Socioeconomic Factors and Suicide: An Analysis of 18 Industrialized Countries for the Years 1983 Through 2007

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Objective: To evaluate the association between socioeconomic factors and suicide rates. **Methods:** Analysis of time series of suicide rates, gross domestic product, unemployment rates, labor force participation, and divorce rates of 18 countries are analyzed by the application of panel-vector error correction models. Main outcome measures are the association between the socioeconomic factors and suicide rates. **Results:** Decreasing economic growth and increasing divorce rates are significantly associated with increasing suicide rates in men. For women, increasing economic growth, increasing unemployment, and increasing divorce rates are significantly associated with increasing suicides. Increasing female labor force participation is associated with decreasing suicides. **Conclusions:** Socioeconomic factors are associated with suicide rates. However, this relationship differs by sex. The current results provide a strong argument that suicide prevention strategies must include the monitoring of socioeconomic development.

Prevention of suicide is a major public health issue. Annually about 1,000,000 persons die as a result of suicide worldwide.[1] During the last few decades, a wide range of risk factors have been considered such as mental illness and psychiatric disorders, trauma from losses, substance abuse, and genetic disposition.[2–5] The effect of social economic factors on the incidence of suicide has been a subject of scientific focus because Durkheim proposed that poverty may have a protective impact on suicide rates.[6] Since then, extensive research on the association between socioeconomic variables and suicide incidence has been carried out. However, findings about the possible relationship remain very controversial and are subject to methodological criticism.[7–11]

There are several studies, which investigate the association between suicide rates and gross domestic product (GDP), which is the most important variable for characterizing the economic development of a country. Gross domestic product measures the amount of goods and services produced by a country's economy within a certain time span, usually 1 year, in monetary terms. On the basis of Latvian data from 1980 to 1998 data, rising suicide rates in Latvia were paralleled by declining GDP and increasing unemployment until 1993.[12] This association disappeared between 1993 and 1998. A German study (1981 to 1989) found that increasing suicide rates correlated with increasing unemployment and decreasing real income.[13] A Finnish study also found a negative association between GDP and suicide from 1985 to 1995.[14] Analysis of Australian data for the period between 1968 and 2002 confirmed the hypothesis that several macroeconomic variables such as GDP and unemployment were significantly associated with suicide incidence.[15] However, the patterns and direction of the relationships remained ambiguous, especially regarding sex and age.

An analysis among 35 countries showed no association between GDP per capita and suicides.[16] A panel data analysis including 15 European countries suggested a significant association between economic growth and suicide rates in both sexes.[17] Gross domestic product per capita had no significant impact on suicide. In a study on the United States and Taiwan for the period 1952 and 1984, a significant association between unemployment, GDP per capita and suicide rates was found for the United States only.[18]

The earlier-mentioned studies are afflicted by serious methodological limitations. Most of them are based on a very small sample size and cover only one specific country, which makes generalizability difficult. Furthermore, the statistical approaches are deficient. Most investigations of time series rely on a regression analysis of suicide incidence or of the corresponding growth rates/first differences (ie. $\log x_t - \log x_{t-1}$ or $x_t - x_{t-1}$).[12–17] The former methodology would only be justified if the data were stationary or cointegrated, whereas the latter approach is sound if levels are nonstationary and growth rates are stationary when there is no cointegration relationship. Nonstationary time series (more precisely: time series with stationary first differences) are cointegrated if some linear combination of these time series is stationary. Parameter estimates could be biased if the model assumptions are violated. Hence, in the case of nonstationary data, tests based on cointegration are unavoidable.

