (Harwood, Sayer, Hirschfeld, 2004; Cohen, 2003; Crown, 1985), which measures the extent to which the non-working population depends for its income and social benefits on the working population. In this case, the economically dependent population involves the nonworking population under age 15 and (to a very large extent) over 65. The resulting variable of the ratio of the population 15-64 to the population under and over 65 portrays the burden of the working population to support itself as well as the nonworking population. In the micro view, one can see that a family with several offspring and elderly to care for would experience a considerable burden of stress in the need to earn a significant income. Similarly at the national level, a society with a substantial and increasing aging population (typical of wealthy industrialized societies), and/or with a substantial birth rate (characterizing less developed countries) would experience some constraints in investing heavily in health care, pensions, occupational health and safety, education and technological development (Lee, 2002; Masson & Tryon, 1990; Razin, Sadka, Swagel, 2002). Thus a relatively high dependency ratio might theoretically tend to decrease the beneficial health effects and sustainability of economic growth. However, the relation between population aging and economic growth appears to depend on economic and social policies (Fougere & Merette, 1999; Borsch-Supan, 1997. And it could sharply decrease the economic wellbeing of the older population under conditions of economic recession.

It would also be useful in a model like this to include, at least as a control, an important 'lifestyle' variable that represents an important risk to health – in this case, tobacco consumption per capita.

Finally, observation of the United States age-standardized mortally rate (ASDR) over 1970-2005 shows a sharp and continuous decline since 1975. This accelerated mortality decline has been attributed in the United States to the influence of a variety of new cardiovascular drugs which are understood to have been important in the sharp mortality declines in coronary heart disease (Ford, Aljani, Croft, 2007). Since we have limited ability to directly measure such an effect, we instead use a dummy variable to represent the downward shift in mortality since 1975. The same procedure is used to allow us a precisely comparable model for analysis of the United Kingdom ASDR over the same time span.

The models for the U.S. and the U.K. ASDR over 1970-2005 thus includes the following independent variables: (1) health expenditures as proportion of GDP in constant dollars; (2) the unemployment rate as a proportion of the labor force; (3) population 15-64 as a percent of the total population; (5) number of daily smokers in proportion of the population over 15; and (6) a dummy variable for 1975-2005.

The U.S. and U.K. provide acceptable times-series models, with nearly all variables significant (and minimal positive autocorrelation of residuals). For both the U.S. and the U.K. health care expenditures as a proportion of GDP is a highly significant inverse explanatory factor for ASDR. However, the coefficient for U.K. expenditures is higher (minus 30.75) than that for the U.S. (minus 21.70). This would indicate that U.K. expenditures "produce" a greater reduction in mortality than is true for U.S. expenditures. For the unemployment rate, the U.K. impact (8.265) is somewhat larger than that of the U.S. (7.213). This may reflect the higher and more rapidly changing unemployment rates in the U.K., compared to the U.S., during 1970-2005.

Figure 4
Regression Summary for total age adjusted mortality in total population (ASDR per 100,000)
Key predictors: health expenditures as percent of GDP, unemployment rate as percent of total labor force
UK, years 1970-2005

R= .99424896 R^2= .98853099 Adjusted R^2= .98661948
F(5,30)=517.15 p<0.0000 Durbin-Watson d=1.77

N=36	Beta	Std.Err.	B	Std.Err.	t(30)	p-level
Intercept			1588.874	455.8486	3.48553	0.001535
Total health expend as prop of GDP (OECD Database)	-0.285069	0.060696	-41.793	8.8985	-4.69664	0.000055
Total unemploy as prop of labor force (OECD Database)	0.150331	0.033483	7.158	1.5942	4.48978	0.000098
Pop 15-64 as proportion of total pop (World Bank Database)	-0.123770	0.053324	-15.134	6.5202	-2.32109	0.027263
Tobacco consumption in grams per adult (WHO Database)	0.677833	0.072545	77.493	8.2937	9.34360	0.000000
Dummy 1975-2005	0.014094	0.032453	5.603	12.9017	0.43429	0.667184

