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A note on the effect of unemployment on mortality

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Abstract

In this note we test if unemployment has an effect on mortality using a large individual level data set of nearly 30,000 individuals in Sweden aged 20–64 years followed-up for 10–17 years. We follow individuals over time that are initially in the same health state, but differ with respect to whether they are employed or unemployed (controlling also for a number of individual characteristics that may affect the depreciation of health over time). Unemployment significantly increases the risk of being dead at the end of follow-up by nearly 50% (from 5.36 to 7.83%). In an analysis of cause-specific mortality, we find that unemployment significantly increases the risk of suicides and the risk of dying from "other diseases" (all diseases except cancer and cardiovascular), but has no significant effect on cancer mortality, cardiovascular mortality or deaths due to "other external causes" (motor vehicle accidents, accidents and homicides).

JEL classification: I12; J60

Keywords: Unemployment; Mortality; Health

1. Introduction

High unemployment is a central concern in many economies and it is important to assess how individuals are affected by unemployment. Unemployment typically involves an income loss for the individual, and several studies also suggest that it leads to a reduction in happiness and general well-being (Clark and Oswald, 1994; Winkelmann and Winkelmann, 1998; Theodossiou, 1998). It has furthermore been argued that unemployment may be a health hazard, and many studies in the public health field have shown that unemployed

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persons have poorer health than employed persons (for an overview of these studies, see Jin et al., 1995; Dooley et al., 1996; Björklund and Eriksson, 1998; Mathers and Schofield, 1998).

The observed association between unemployment and health does, however, not necessarily mean that unemployment causes poor health (Björklund, 1985; Martikainen and Valkonen, 1996, 1998; Smith, 1999). The causality may go in the other direction, i.e. that poor health leads to unemployment. To control for this reversed causality problem is the major empirical problem of estimating the effect of unemployment on health (Stewart, 2001).[1]

In this note, we test the effect of unemployment on mortality using a large individual level data set of nearly 30,000 individuals aged 20–64 years that were interviewed as part of a public survey in Sweden 1980–1986. At the time of the interview, data on employment status, health status and individual characteristics were collected, and the mortality of the individuals was followed until the end of 1996. We test if the unemployment status at the time of the interview is related to the mortality during follow-up. To control for the reversed causality problem between unemployment and health, we control for the initial health status at the time of the interview. This essentially means that we follow individuals over time that are initially in the same health state, but differ with respect to whether they are employed or unemployed. We also control for a number of personal characteristics that may affect the depreciation of health over time (i.e. income, age, gender, immigration, education, marital status, and the number of children).

We find that unemployment significantly increases the risk of being dead at the end of follow-up by nearly 50% (from 5.36 to 7.83%). In an examination of cause-specific mortality, we find that unemployment increases the risk of suicides and the risk of dying from "other diseases" (all diseases except cancer and cardiovascular), but has no significant effect on cancer mortality, cardiovascular mortality or deaths due to "other external causes" (motor vehicle accidents, accidents and homicides).

2. Data and variables

The purpose of this study is to estimate the effect of unemployment on the mortality risk. We therefore estimate the mortality risk as a function of unemployment, controlling for the initial health status and a number of exogenous personal characteristics that may be related to the mortality risk. In principle, unemployment could affect mortality both directly and indirectly through the reduction in income due to unemployment. Here we are interested in measuring the direct effect of unemployment, to test if unemployment has an effect on mortality that is independent of income. We therefore control for income in the analysis.