In addition to these econometric shortcomings, there are some other problems. Sometimes it is even unclear whether real or nominal GDP has been used. To account for actual purchasing power and to adjust for different levels of inflation—if several countries are studied—real GDP per capita should be used.[12,15]

Most of the existing studies on the impact of the economy on suicide focused on unemployment. Swedish and Finnish case control studies in particular consistently reported increased suicide risks from unemployment.[19–23] Two epidemiological studies using data from large samples of countries also showed a positive association between unemployment and suicide rates.[16,24] However, another recent investigation among the Swedish population indicated—by applying a longitudinal study design—that the increased risk of suicide among unemployed people is not directly caused by unemployment itself.[25] The elevated suicide risk seems to be mainly because of an a priori higher likelihood to become unemployed for people with an increased suicide risk (eg, mental illness).[26] The previously mentioned studies by Andres[17] revealed no significant association between unemployment and suicide rates.

There are several studies on the association between divorce and suicide incidence. A study in Taiwan found an increased suicide risk for divorced people.[27] The same result was reported for Italy, England, Wales, Northern Ireland, and the United States.[28–31] An earlier study in Japan, however, showed no effect of divorce on suicide rates.[32]

However, all of these studies covered only specific countries or short time periods, which complicates generalizability. In the

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current article, we overcome these methodological problems. Our analysis is based on a large sample of 18 countries (17 European industrialized countries and the United States) for the period between 1983 and 2007. We investigate the impact of economic growth—measured by real GDP per capita—together with the unemployment rate, labor force participation and divorce rates on suicide rates by estimating panel-vector error correction models.[33–35] We focus on a homogenous sample of industrialized European countries, which are at least approximately comparable with regard to their political and economic backgrounds. Hence, European countries of the former Eastern bloc with communist backgrounds (and therefore a very different economic and political background) are excluded. An exception is made for the population of the former German Democratic Republic, which we included in our analysis after German reunification. Additionally, we decided to include the United States, because it is the most important national economy in the world.

METHODS

Study Population

In our analysis of time series, we used suicides per million inhabitants, real GDP per capita and the unemployment rate measured as the number of unemployed people as a percentage of the workforce.

Data from the following 18 countries were included: Austria, Belgium, Denmark, France, Finland, Germany (including the population of the former German Democratic Republic after 1989), Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Population data and divorce rates for the European countries were obtained from Eurostat.[36] Suicide data for the European countries except Sweden were obtained from World Health Organization International.[37] The Swedish suicide data was obtained from the Karolinska Institute.[38] The unemployment rates for the European countries except Austria and Switzerland were obtained from Eurostat.[36] The reported Austrian unemployment rate was obtained from Statistics Austria.[39] The Swiss unemployment rate was obtained from the OECD.[40] The labor force ratio and GDP per capita at constant prices (basis year 2000) for all countries were obtained from the OECD.[40] Population data, unemployment rates, suicide data and divorce rates for the United States were obtained from the US Census Bureau.[41] All data were obtained for the period between 1983 and 2007 except for Germany, where data were restricted to the period 1990 to 2007.

Statistical Analysis

Because we analyzed data from several countries, cross-sectional as well as time-series information could be used. To use cross-sectional and time series information within one model, more advanced statistical techniques were necessary. For this purpose, panel cointegration models were applied to allow for a joint treatment of time series and cross-sectional data, with the advantage that the results were supported by many more data points.

Analysis of the time series of suicide incidence, GDP per capita, unemployment rates, labor force ratio, and divorce rates showed that these time series are not stationary, whereas first differences are stationary; that is, these variables are integrated of order one. Therefore, a regression of suicide incidence levels could result in biased estimates.[42] A regression on levels of integrated data makes sense if a linear combination is stationary. Such an association is called a cointegration relationship. Often a cointegration relationship is called a long-run relationship. When performing Pedroni-type tests on panel cointegration, a cointegration relationship was detected.[33,43] We estimated the cointegration equation (SUIC . . . suicide incidence, GDP . . . gross domestic product per capita, UNEM. . .unemployment rate, LFR. . . labor force ratio, DIV. . .divorce rate):