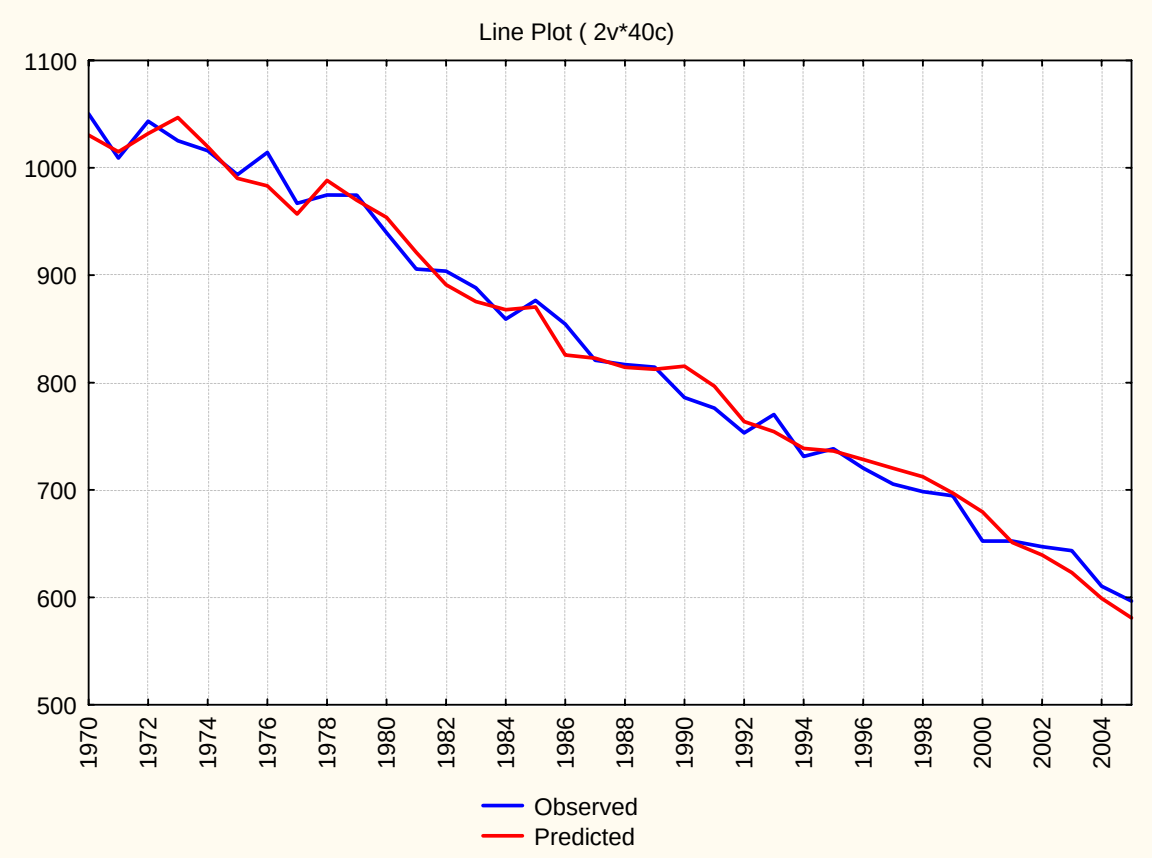


Figure 5
Regression Summary for total age adjusted mortality in total population (ASDR per 100,000)
Key predictors: health expenditures as percent of GDP, unemployment rate as percent of total labor force
US, years 1970-2005

R= .99673604 R^2= .99348273 Adjusted R^2= .99239652
F(5,30)=914.63 p<0.0000 Durbin-Watson d=1.88

N=36	Beta	Std.Err.	B	Std.Err.	t(30)	p-level
Intercept			1588.874	455.8486	3.48553	0.001535
Total health expend as prop of GDP (OECD Database)	-0.285069	0.060696	-41.793	8.8985	-4.69664	0.000055
Total unemploy as prop of labor force (OECD Database)	0.150331	0.033483	7.158	1.5942	4.48978	0.000098
Pop 15-64 as proportion of total pop (World Bank Database)	-0.123770	0.053324	-15.134	6.5202	-2.32109	0.027263
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Dummy 1975-2005	0.014094	0.032453	5.603	12.9017	0.43429	0.667184