The analysis is based on data from Statistic Sweden's Survey of Living Conditions (the ULF survey) (Statistics Sweden, 1997), which have been linked to mortality data from

[1] The relationship between unemployment and mortality has also been studied using aggregate data, with conflicting results (Joyce and Mocan, 1993; Junankar, 1991; Ruhm, 2000). Using aggregate data, however, introduces some additional econometric problems and also makes it hard to distinguish between the effect of individual unemployment and the effect of cyclical variations in the economy.

the National Causes of Death Statistics and to income data from the National Income Tax Statistics. Since 1975, Statistics Sweden conducts systematic surveys of living conditions every year, in the form of 1-h personal interviews with randomly selected adults aged 16–84 years. In this paper, we use pooled data from the annual interviews conducted in 1980–1986 for all the subjects aged 20–64 years at the time of the interview. Subjects older than 65 years of age are excluded, since that is the retirement age in Sweden. Subjects not in the labour force at the time of the interview are also excluded (14.7% of the subjects aged 20–64 years), so that our sample consists of subjects that were either working or unemployed at the time of the interview.

The total sample in the age group 20–64 years consists of 33,495 individuals and after excluding individuals not in the labour force and correcting for missing values, the sample is reduced to 27,994 individuals. The mortality experience of the sample was recorded until 31 December 1996. In Table 1 the variables in the regression analysis are defined and summary statistics are given.

2.1. Dependent variable

The dependent variable in the regression analysis is the survival status at the end of follow-up (31 December 1996), coded as 1 if dead at the end of follow-up and 0 if alive at the end of follow-up. At the end of follow-up, 5.4% of the subjects had died, and the follow-up time ranged between 10 and 17 years.[2]

2.2. Independent variables

2.2.1. Unemployment

As part of the Survey of Living Conditions data about employment status was collected based on the employment status of the subjects in the week prior to the interview. Subjects were divided into employed, unemployed and not in the labour force. Subjects not in the labour force were excluded from this study and for the remaining subjects a dummy variable for unemployment at the time of the interview is included in the analysis. The fraction of unemployed is 3.1% of the labour force in our sample, which is close to the average official unemployment rate in Sweden 1980–1986 of 2.8% (Statistics Sweden, 1998).

2.2.2. Initial health status

Four variables are included to control for the initial health status. A categorical measure of the overall health status is included. In the categorical health rating question the individuals rated their own current health status on a three-point scale (poor health, fair health, good health). This type of categorical health measure has been shown to capture important information about the individual's health and to be an important predictor of mortality

[2] If individuals are lost to follow-up, this could lead to attrition bias. Our mortality data is collected from The National Causes of Death Statistics that registers all deaths of individuals registered as living in Sweden. Thus the only possibility for an individual in our study to be lost to follow-up would be if he/she has permanently emigrated during our observation period (and these individuals would only be a cause of bias if they have died during our observation period). Due to the low rate of emigration from Sweden (about 0.3% annually during our observation period) (Statistics Sweden, 1998) attrition bias is not a major concern in our study.

Table 1
Descriptive statistics of the variables used in the regression analysis

Variable	Mean	S.D.
Dependent variable		
Survival status (=1 if dead at the end of follow-up)	0.054	0.227
Independent variables		
Unemployed	0.030	0.170
No limitations in functional ability[a]		
Some limitations in functional ability	0.026	0.159
Severe limitations in functional ability	0.030	0.171
Self-assessed health status: good health[a]		
Self-assessed health status: fair health	0.135	0.341
Self-assessed health status: poor health	0.027	0.161
High blood pressure	0.043	0.202
Parents deceased	0.215	0.411
Annual income[b]	126809.8	67076
Male	0.534	0.499
Age	39.827	12.036
No children in the household[a]		
1 child in the household	0.200	0.400
2 children in the household	0.209	0.406
≥3 children in the household	0.069	0.254
Non-immigrant[a]		
First-generation immigrant[c]	0.088	0.284
Second-generation immigrant[d]	0.009	0.095
Single (not married or cohabiting)	0.268	0.443
Pre-secondary education[a]		
Short secondary education (≤2 years)	0.353	0.478
Secondary education (>2 years)	0.112	0.315
University education	0.221	0.415
Urbanisation[e]	482.7	979.2
Included in the study 1980[a]		
Included in the study 1981	0.150	0.357
Included in the study 1982	0.160	0.367
Included in the study 1983	0.146	0.354
Included in the study 1984	0.159	0.366
Included in the study 1985	0.141	0.349
Included in the study 1986	0.105	0.307

Number of observations = 27,994.