$$\mathrm{SUIC}_{\mathrm{female}} = \beta_{\mathrm{gdp,female}}\,\mathrm{GDP} + \beta_{\mathrm{unem,female}}\,\mathrm{UNEM} + \beta_{\mathrm{lfr,female}}\,\mathrm{LFR} + \beta_{\mathrm{div,female}}\,\mathrm{DIV} + c_{\mathrm{i,female}} + \beta_{\mathrm{i,female}}\,(t-1)$$

$$\mathrm{SUIC}_{\mathrm{male}} = \beta_{\mathrm{gdp,male}}\,\mathrm{GDP} + \beta_{\mathrm{unem,male}}\,\mathrm{UNEM} + \beta_{\mathrm{div,male}}\,\mathrm{DIV} + c_{\mathrm{i,male}} + \beta_{\mathrm{i,male}}\,(t-1)$$

$$\mathrm{SUIC}_{\mathrm{aggr}} = \beta_{\mathrm{gdp,aggr}}\,\mathrm{GDP} + \beta_{\mathrm{unem,aggr}}\,\mathrm{UNEM} + \beta_{\mathrm{lfr,aggr}}\,\mathrm{LFR} + \beta_{\mathrm{div,aggr}}\,\mathrm{DIV} + c_{\mathrm{i,aggr}} + \beta_{\mathrm{i,aggr}}\,(t-1)$$

by means of dynamic ordinary least squares (DOLS), as suggested in Wagner and Hlouskova.[44] Note that $\beta_{\mathrm{gdp,female}}$, $\beta_{\mathrm{unem,female}}$, $\beta_{\mathrm{lfr,female}}$ and $\beta_{\mathrm{div,female}}$ do not depend on the country index i, which implies that we have assumed that GDP, unemployment, labor force ratio, and divorce rate affect female suicide incidence in the same way in every country. The constant $c_{\mathrm{i,female}}$ is country specific, as well as the time trend coefficient $\beta_{\mathrm{i,female}}$. The time trend was included to avoid spurious results. The same methodology was applied to the male population and to the aggregated population of both men and women. However, for the male population we excluded the labor force ratio, as these time series were almost flat for all countries except Luxembourg.

To cope with the short run effects, we ultimately constructed an error correction model. By assuming that suicide incidence does not affect the other variables in the model, such a model can be reduced to a (fixed effects) panel regression model:

$$\Delta\mathrm{SUIC}_{t,i,\mathrm{female}} = \gamma_0 + \gamma_{\mathrm{i}} + \gamma_1\mathrm{GAP}_{t,i,\mathrm{female}} + \gamma_2\Delta\mathrm{UNEM}_{t,i,} + \gamma_3\Delta\mathrm{GDP}_{t,i} + \gamma_4\Delta\mathrm{LFR}_{t,i} + \gamma_5\Delta\mathrm{DIV}_{t,i} + \gamma_6\Delta\mathrm{SUIC}_{t-1,i,\mathrm{female}} + \varepsilon_{t,i,\mathrm{female}}$$

Here, $\Delta x_{t,i} = x_{t,i} - x_{t-1,i}$ are the first differences. The coefficient γ_1 is called error correction term and measures the impact of the GAP (the deviation from the cointegration equation) on actual first difference of suicide incidences. Models like this were estimated for the woman, for the man, and the aggregated population. In all fixed effects regressions, White robust standard errors were used to calculate confidence intervals.

RESULTS

Long-Run Relationships

Pedroni tests clearly supported a model with one cointegration relationship each for the male and the female population. On the basis of the approach of Wagner and Hlouskova, we applied DOLS to estimate a model with common effects for GDP, the unemployment rate, the labor force ratio, the divorce rate, country specific constants, and country specific time trends.[44] This setting is preferred to a model with common (homogeneous) effects only or separate (heterogeneous) effects for all of these variables.