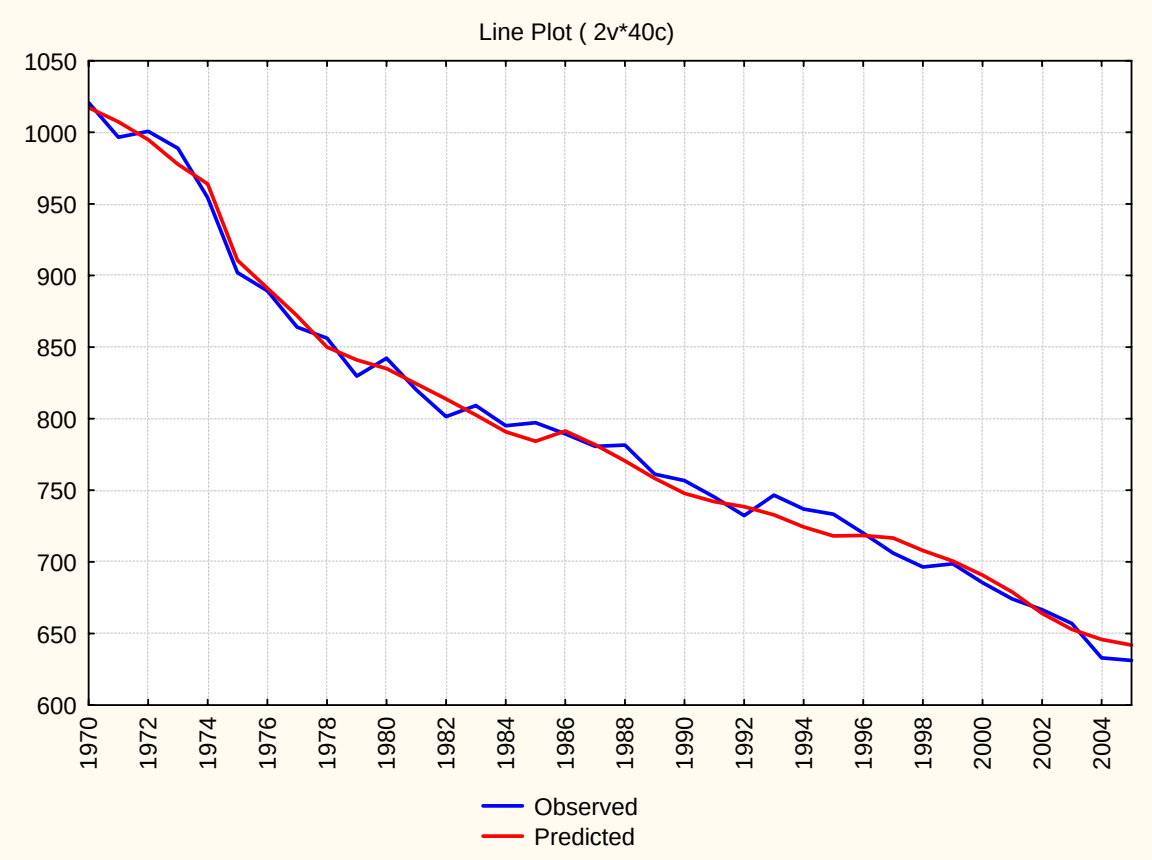


Figure 6

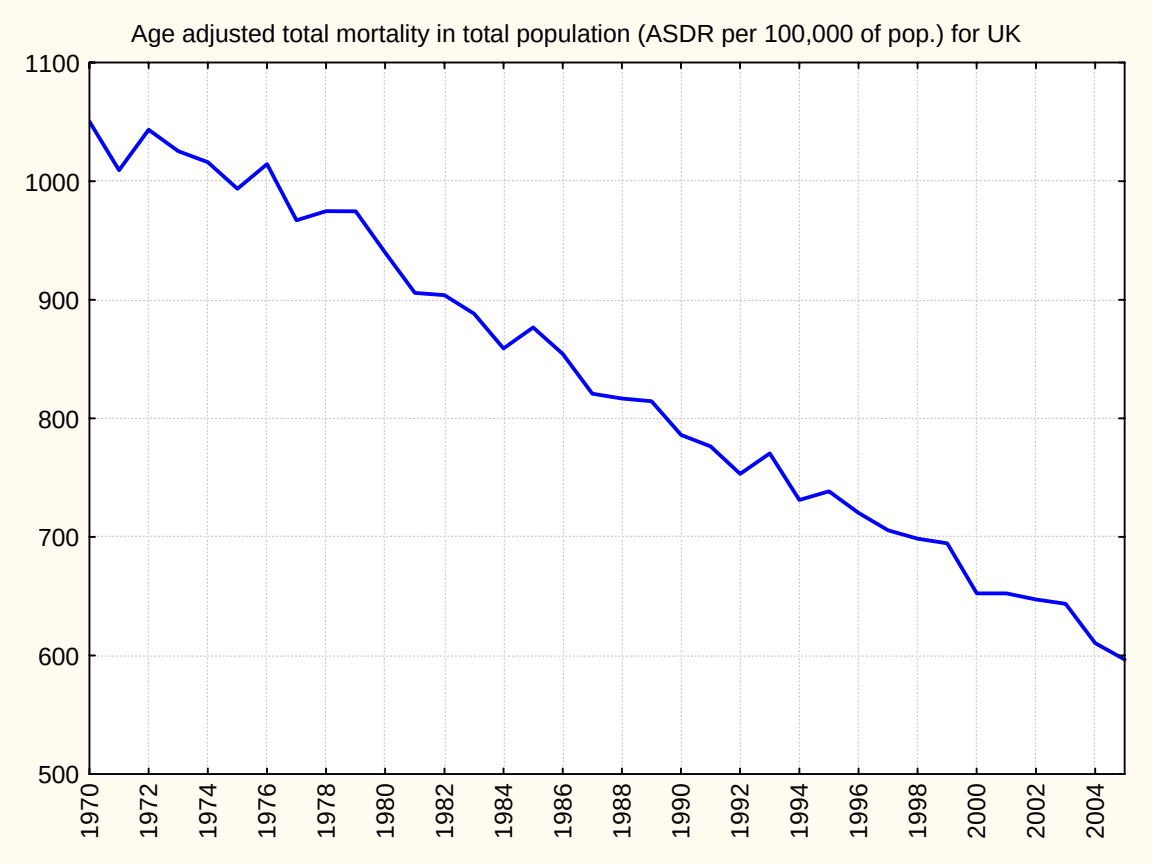

Age adjusted total mortality in total population (ASDR per 100,000 of pop.) for UK
1100
1000
900
800
700
600
500
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 7

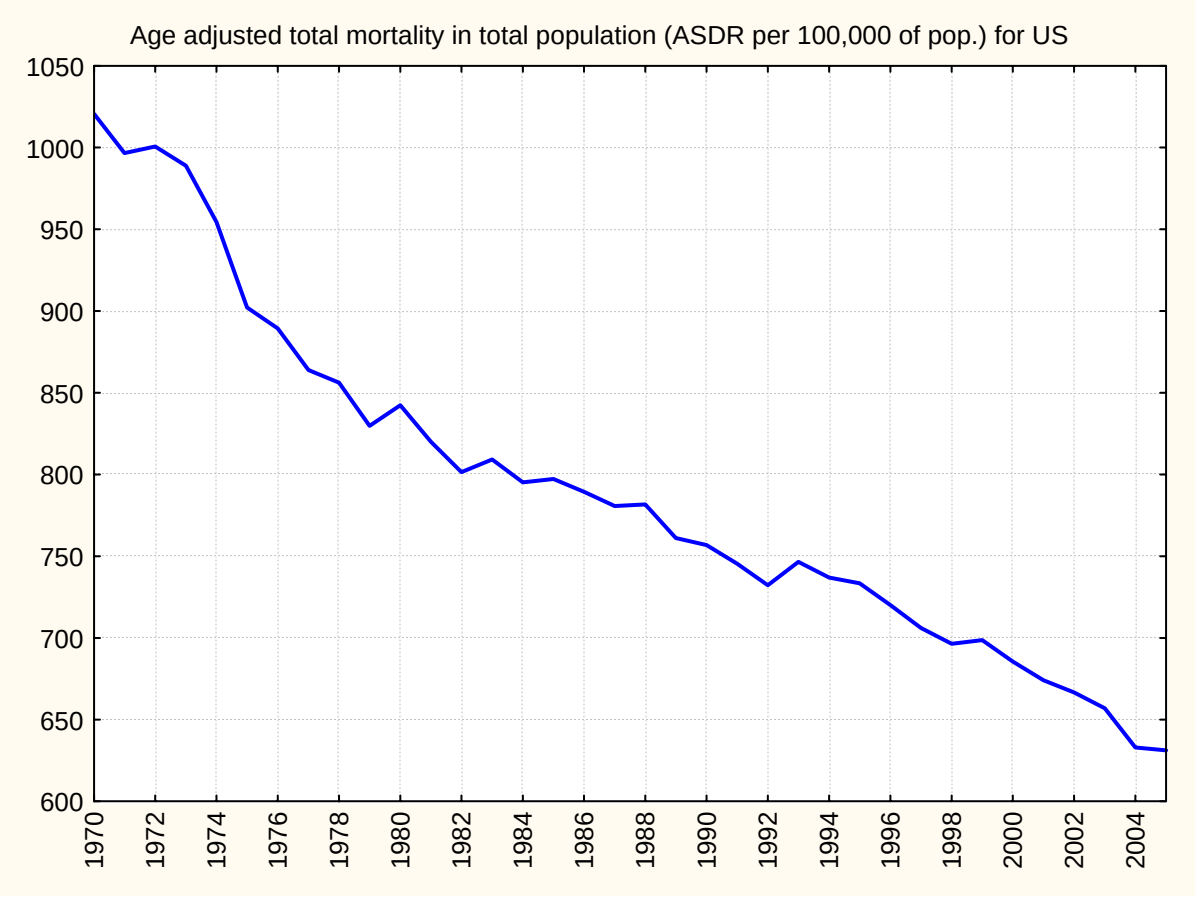

Age adjusted total mortality in total population (ASDR per 100,000 of pop.) for US
1050
1000
950
900
850
800
750
700
650
600
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 8