[a] Baseline category in the regression analysis.

[b] Annual income = annual disposable income + annuity of net wealth, and is estimated per adult person in the household in 1996 Swedish Crowns (SEK; exchange rate 1996 US$ 1 = SEK 6.71, purchasing power parity 1996 US$ 1 = SEK 9.83).

[c] Persons born abroad whose parents are current or previous foreign citizens.

[d] Persons born in Sweden whose parents are current or previous foreign citizens.

[e] Inhabitants per square kilometre in the municipality of the individual.

(Kaplan and Camacho, 1983; Wannamethe and Shaper, 1991). We expect the mortality risk to decrease with increasing self-assessed health status.

A variable is included for functional abilities. In the Survey of Living Conditions, the respondents were asked two questions about functional ability. In the first question the respondents were asked if they could run a short distance (e.g. 100 m) if they were in a hurry, and in the second question the respondents were asked if they could climb stairs without difficulty (this question was only asked of individuals who were unable to run a short distance). These two questions divide the respondents into three classes of functional ability: (1) persons who are able to run a short distance and climb stairs without difficulty (no limitations in functional ability); (2) persons who are unable to run a short distance but are able to climb stairs without difficulty (some limitations in functional ability); (3) persons who are unable to run a short distance and are unable to climb stairs without difficulty (severe limitations in functional ability). We expect the mortality risk to increase with decreasing functional ability.

A dummy variable is included for persons diagnosed with hypertension (high blood pressure). High blood pressure is one of the most important risk factors of cardiovascular disease, and we expect hypertension to increase the mortality risk (MacMahon et al., 1990).

Finally, a dummy variable is included for if none of the parents were alive at the time of the interview. Subjects with deceased parents may have a greater genetic predisposition for future diseases, and we therefore expect the mortality to be higher for these subjects (Chapman and Hariharan, 1994).

2.2.3. Personal characteristics

We include the following socio-economic variables: annual income, age (at the inclusion in the study), gender, immigration, education, marital status, and the number of children.

Our income measure consist of two components that are added together to form a measure of permanent income: annual disposable income and the annuity of net wealth. From the National Income Tax Statistics, we have data about the disposable income of the household (the income of the individual included in the study plus the income of the spouse/cohabitant) in the interview year.[3] From the National Income Tax Statistics, we also have data about the taxable net wealth (total taxable assets minus total liabilities) of the household during the interview year.[4] The taxable net wealth is converted to net wealth at market value through an approximation (see Gerdtham and Johannesson, 2002), and the annuity of net wealth is based on the life-expectancy for men and women of different ages in Sweden and a 3% interest rate (Statistics Sweden, 1998). Income is converted to 1996 prices using the consumer price index and for persons who are married or cohabiting the income of the household is divided by two to get the income per adult person in the household. Thus we assume that the household income is evenly divided between the spouses. The mortality risk is expected to decrease with higher income.[5] The mortality risk is expected to increase with age and to be higher for men than women (Statistics Sweden, 1998). Since the life-expectancy in Sweden is one of the highest in the world immigrants are expected to have a higher mortality risk

[3] Disposable income consists of income from capital, income from employment and business and all income transfers (e.g. pension payments, unemployment benefits, paid sick-leave, housing assistance, etc.) net of taxes. Income from capital consists of interest rates, dividends and capital gains.

[4] Taxable net wealth includes property owned by the individual (including own homes and apartments), financial assets (e.g. bank savings, stocks, bonds, debts), business inventories, jewellery, and exterior inventories (e.g. cars, boats, etc.).

[5] This pattern was also observed in a study by Gerdtham and Johannesson (2002) using the same data set as in the present study, although also including subjects older than 65 years and subjects not in the labour force.