For the male population, our analysis showed that GDP is significantly associated with suicides (coefficient $= -5.68$, $P < 0.01$): In the long run, increasing GDP is associated with decreasing suicide rates. An increase in GDP per capita of EUR 1000 decreased male suicides by 5.68 per million over the long term. Rising divorce rates, on the contrary, resulted in significantly higher suicide rates (coefficient $= 8.02$, $P = 0.02$). Unemployment exhibited no significant association with male suicide rates (coefficient $= -0.88$, $P = 0.19$).

For the female population, a higher GDP, higher unemployment, a lower labor force ratio and a higher divorce rate were significantly ($P < 0.01$) associated with higher suicide rates. The parameter estimates were 3.22, 0.52, 93.00, and 12.49, respectively.

Analyzing male and female data together, there was no significant association between GDP and suicides (coefficient $= 0.48$, $P = 0.37$) or unemployment and suicides (coefficient $= 0.16$, $P = 0.44$). However, higher divorce rates (coefficient $= 19.07$, $P < 0.01$) resulted in increased suicide rates. On the contrary, an increased labor

force ratio (coefficient = −64.11, $P = 0.04$) was associated with decreased suicide rates. These results are summarized in Table 1.

Short-Run Relationships and Prediction

We estimated fixed effects panel regression models of the error correction type detailed in Statistical Methods for the man, the woman, and the total population. The variable GAP is the actual deviation from the cointegration equation; in the current case the cointegration equation can be considered as the long-run equilibrium relationship between suicides, unemployment, GDP, labor force ratio, and divorce rates. Table 2 presents the estimates for the parameters γ_0 to γ_6. P values based on White standard errors are presented in parenthesis. The last row of Table 2 presents the coefficient of determination R^2. We estimated the fixed effects model with and without the GAP variables (estimates with and without the coefficient γ_1), for the total, the male and the female population. In regression models without the variable GAP, significant coefficients for ΔLFR_t and ΔGDP_t are observed for the male population. Throughout the analysis a significance level of 5% is applied. However, comparing these results to models with GAP included, a higher proportion of variance is accounted for in models including GAP. In this case, the first differences of the labor force ratio were not associated with the change in suicide rates (see estimates γ_4 and P values in Table 2). Therefore, only a change in GDP was linked to a change in the suicides rates, $\Delta SUIC_{ti}$, as the coefficient γ_3 is significant. For female populations, no direct effects of the predictors could be observed (the estimates γ_2 to γ_5 are not significant in Table 2). However, for the forecasts we have to consider both the long-term effect as well as the impact of GAP. Because of the existence of a significant γ_1 for the GAP and a significant $\beta_{gdp,female}$, the impact of a change in GDP of one unit caused a change in suicides by $\gamma_1\ \beta_{gdp,female}$. Comparably, the indirect effects via the variable GAP were significant for unemployment, the labor force ratio and the divorce rates. We conclude that a direct association between suicides and GDP can be observed in male populations only. For female populations, GDP and the three other variables studied are indirectly associated with suicide rates.

On the basis of the cointegration and panel regression model, the impact of a change in GDP on suicide rates can be estimated: For the male population, an increase of GDP per capita of EUR 1000 changes the variable GDP in the cointegration equation by 1 (GDP per capita was measured in 1000 EUR). This has an impact of −5.68 on the variable GAP. The coefficient $\gamma_1 = 0.56$ estimates the actual impact of the variable GAP on the change in suicide rates $\Delta SUIC_{ti,male}$; this results in an indirect effect of $0.56^* -5.68 = -3.18$, a direct effect of $\gamma_3(\Delta GDP) = -0.01$, and a total effect of $-3.18 + (-0.01) = -3.19$. In other words, we conclude that an increase in GDP per capita of EUR 1000 decreases suicides per million inhabitants by 3.19 in the male population within the next year. For the female population, we estimate an indirect effect of $0.65 \times 3.22 = 2.09$; that is, an increase in GDP per capita of EUR 1000 increases female suicides by 2.09 within the next year.

DISCUSSION

Possibly because of methodological shortcomings, the existing studies about the association between economic variables and suicide rates have been inconsistent. Unlike previous investigations, our approach included a large sample of industrialized countries, which we analyzed by estimating panel-vector error correction models.