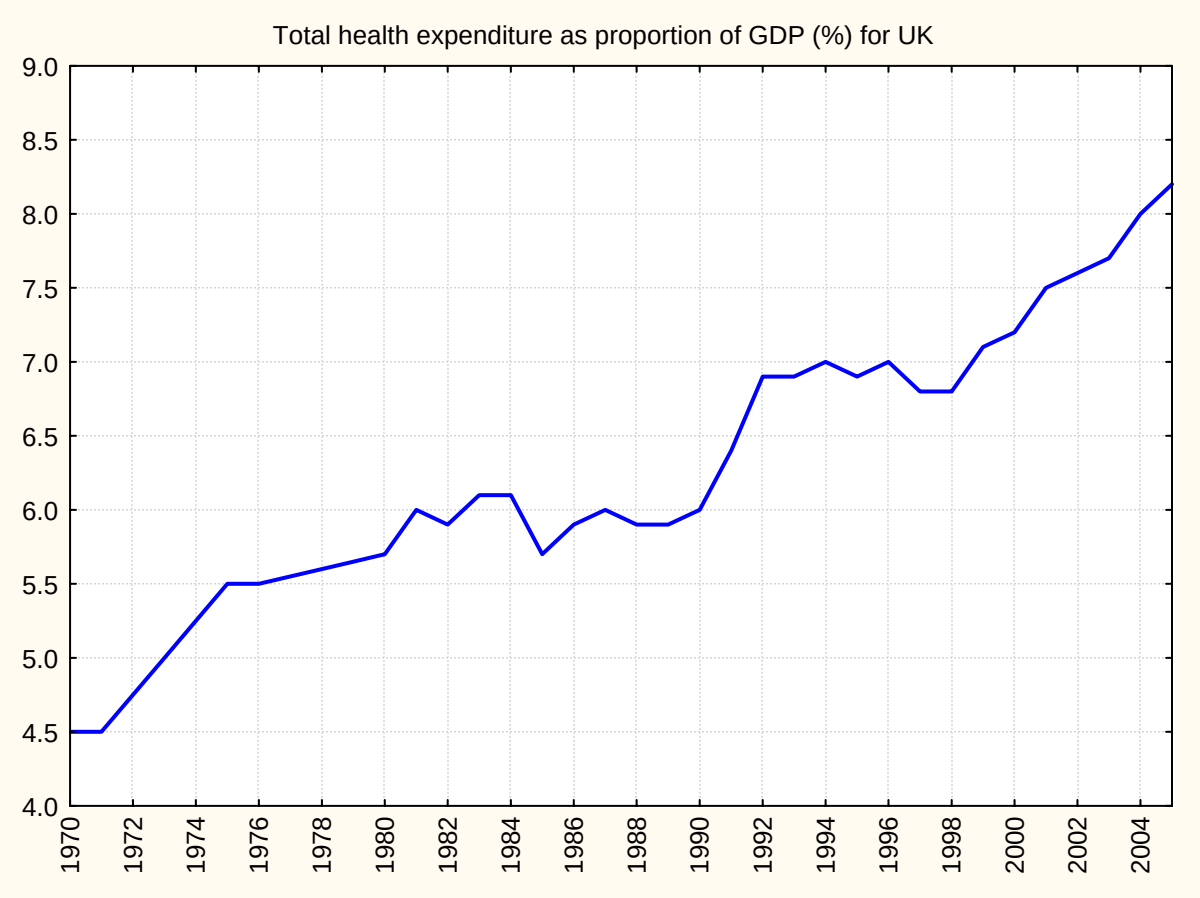

Total health expenditure as proportion of GDP (%) for UK
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 9

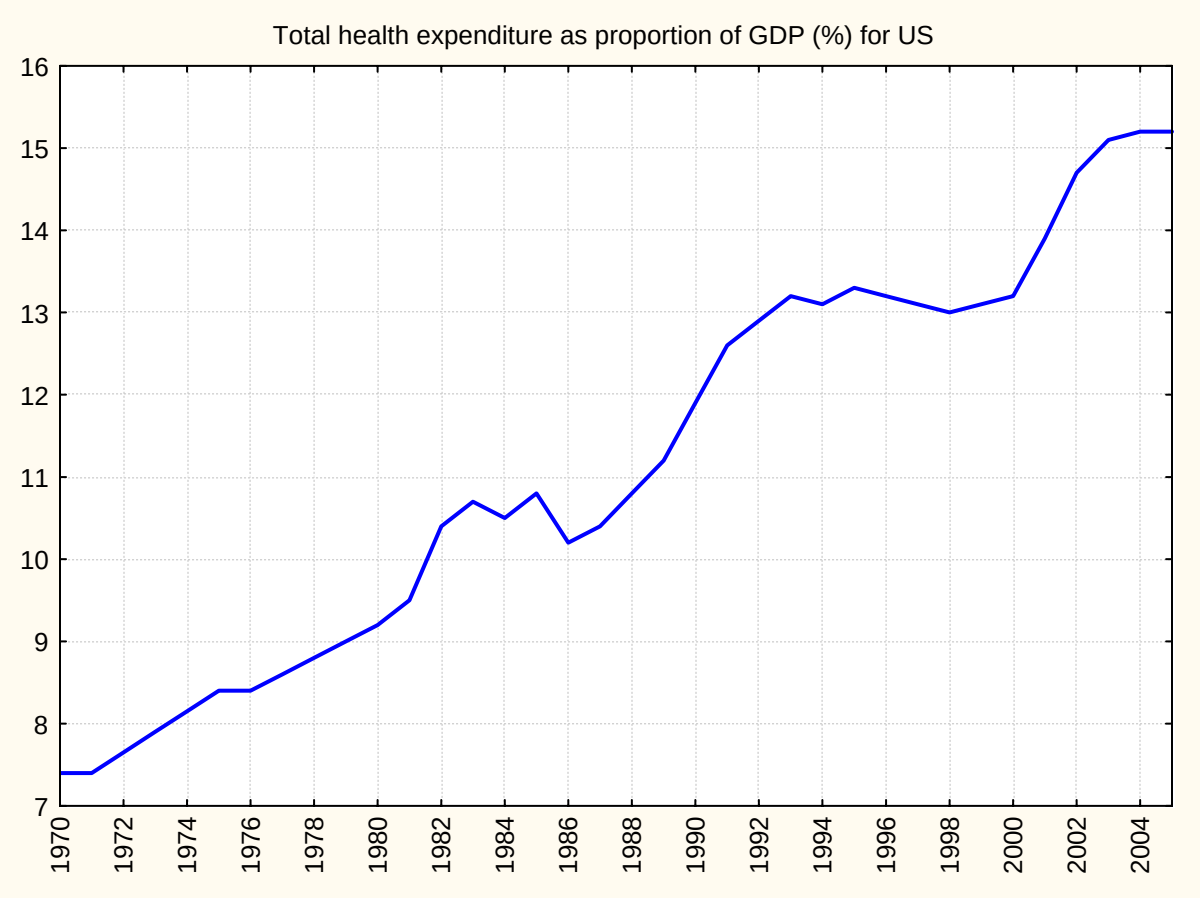

Total health expenditure as proportion of GDP (%) for US
16
15
14
13
12
11
10
9
8
7
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 10