(Statistics Sweden, 1998). We expect the mortality risk to be higher for persons who are single compared to persons who are married or cohabitant. Grossman (1972) has argued that education increases the productivity of producing health, and we thus expect the mortality risk to decrease with education. Education may also control for differences in the rate of time preference between unemployed and employed persons (Fuchs, 1982). It is important to control for the number of children since they reduce the consumption level of the adult persons in the household. The number of children may also have other effects on mortality, through for instance increasing the incentives to stay healthy.

2.2.4. Additional independent variables

We include two variables to control for the geograhipcal location of the respondent. Firstly, we include dummy variables for the county of the individual (Sweden was divided into 24 counties at the time of the study). Secondly, we include a variable for urbanisation, defined as the number of inhabitants per square kilometre in the municipality of the individual (Statistics Sweden, 1998).[6] We also include six dummy variables for the year of inclusion into the study, to control for any differences between the populations included in different years and to control for that the length of follow-up differs depending on the year of inclusion into the study.

3. Methods

To estimate the effect of unemployment and the other co-variates on the mortality risk we estimate a probit model (Greene, 2000). Following standard econometrics, a probit likelihood function of being dead is derived as follows:

$$L(\beta) = \prod_{i=1} F(\beta' x_i)^{D_i}[1 - F(\beta' x_i)]^{1-D_i}$$

$$\Pr(D_i = 1) = \beta(F' x_i), \qquad \Pr(D_i = 0) = 1 - \beta(F' x_i)$$

where D_i is a dummy variable taking the value 1 if individual i is dead at the end of follow-up and the value 0 if alive; $\beta' x_i$ is the predictor of the probability of being dead at the end of follow-up, $F(\beta' x_i)$, for an individual with the characteristic vector x_i. $F(\cdot)$ is the cumulative density function which is taken to be normal in the probit model. Estimations are undertaken by maximum likelihood methods, but the standard errors and "*t*-ratios" of coefficients are estimated using the robust ("sandwich") variance formula (Greene, 2000). This is desirable because of the possibility of a mis-specification of the unknown density.

By controlling for the initial health status, we hope to avoid the reversed causality problem between unemployment and health. It is, however, possible that there will still be a selection problem. This could be the case if there is some component of health status that is not fully

[6] An alternative to including these two geographical variables would have been to include dummy variables for the municipality of the individual (the number of municipalities was 284 during the time of this study). For several of the municipalities there is, however, no variation in the mortality between individuals (i.e. no individual from these municipalities died during the follow-up), making it difficult to estimate these coefficients in the probit model. This is a problem especially in the analyses on specific causes of death.

controlled for. There could also be a selection problem related to unobserved life-style variables that affect the rate of depreciation of health over time. To test for this we also estimate a bi-variate probit model which consists of two simultaneous binary-response equations, one for the selection of being unemployed and another for being dead at the end of the follow-up (Greene, 2000). In the selection equation of the bi-variate probit model, we include all the variables in the mortality equation, plus dummy variables for the occupational group of the subjects.[7] The geographical variable also differs between the mortality and the selection equation. In the selection equation, we include local labour markets instead of the county and urbanisation variables in the mortality equation.[8]

All variables except age, income and urbanisation are entered as dummy variables. For the continuous variables we include the variable and the square of the variable to allow for a flexible functional form. The squared terms are only included in the final model if they are significant. All tests of statistical significance are carried out at the 5% level.

4. Results

4.1. Total mortality

The estimated probit model for all-cause mortality is shown in Table 2. The unemployment variable is highly significant with a positive sign implying that unemployment increases the mortality risk. To estimate by how much the unemployment affects mortality, we estimate the probability of being dead at the end of follow-up with and without unemployment for all individuals in our sample.[9] Unemployment increases the risk of being dead from 5.36 to 7.83%, i.e. an increased risk of 46%.