For the male population, we were able to demonstrate that decreasing economic growth was associated with increasing suicide rates. By contrast, unemployment was not associated with suicides. Furthermore, increasing divorce rates were linked to increasing suicides.

TABLE 1. Estimated Regression Coefficients and *P* Values of the Cointegration Equations

	Male Population		Female Population		Total Population	
	B	***P***	***β***	***P***	***β***	***P***
GDP	−5.6802	0.0011	3.2196	0.0000	0.4751	0.3722
Unemployment	−0.8841	0.1864	0.5244	0.0000	0.1617	0.4443
Labor force ratio			−92.9961	0.0000	−64.1121	0.0359
Divorce rate	8.0164	0.0236	12.4860	0.0000	19.0749	0.0000

TABLE 2. Parameter Estimates for the Fixed Effects Panel Regression Models*

	Dependent variable											
	$\Delta SUIC_{male}$				$\Delta SUIC_{female}$				$\Delta SUIC_{total}$			
Parameter	Without GAP		With GAP		Without GAP		With GAP		Without GAP		With GAP	
Model	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*
γ_0	0.6190	0.8315	−0.6522	0.7600	−5.7661	0.0061	8.3621	0.0027	−4.7308	0.0399	11.1092	0.0000
γ_1 (GAP)			0.5620	0.0000			0.6520	(0.0000)			0.5514	0.0000
γ_2 (ΔUNEM)	−3.0801	0.0707	−2.4251	0.0767	1.2149	0.2701	1.6667	0.0912	0.7820	0.4875	−0.2362	0.7954
γ_3 (ΔGDP)	−0.0101	0.0381	−0.0094	0.0153	0.0050	0.1605	0.0026	0.3620	0.0013	0.7110	0.0022	0.3196
γ_4 (ΔLFR_{t-1})	256.5578	0.0165	170.6859	0.2410	55.6706	0.4530	57.7360	0.4091	127.3069	0.2451	117.7811	0.1590
γ_5 (ΔDIV_{t-1})	0.4853	0.9059	−2.3834	0.5534	−0.3940	0.8556	−3.9310	0.0808	5.9142	0.2908	9.8051	0.0264
γ_6 ($\Delta SUIC_{t-1}$)	−0.3429	0.0065	−0.0713	0.5659	−0.4243	0.0001	−0.1011	0.3356	−0.3539	0.0000	−0.4230	0.0000
R^2	0.19		0.36		0.22		0.39		0.17		0.48	

*P values based on White robust standard errors. ΔSUIC, ΔUNEM, ΔGDP, ΔLFR, ΔDIV . . . first differences of suicide rates, unemployment rates, gross domestic product, labor force ratio and divorce rate, respectively. GAP. . .deviation from the cointegration equation. The country specific parameters γ_i (gamma$_i$) are not reported.

For the female population, we found that increasing GDP was associated with increasing suicides. Increasing unemployment and increasing divorce rates were linked with increasing suicides. Increasing labor force participation was associated with decreasing suicides in women.

There are two ways to explain how GDP exerts an influence on suicide rates in men. First, it should be mentioned that decreasing GDP on a macro level is always accompanied by decreasing average income per capita and average wealth status on an individual level. This may lead to a reduction of opportunities and chances in life, as well as to an elevation of the financial burden on an individual, all of which increase the likelihood of other stressful life events. Together with the fact that social status is closely linked to material prosperity, these factors may contribute to higher suicide rates. Men do suffer from economic difficulties because they tend to attribute a loss of wealth and social status to personal failure rather than to their socioeconomic environment. Moreover, economic success is strongly linked to the traditional masculine role. A lack of economic success may thus have an adverse effect on masculine identity, which may result in helplessness and depression. As a consequence, the risk of self-destructive behavior and suicide may increase.[45,46] Secondly, macroeconomic development may be associated with suicide rates by influencing the socioeconomic environment of the individual. In economic literature, a strong and positive relationship between health care spending and GDP has been established.[47,48] Since decreasing GDP leads to declining tax and health insurance revenues, expenditure on health care is likely to be cut during recessions. In turn, increasing health care spending facilitates the population's access to mental health care and improves the quality and efficiency of health care institutions.[48] Increasing suicide rates can thus also be the consequence of deteriorating health care conditions during economic downturns.[31]