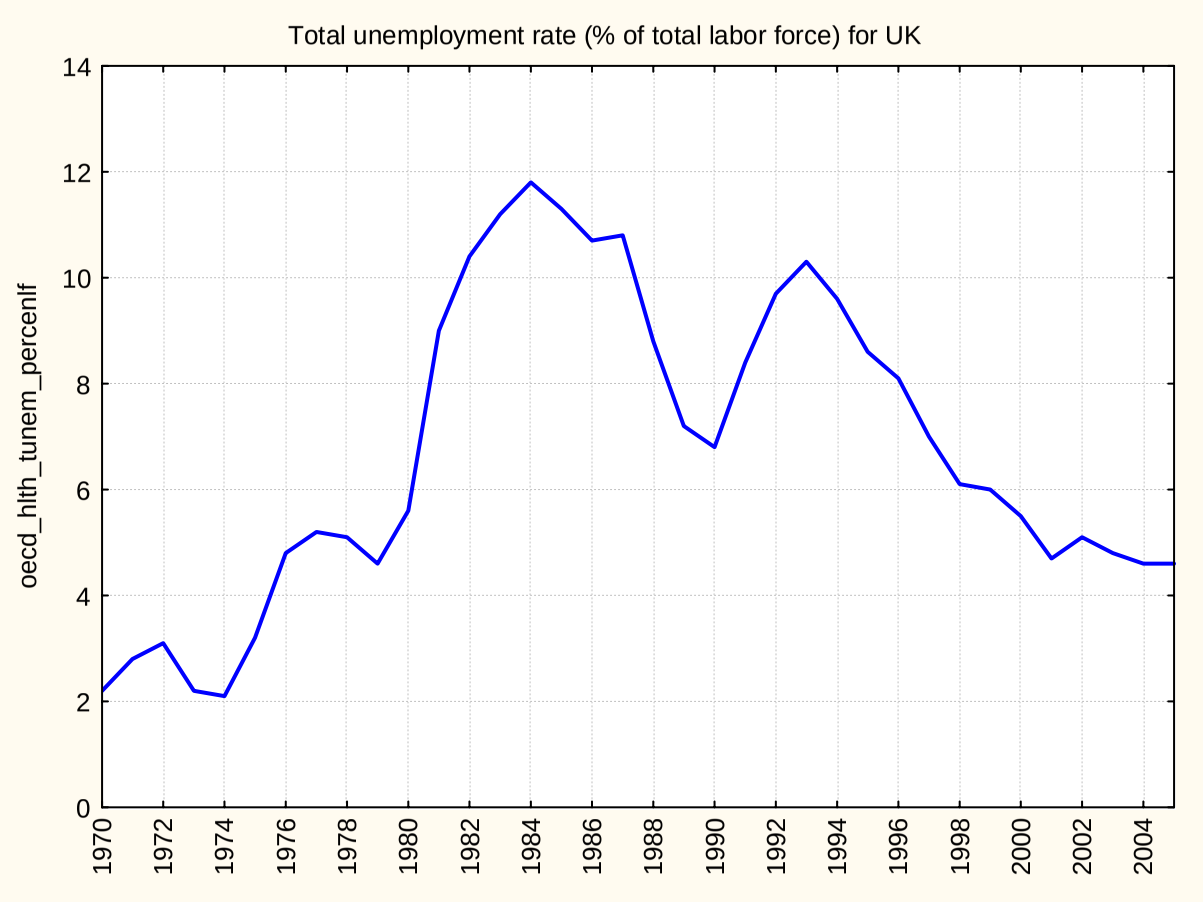

Total unemployment rate (% of total labor force) for UK
oecd_hlth_tunem_percenlf
0
2
4
6
8
10
12
14
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 11