Most of the variables for initial health status are highly significant with the expected signs. The exception to this is the variable reflecting that both parents are deceased that goes in the expected direction, but is not quite significant ($P = 0.121$). The variable for income is highly significant and, as expected, the mortality risk decreases with higher income. The mortality risk is also significantly higher for men than for women and increases significantly with age.[10] Persons who are single have a significantly higher mortality risk than persons who are married/cohabiting. The mortality risk is significantly lower for persons with two children in the household compared to individuals without children, but none of the other dummy variables for number of children are significant. The urbanisation variable is not significant. The education variables are not significant and the variables for first- and second-generation immigrants are not significant either. All the dummy variables for year

[7] The population is divided into the following eight occupational groups: unqualified manual workers, qualified manual workers, lower non-manual workers, intermediate non-manual workers, higher non-manual workers, small business owners, large business owners, and farmers. To test the appropriateness of using occupational group only in the selection equation, we check if occupational group has an independent effect on mortality after controlling for our other co-variates, but it is not significant according to a likelihood ratio test ($P = 0.367$).

[8] Sweden has been divided into 100 local labour markets by Statistics Sweden.

[9] With this procedure we estimate the effect of unemployment at the mean risk level in our sample.

[10] We also test including a dummy variable for each age in the data, but this does not significantly improve the model according to a likelihood ratio test ($P = 0.353$).

Table 2
Estimation results[a]

Co-variate	Probit coefficients (*t*-value)	Bi-variate probit coefficients (*t*-value)
Constant	−3.104* (−23.99)	−3.163* (−24.53)
Unemployed	0.235* (3.06)	0.717* (2.45)
Some limitations in functional ability	0.214* (3.69)	0.204* (3.49)
Severe limitations in functional ability	0.259* (3.88)	0.262* (3.93)
Self-assessed health status: fair health	0.193* (5.25)	0.188* (5.08)
Self-assessed health status: poor health	0.445* (6.63)	0.431* (6.38)
High blood pressure	0.116* (2.33)	0.114* (2.30)
Parents	0.054 (1.55)	0.054 (1.55)
Annual income	−1.15E−06* (−3.30)	−9.77E−07* (−2.81)
Male	0.368* (12.31)	0.371* (12.43)
Age	0.042* (24.19)	0.042* (24.23)
1 child in the household	0.013* (0.34)	0.015 (0.39)
2 children in the household	−0.106* (−2.19)	−0.105* (−2.17)
≥3 children in the household	−0.052 (−0.73)	−0.052 (−0.74)
First-generation immigrant	−0.010 (−0.21)	−0.018 (−0.36)
Second-generation immigrant	−0.020 (−0.10)	−0.026 (−0.13)
Single	0.247* (7.12)	0.239* (6.87)
Short secondary education (≤2 years)	0.045 (1.34)	0.045 (1.35)
Secondary education (>2 years)	−0.084 (−1.65)	−0.081 (−1.61)
University education	−0.034 (−0.80)	−0.034 (−0.80)
Urbanisation	0.0000119 (0.58)	0.0000119 (0.58)
Included in the study 1981	−0.095* (−2.02)	−0.097* (−2.07)
Included in the study 1982	−0.154* (−3.27)	−0.160* (−3.39)
Included in the study 1983	−0.214* (−4.39)	−0.220* (−4.52)
Included in the study 1984	−0.387* (−7.60)	−0.389* (−7.65)
Included in the study 1985	−0.338* (−6.46)	−0.339* (−6.50)
Included in the study 1986	−0.410* (−6.77)	−0.413* (−6.83)
ρ selection on unobservable	–	−0.229 (−1.79)
Log-likelihood	−4780.314	−7909.008
Pseudo R^2	0.191	–

[a] All cause mortality (number of observations = 27,994). The regression equation also includes dummy variables for the county of residence of the individuals, but these coefficients are not shown in the table.