That unemployment is not significantly associated with suicide rates for men is in conflict with a large body of evidence pointing to an elevated suicide risk among unemployed people.[19–23] And it raises the question as to why GDP affects suicides in men whereas unemployment does not. Indeed, there are some considerations, which might help us to obtain deeper insights into this crucial point. It has to be stressed that, from an economic point of view, increasing unemployment does not usually lead to a reduction of social support for unemployed people. This holds for highly developed countries such as those included in our sample.[49] Governments do in fact make great efforts to absorb rising unemployment rates by increasing public spending on labor market policies (eg, unemployment benefits, active labor market programmes). With regard to the political and economic stability of a country, reducing unemployment is a major target of politics in western democracies during economic downturns. Hence, unemployment per se and in particular short-term fluctuations in unemployment rates might not strongly affect individual aspirations in men.

Our results, which we obtained on a macro level, concur with a recent Swedish study, which applied a longitudinal design on an individual level. In this study, it was shown that the increased suicide risk often found among unemployed men is not necessarily caused by unemployment itself. People with a preexisting increased suicide risk (eg, mental illness) are more likely to become unemployed.[25,26] Taking these findings seriously, the combination with our results at the macro level suggests that unemployment is not an independent risk factor for men.

The fact that rising GDP is associated with rising suicide rates among women is very surprising (particularly given that among men, rising GDP was linked to falling suicide rates). We interpret this result as showing that men are the main beneficiaries of the growth of both personal income and social and health care expenditure, which accompanies increases in GDP. We may further speculate that increasing economic growth intensifies pressure on women to give up traditional sex roles, which in turn has an effect on female suicide rates. The finding that rising unemployment is associated with increasing suicide rates among women is interesting in that we were unable to find such a correlation among men. One explanation could be that labor market policy measures aimed at reducing unemployment, such as training courses or job application training, are primarily directed toward men. This focus on male unemployment is plausible in that the absolute proportion of women among the unemployed has always been considerably lower than that of men. Our findings that increasing labor force participation is associated with decreasing female suicides reveal the protective value for women of economic independence and having their own income. The fact that increasing divorce rates are linked with increasing suicides in men as well as in women can be interpreted as showing that stable social relationships provide protection against suicide.

The current investigation has some limitations. Because we analyzed aggregate data at the country level, inference to individual suicide risk is not straightforward. It must be emphasized that, as in all ecological study designs, individual risk factors, and contextual conditions cannot be separated.[50,51] Furthermore, we only studied developed countries. For transition economies, third world countries, or countries that have recently undergone drastic political and economic changes, no inferences can be made. Here, we would expect different interdependences of suicide rates and economic variables. In addition, the statistical setting applied in this article assumes the same coefficients in all states. It might be of interest whether suicides react differently to economic upturns and downturns. As a further limitation it has to be mentioned that age or age-based variables have not been included as an explanatory variable. Both issues have to be clarified in future research.

The strength of our study clearly lies in its econometric methodology: cross-sectional and time series information are used within one model by applying panel cointegration. The large and homogenous sample size of 18 countries and the long-time period from 1983 to 2007 are further advantages.

In summary, our study provides clear evidence that socioeconomic factors are associated with suicide rates. However, this relationship differs strongly by sex. As a consequence, we recommend that suicide risk assessment should include the monitoring of socioeconomic development.