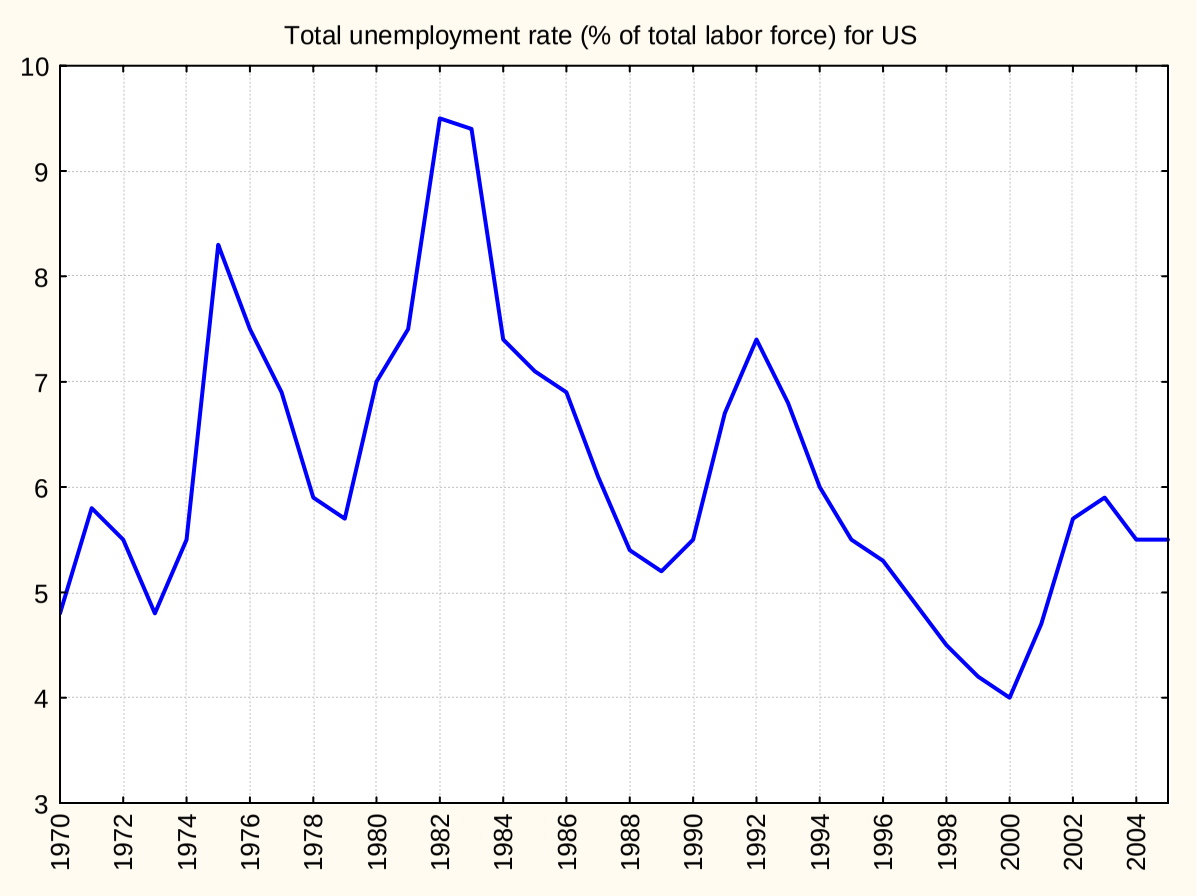

Total unemployment rate (% of total labor force) for US
10
9
8
7
6
5
4
3
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 12

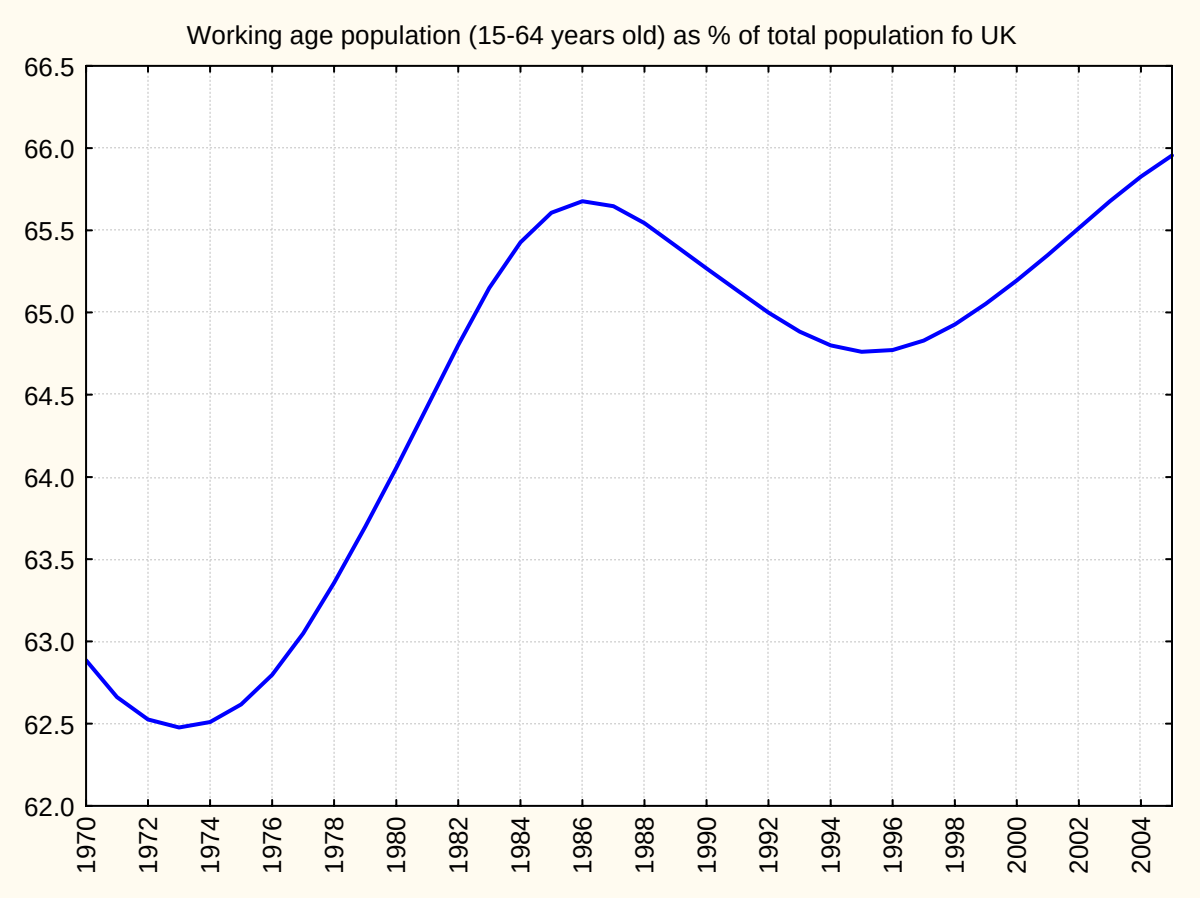

Working age population (15-64 years old) as % of total population fo UK
66.5
66.0
65.5
65.0
64.5
64.0
63.5
63.0
62.5
62.0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 13