* Statistically significant at the 5% level (two-tailed test).

of inclusion into the study are significant reflecting an increased mortality risk with a longer follow-up.[11]

In the second equation in Table 2, the results of the bi-variate probit equation is reported (only the mortality equation is included in Table 2). The unemployment coefficient increases from 0.235 ($P = 0.002$) in the standard probit model to 0.717 ($P = 0.014$) in the bi-variate probit model, but the difference between the coefficients is not statistically significant ($P = 0.087$). According to the point estimate of the unemployment variable in the bi-variate probit model, unemployment increases the risk of being dead from 5.27 to 15.25%. According to

[11] Age squared, income squared and urbanisation squared are not significant and are therefore not included in the final model in Table 2.

the bi-variate probit model we cannot, however, reject the null hypothesis of no selection bias ρ in the ordinary probit model ($P = 0.074$).

A number of sensitivity analyses are also carried out to test the stability of the results. In principle a duration model could be used to estimate the effect of unemployment on mortality. We therefore estimate our model both with a semi-parametric Cox proportional hazard model and some common parametric alternatives to the Cox model, i.e. Weibull, exponential, log-logistic, log-normal, Gompertz and generalised Gamma models (Greene, 2000). The unemployment variable is statistically significant in all these models with unemployment increasing the mortality risk.

The base-line model did not include smoking as a variable since it may be endogenous to unemployment, i.e. unemployment may change the smoking habits. Including smoking in the model has little effect on the results; the unemployment coefficient is 0.194 ($P = 0.012$) with a dummy variable for daily smoking included.[12]

We also test the stability of the results by excluding each sub-sample from the estimations (the sample from each interview year). The unemployment coefficient is significant in all these estimations with the coefficient varying from 0.182 ($P = 0.032$) to 0.283 ($P = 0.000$).

Finally, we test if the unemployment coefficient differs between men and women and between different ages. This is done by including interaction variables between age and unemployment and gender and unemployment. The interaction between unemployment and gender is not significant (coefficient $= 0.115$; $P = 0.459$). The interaction between age and unemployment also fails to be significant (coefficient $= -0.007$; $P = 0.147$), but the effect suggests that the unemployment coefficient decreases with age.[13] Finally, we test if there is an interaction effect between initial health status and unemployment, by interacting the variables for initial health status with unemployment. These interaction terms are not significant individually or jointly.

4.2. *Cause-specific mortality*

We also analyse the effect of unemployment on specific causes of death. We divide mortality into five groups. First we make a distinction between deaths due to diseases and deaths due to external causes (motor vehicle accidents, accidents, homicides, and suicides). For diseases, we analyse cancer mortality and cardiovascular mortality separately. We expect the effect of unemployment to be greater on cardiovascular diseases than cancer, since the risk of cardiovascular disease is heavily related to lifestyle factors like diet, exercise, smoking, and stress that may be related to unemployment (Anderson et al., 1990; Grundy et al., 1987). As a residual group we also run one analysis for mortality from other diseases (i.e. mortality due to other causes than cancer and cardiovascular diseases). This is a very heterogeneous group that includes many diseases that may potentially be related to unem-

[12] The smoking variable as such is highly significant with a mortality increasing effect (coefficient $= 0.331$; $P = 0.000$).

[13] It should be noted that the relative effect of unemployment on the mortality risk in the probit model depends on the values of the other variables. In the baseline model unemployment increases the mortality risk by 100% for a 20-year-old and 38% for a 64-year-old at the mean of the other co-variates. With the (non-significant) interaction term between unemployment and age included, unemployment increases the mortality risk by 244% for a 20-year-old and 14% for a 64-year-old at the mean of the other co-variates.