REFERENCES

1. Goldsmith SK, Pellmar TC, Kleinman AM, Bunney WE. *Magnitude of the Problem.* Washington, DC: Institute of Medicine of The National Academic Press; 2002.
2. Cavanagh JT, Carson AJ, Sharpe M, Lawrie SM. Psychological autopsy studies of suicide: a systematic review. *Psychol Med.* 2003;33:395–405.
3. Brezo J, Klempan T, Turecki G. The genetics of suicide: a critical review of molecular studies. *Psychiatr Clin North Am*. 2008;31:179–203.
4. Di Tella R, MacCulloch RJ, Oswald AJ. The macroeconomics of happiness. *Rev Econ Statis*. 2003;85:809–827.
5. Boxer PA, Burnett C, Swanson N. Suicide and occupation: a review of the literature. *J Occup Environ Med*. 1995;37:442–452.
6. Durkheim E. *Suicide: A Study in Sociology*. New York, NY: The Free Press; 1951
7. Cubbin C, LeClere FB, Smith GS. Socioeconomic status and the occurrence of fatal a nonfatal injury in the United States. *Am J Public Health.* 2000;90:70–77.
8. Gunnell DJ, Peters TJ, Kammerlin RM, Brooks J. Relation between parasuicide, suicide, psychiatric admissions and socioeconomic deprivation. *Brit Med J*. 1995;311:226–230.
9. Melinder KA, Andersson R. The impact of structural factors on injury rate in different European countries. *Eur J Public Health.* 2001;11:301–308.
10. Lucey S, Corcoran P, Keeley HS, Brophy J, Arensman E, Perry IJ. Socioeconomic change and suicide: a time-series study from the Republic of Ireland. *Crisis*. 2005;26:90–94.
11. Rehkopf DH, Buka SL. The association between suicide and the socioeconomic characteristics of geographical areas: a systematic review. *Psychol Med*. 2006;36:145–157.