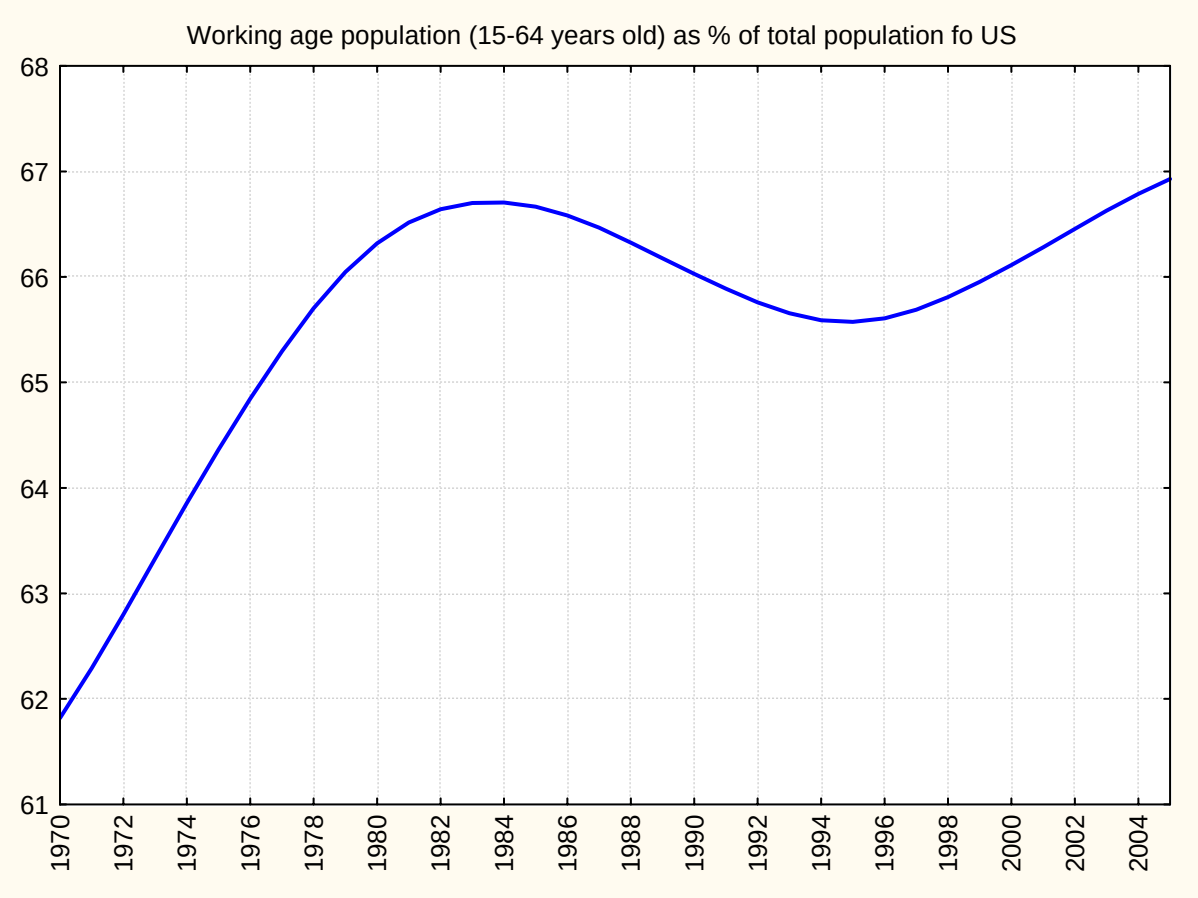

Working age population (15-64 years old) as % of total population fo US
68
67
66
65
64
63
62
61
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 14

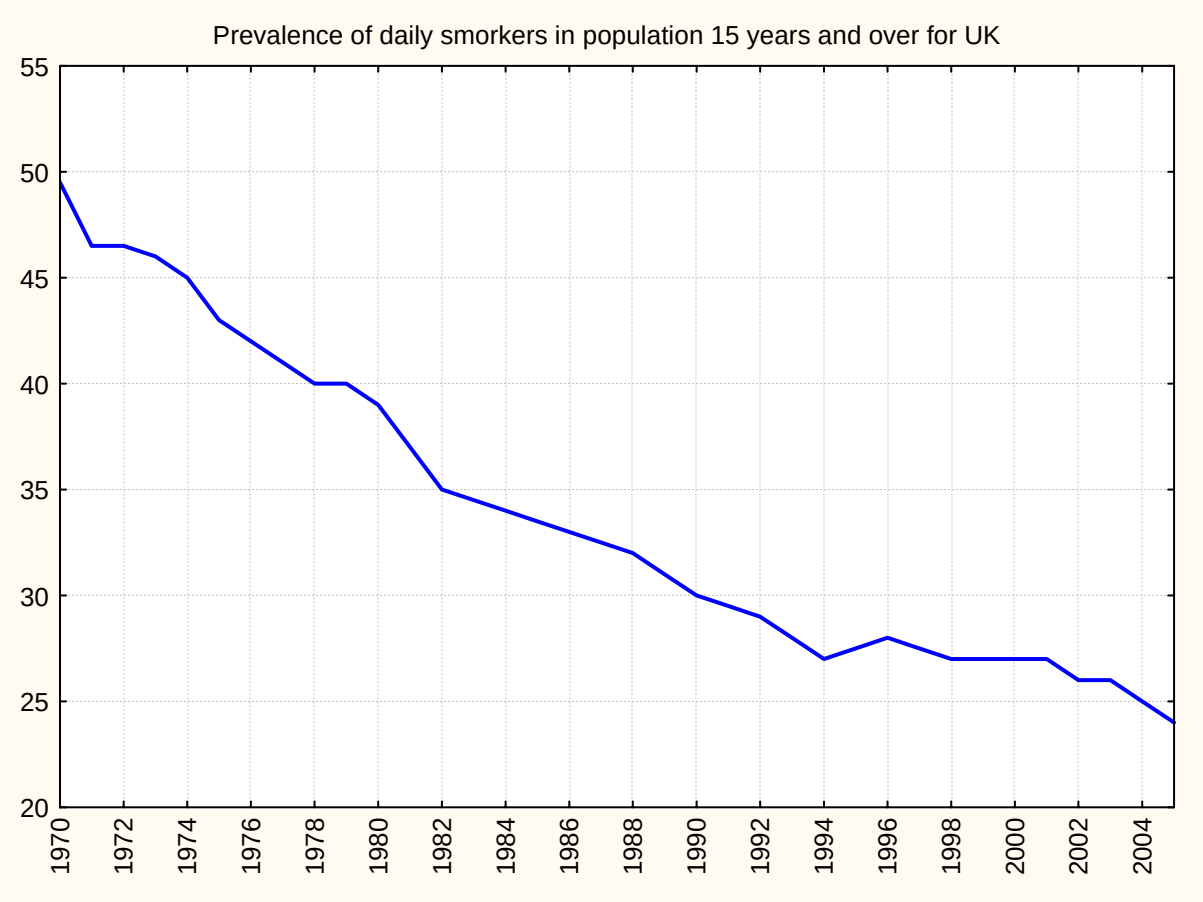
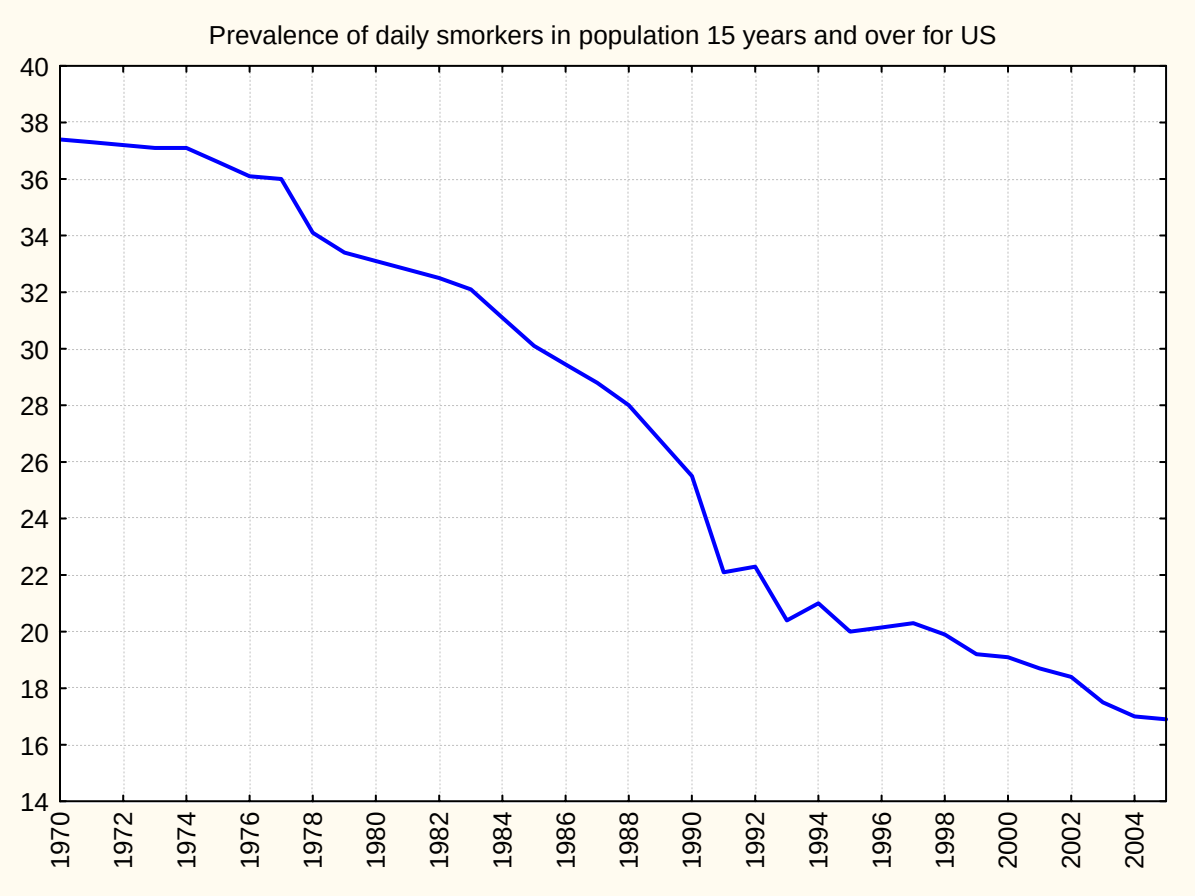