Table 3
Effects of unemployment on cause-specific mortality

	Number of deaths (%)	Coefficient	t-value	P-value	Effect of unemployment	
					Absolute risk change[a]	Relative risk
All cause mortality	1521 (100)	0.235	3.06	0.002	2.467	1.460
Cause-specific mortality						
Cancer	595 (39.1)	−0.022	−0.18	0.856	−0.095	0.955
Cardiovascular	560 (36.8)	0.122	1.06	0.289	0.520	1.262
Other diseases	214 (14.1)	0.467	4.08	0.000	1.350	2.877
Suicides	67 (4.4)	0.317	2.03	0.043	0.329	2.447
Other external	85 (5.6)	−0.043	−0.02	0.832	−0.036	0.882

Number of observations = 27,994.
[a] Percentage units.

ployment, e.g. pneumonia and influenza, liver diseases, respiratory diseases and diseases of the gastrointestinal system.[14] Deaths due to external causes is divided into two groups: suicides and other external deaths (motor vehicle accidents, accidents and homicides). We include suicides as a separate group due to the special interest in this cause of death in the literature (Dooley et al., 1996; Mathers and Schofield, 1998). We expect unemployment to increase the risk of suicides in line with previous studies. For other external deaths the expected effect is less clear, since it is possible that unemployment may decrease the risk of job related accidents.

Our results for cause-specific mortality are shown in Table 3 based on the standard probit model.[15,16] The estimated effect of unemployment on cancer mortality is negative, but far from significant. For cardiovascular disease mortality the unemployment coefficient is as expected positive and the point estimate implies an increased risk of 26%, but the effect is not significant ($P = 0.289$). For mortality from other diseases (non-cancer and cardiovascular) unemployment leads to more than a doubling of the risk, and this effect is significant. Also for suicides the estimated effect of unemployment is significant, and the point estimate implies that unemployment increases the risk of suicides by 145%.[17] Unemployment has no significant effect on the risk of dying from other external causes. We cannot reject the null hypothesis of no selection bias for any of the five models in Table 3.

[14] We do not subdivide this group further since it leads to very few fatalities in each group and thus a lack of statistical power to detect any effects.

[15] The classification of diseases are based on the Ninth Revision of the International Classification of Diseases (ICD-9 categories). The following classifications are used in Table 3: cancer (140–239), cardiovascular (390–459), other diseases (all disease codes except cancer and cardiovascular), suicides (E950–E959), other external deaths (E800–E949, E960–E989).

[16] We have also estimated cause-specific mortality equations by use of a multinomial logit model, which provides similar results and does not change any of the reported conclusions.

[17] The effect of unemployment on suicides is consistent with the result of another study for Sweden (Johansson and Sundquist, 1997).

5. Discussion and conclusions

We have analysed the effect of unemployment on mortality using a large individual level data set. To avoid reversed causality we controlled for the initial health status. This essentially means that we followed individuals over time that were initially in the same health state, but differed with respect to whether they were employed or unemployed. We also controlled for a number of individual characteristics that may affect the depreciation of health over time (i.e. income, age, gender, immigration, education, marital status and the number of children). We found a highly significant effect of unemployment on mortality, with unemployment being a health hazard. Unemployment increased the risk of being dead at the end of follow-up by 46% (from 5.36 to 7.83%). The significant effect of unemployment was also stable in our sensitivity analysis, where we, for instance, tested for selection bias and used alternative hazard functions. Since we controlled for income in the analyses our results suggests that unemployment per se causes an increased mortality risk, i.e. an effect over and above the effect that can be expected from the reduction in income due to unemployment. To test the importance of controlling for income we re-estimated our results without controlling for income. This increased the unemployment coefficient somewhat from 0.235 to 0.260. From a policy perspective it is interesting to note that although Sweden is typically characterized as a "welfare state" with for instance generous unemployment benefits, this does not seem to prevent unemployment from being a health hazard.

A problem in studies that assess the impact of unemployment on mortality is that omitted variables may be correlated with both health and unemployment. We tried to control for this problem by controlling for initial health status. However, because our measures of initial health status may not be comprehensive enough there could still be a selection problem. We tested for this by estimating a bivariate probit model. According to the bivariate probit model we could not reject the null hypothesis of no selection bias ρ in the ordinary probit model. Surprisingly, the unemployment coefficient increased rather than decreased in the bivariate probit model, but the increase was not statistically significant.