12. Rancans E, Salander Renberg E, Jacobsson L. Major demographic, social and economic factors associated to suicide rates in Latvia 1980–1998. *Acta Psychiatr Scand*. 2001;103:275–281.
13. Weyerer S, Wiedenmann A. Economic factors and the rates of suicide in Germany between 1881 and 1989. *Psychol Rep.* 1995;76:1331–1341.
14. Hintikka J, Saarinen PI, Viinamaki H. Suicide mortality in Finland during an economic cycle, 1985–1995. *Scand J Public Health.* 1999;27:85–88.
15. Berk M, Seetal D, Henry M. The effect of macroeconomic variables on suicide. *Psychol Med.* 2006;36:181–189.
16. Milner A, McClure R, De Leo D. Socio-economic determinants of suicide: an ecological analysis of 35 countries [published online ahead of print November 17, 2010]. *Soc Psychiatry Psychiatr Epidemiol*. doi: 10.1007/s00127-010-0316-x.
17. Andres AR. Income inequalitiy, unemployment and suicide: a panel data analysis of 15 European countries. *Appl Econ*. 2005;37:439–451.
18. Yang B, Lester D, Yang CH. Sociological and economic theories of suicide: a comparison of the U.S.A. and Taiwan. *Soc Sci Med*. 1992;34:333–334.
19. Voss M, Nylen L, Floderus B, Diderichsen F, Terry PD. Unemployment and early cause- specific mortality: a study based on the Swedish twin registry. *Am J Public Health*. 2004;94:2155–2161.
20. Johansson SE, Sundquist J. Unemployment is an important risk factor for suicide in contemporary Sweden: an 11-year follow-up study of a cross-sectional sample of 37,789 people. *Public Health*. 1997;111:41–45.
21. Eliason M, Storrie D. Does job loss shorten life? *J Hum Res*. 2009;44:277–302.
22. Ahs AM, Westerling R. Mortality in relation to employment status during different levels of unemployment. *Scand J Public Health*. 2006;34:159–167.
23. Martikainen PT. Unemployment and mortality among Finnish men, 1981–1985. *BMJ.* 1990;301:407–411.
24. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. *Lancet*. 2009;37:315–323.
25. Lundin A, Lundberg I, Hallsten L, Ottosson J, Hemmingsson T. Unemployment and mortality—a longitudinal prospective study on selection and causation in 49,321 Swedish middle aged men. *J Epidemiol Community Health*. 2010;64:22–28.
26. Lundin A, Hemmingsson T. Unemployment and suicide. *Lancet.* 2009;374:270–271.
27. Yeh JY, Xirasagar S, Liu TC, Li CY, Lin HC. Does marital status predict the odds of suicidal death in Taiwan? A seven-year population-based study. *Suicide Life Threat Behav*. 2008;38:302–310.
28. Masocco M, Pompili M, Vichi M, Vanacore N, Lester D, Tatarelli R. Suicide and marital status in Italy. *Psychiatr Q*. 2008;79:275–285.
29. Griffiths C, Ladva G, Brock A, Baker A. Trends in suicide by marital status in England and Wales, 1982–2005. *Health Stat Q*. 2008;37:8–14.
30. Corcoran P, Nagar A. Suicide and marital status in Northern Ireland. *Soc Psychiatry Psychiatr Epidemiol*. 2010;45:795–800.
31. Minoiu C, Andrés AR. The effect of public spending on suicide: evidence from U.S. state data. *J Socio-Econ*. 2008;37:237–261.
32. Stack S. The effect of divorce on Suicide in Japan: a time series analysis, 1950–1980. *J Marriage Fam*. 1992;54:327–334.
33. Pedroni P. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*.
34. Groen JJJ, Kleibergen F. Likelihood-based cointegration analysis in panels of vector error-correction models. *J Bus Econ Stat*. 2003;21:295–318.
35. Nelson MC, Sul D. Dynamic seemingly unrelated cointegrating regressions. *Rev Econ Stud*. 2005;72:797–820.
36. Eurostat. http://ec.europa.eu/eurostat. Accessed September 10 2010.
37. World Health Organization. http://www.euro.who.int. Accessed September 10 2010.
38. Karolinska Institute. http://ki.se. Accessed September 10 2010.
39. Statistic Austria. http://statistik.at. Accessed September 10 2010.
40. OECD. http.//webnet.oecd.org. Accessed September 10 2010.
41. US Census Bureau. http://www.census.gov. Accessed September 10 2010.
42. Hamilton JD. *Time*. Series Analysis. Princeton, NJ: Princeton University Press; 1994
43. Pedroni P. Panel cointegration. asymptotic and finite sample properties of pooled time series tests with an application to the PPP. *Hypothesis Econom Theor.* 2004;20:597–625.
44. Wagner M, Hlouskova J. The performance of panel cointegration methods—results from a large scale simulation study. *Econometr Rev.* 2010;29:182–223.
45. Murphy GE. Why women are less likely than men to commit suicide. *Comp Psychiat*. 1998;39:165–175.
46. Möller-Leimkühler AM. The gender gap in suicide an premature death or: why are men so vulnerable? *Eur Arch Psychiatry Clin Neurosci.* 2003;253:1–8.
47. Pritchett L, Summers LH. Wealthier is healthier. *J Hum Res*. 1996;31:841–868.
48. Roberts J. Sensitivity of elasticity estimates for OECD health care spending: analysis of a dynamic heterogeneous data field. *Health Econ.* 1999;8:459–472.
49. Martin JP. What works among active labour market policies: evidence from OECD countries' experiences. OECD Economic Studies 2000. http://www.oecd.org/ dataoecd/31/35/2732343.pdf. Accessed September 20, 2010.
50. Morgenstern H. Ecologic studies in epidemiology: concepts, principles and methods. *Annu Rev Publ Health.* 1995;16:61–81.
51. Greenland S. Ecologic versus individual-level sources of bias in ecologic estimates of contextual health effects. *Int J Epidemiol.* 2001;30:1343–1350.