Prevalence of daily smorkers in population 15 years and over for UK
55
50
45
40
35
30
25
20
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Figure 15


Prevalence of daily smorkers in population 15 years and over for US
40
38
36
34
32
30
28
26
24
22
20
18
16
14
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

Projected impact of health care expenditure, and unemployment, on mortality

In Table 1 below the impact of public health expenditure (as percentage of GDP) is estimated, in relation to changes in mortality under scenarios where the public health expenditure is reduced by 15%, and by 25%. Similarly the impact of decreases in unemployment (male) is increased by 50% and by 100%. A third set of situations is estimated whereby both public health expenditure is decreased and unemployment rates are also increased.

In the scenario where only public health expenditure declines by 15% and 25% the equivalent total change of deaths in the original 40-country sample is approximately 341,000 and 569,000. Using the same model for the 40 countries and making estimates only for 24 of the 27 E.U. countries (without Cyprus, Luxemburg, Malta) is approximately 143,000 and 238,000.

Under the scenario where only unemployment (male) increases by 50%, and by 100%, the equivalent number of deaths in the 40-country sample are approximately 257, 000 and 514,000. For the 24 E.U. countries (based on the 40-country model) the estimates of deaths are approximately 93,000 and 186,000.

Should both public health expenditures (percentage of GDP) decline by 15% and unemployment (male) increases by 50%, the estimated number of deaths in the 40 countries are approximately 599,000 and 236,000 for the 24 E.U. countries. If public health expenditures decrease by 15% and unemployment (male) increases by 100%, mortality increases in the 40 countries by 856,000 and in the 24 E.U. countries by 329,000. if public health expenditures decline by 25% and unemployment (male) increases by 50% total deaths in the 40 countries increase by approximate 826,000 and , in the 24 E.U. countries 331,000. If public health expenditures decline by 25% and unemployment (male) increases 100% then total increases in deaths for the 40 countries are approximately 1,083,600, and in the E.U. 24 countries by 424,000. (All of the above estimates assume that the changes in public health expenditures in unemployment, and the changes in mortality occur within a single year.)

Table 1

Impact of variations of public health expenditures and unemployment on mortality

Public Health Expenditure (as percentage of GDP)		Unemployment (Male)		Total Change of Deaths (40 countries)	Total Change of Deaths (only EU countries N=24)*
Factor	% decrease	Factor	% increase	(absolute numbers)	(absolute numbers)
1.00	0%	1.50	50%	257,208	92,885
1.00	0%	2.00	100%	514,416	185,770
0.85	15%	1.00	0%	341,514	142,852
0.75	25%	1.00	0%	569,190	238,086
0.85	15%	1.50	50%	598,722	235,737
0.85	15%	2.00	100%	855,930	328,621
0.75	25%	1.50	50%	826,398	330,971
0.75	25%	2.00	100%	1,083,606	423,856

***EU 27 without Cypress, Luxembourg, Malta**

Comment:

(1) A 25% decrease of public health expenditure as percentage of GDP means that e.g. when public health expenditure as percentage of GDP is 10% it will be reduced to 7.5%

(2) A 50% increase of the unemployment rate means that e.g. when the unemployment rate is at 10% it will go up to 15%

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