The estimate of the relative risk increase of unemployment in our study (46%) is similar to the estimates by Iversen et al. (1987) and Moser et al. (1984, 1986, 1987), who used similar date sets but did not control for initial health status. We therefore tested the importance of controlling for initial health status, by excluding these variables from our model. This led to a relatively modest increase in the unemployment coefficient from 0.235 to 0.271.

We also analysed our results for different causes of death. Consistent with other studies we found that unemployment significantly increased the risk of suicides (Dooley et al., 1996; Johansson and Sundquist, 1997; Mathers and Schofield, 1998). Unemployment also significantly increased the risk of mortality from other diseases (non-cancer and cardiovascular), whereas the effect on cancer mortality, cardiovascular mortality and deaths from other external causes was non-significant. To get more precise estimates for specific causes of death a larger sample size is needed.

Our measure of unemployment is based on the unemployment status at a single point in time at the start of our follow-up period. Some of the persons that are initially unemployed will thus become unemployed during follow-up and some of the persons initially unemployed will find employment. This is likely to dilute the effect of the unemployment variable and ideally one would like to relate the total duration of unemployment during follow-up to the mortality risk. If being in a state of unemployment is a risk factor of mortality (like a high blood pressure or smoking), the mortality risk will increase with the duration of unemployment. Since we did not have data about the duration of unemployment during follow-up in our study this could not be investigated.

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Appendix A

The estimation results for the unemployment equation in the bi-variate probit model with 27,994 observations is shown in the following table.

Variables	Coefficients	S.D.	*t*-value	*P*-value
Male	−0.190	0.03419	−5.55	0.0000
Age	0.000	0.00198	0.04	0.9650
Square of age	−0.115	0.04293	−2.69	0.0070
Some limitations in functional ability	−0.134	0.10584	−1.26	0.2060
Severe limitations in functional ability	0.272	0.08315	3.27	0.0010
Self-assessed health status: fair health	0.168	0.04723	3.55	0.0000
Self-assessed health status: poor health	0.372	0.08570	4.34	0.0000
High blood pressure	0.041	0.08050	0.51	0.6110
1 child in the household	0.017	0.05056	0.34	0.7320
2 children in the household	0.086	0.05695	1.51	0.1300
≥3 children in the household	0.263	0.08083	3.25	0.0010
First-generation immigrant	0.218	0.05364	4.06	0.0000
Second-generation immigrant	0.029	0.15820	0.18	0.8550
Parents	0.002	0.05430	0.03	0.9780
Alone	0.229	0.04476	5.13	0.0000
Annual income	0.000	0.00000	−16.05	0.0000
Square of annual income	0.000	0.00000	16.16	0.0000
Short secondary education (≤2 years)	−0.049	0.04138	−1.19	0.2330
Secondary education (>2 years)	−0.163	0.06493	−2.52	0.0120
University education	−0.083	0.06562	−1.26	0.2090
Included in the study 1981	0.066	0.06855	0.97	0.3340
Included in the study 1982	0.189	0.06447	2.93	0.0030
Included in the study 1983	0.206	0.06494	3.17	0.0020
Included in the study 1984	0.127	0.06619	1.91	0.0560
Included in the study 1985	0.072	0.06897	1.05	0.2950

Appendix A (*Continued*)

Variables	Coefficients	S.D.	*t*-value	*P*-value
Included in the study 1986	0.116	0.07401	1.57	0.1170
Qualified manual workers	0.160	0.04466	3.59	0.0000
Lower non-manual workers	0.074	0.04858	1.53	0.1270
Intermediate non-manual workers	−0.086	0.06552	−1.31	0.1910
Higher non-manual workers	−0.096	0.09884	−0.97	0.3330
Small business owners	−1.782	0.30382	−5.87	0.0000
Large business owners	−6.271	0.15384	−40.76	0.0000
Farmers	−1.428	0.26618	−5.37	0.0000

Note: The unemployment equation also include vectors of local labour market dummy variables.

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