DEPARTMENT OF ECONOMICS, MANAGEMENT AND STATISTICS

UNIVERSITY OF MILAN – BICOCCA

DEMS WORKING PAPER SERIES

Addressing the unemployment-mortality conundrum: Non-linearity is the answer

Giorgio Bonamore, Fabrizio Carmignani, Emilio Colombo

No. 281 – October 2014

Dipartimento di Economia, Metodi Quantitativi e Strategie di Impresa
Università degli Studi di Milano - Bicocca
http://dems.unimib.it/

Addressing the unemployment-mortality conundrum:

Non-linearity is the answer

Giorgio Bonamore, Fabrizio Carmignani, Emilio Colombo

Abstract

The effect of unemployment on mortality is the object of a lively literature. However, this literature is characterized by sharply conflicting results. We revisit this issue and suggest that the relationship might be non-linear. We use regional (NUTS 2) data from 23 European countries to estimate a multivariate regression of mortality. The estimating equation allows for a quadratic relationship between unemployment and mortality. We control for various other determinants of mortality at regional and national level and we include region-specific and time-specific fixed effects. The model is also extended to account for the dynamic adjustment of mortality and possible lagged effects of unemployment. We find that the relationship between mortality and unemployment is U shaped. In the benchmark regression, when the unemployment rate is low, at 3%, an increase by one percentage point decreases average mortality by 0.7%. As unemployment increases, the effect decays: when the unemployment rate is 8% (sample average) a further increase by one percentage point decreases average mortality by 0.4%. The effect changes sign, turning from negative to positive, when unemployment is around 17%. When the unemployment rate is 25%, a further increase by one percentage point raises average mortality by 0.4%. Results hold for different causes of death and across different specifications of the estimating equation. We argue that the non-linearity arises because the level of unemployment affects the psychological and behavioural response of individuals to worsening economic conditions.

Keywords: unemployment; economic crisis; mortality; Europe.

Authors:

Giorgio Bonamore, DEMS, Universita' degli Studi di Milano-Bicocca, Milano (Italy)

Fabrizio Carmignani (corresponding author): Griffith Business School, Griffith University, Brisbane (Australia), f.carmignani@griffith.edu.au

Emilio Colombo, DEMS, Universita' degli Studi di Milano-Bicocca, Milano (Italy)

1. **Introduction**

What is the effect of unemployment on mortality? The interest in this question is twofold. At a more general level, exploring the linkages between economic activity and health is central to the analysis of human well-being and development. More specifically, the ongoing financial and economic turmoil requires policymakers to have a comprehensive understanding of the broad non-monetary consequences of raising unemployment rates. This is particularly true for several European countries, where the crisis has been more severe and the implementation of austerity programmes has strongly limited the ability of governments to spend on social welfare and to support the unemployed. It is therefore unsurprising to find a large and lively literature on this topic. The fundamental problem, however, is that the existing voluminous body of research seems to be unable to provide a consensual answer to the question. As discussed further below, some papers report that higher unemployment reduces mortality, others find the exact opposite, and a few more studies conclude that the relationship is not statistically significant.

A possible way to make sense of conflicting findings is to attribute them to differences in the methodologies used. Some evidence, in fact, does point out that empirical results are quite sensitive to changes in model specification and method of estimation (Neumayer, 2004, Tapia Granados and Ionides, 2011). This explanation, however, cannot be fully satisfactory since it implies that the answer to the question of how unemployment affects mortality is necessarily ambiguous. Our paper takes a different route: our hypothesis is that differences in reported findings are indicative of a possible non-linearity in the effect of unemployment. More precisely, we posit that the relationship between unemployment and mortality is U-shaped. This implies that the effect of an increase in unemployment can be positive, negative, or insignificant depending on the level of unemployment itself. This non-linearity would occur because of the way in which the level of unemployment affects individuals' perception of the possible duration of unemployment spells and therefore of the risk associated with being (or becoming) unemployed. Our hypothesis turns out to be supported by consistent and robust econometric results.

To illustrate our thinking in more detail, it is convenient to start from the two opposing views that have emerged in the literature on the health implications of unemployment. One view is that in time of economic hardship and rising unemployment, individuals tend to be more stressed, depressed, and likely to undertake unhealthy behaviours (e.g. heavy drinking, smoking, and poor diets). Furthermore, tighter household budget constraints might imply cuts in health related expenditures such as preventive screening or routine medical check-ups. The quality of the public health system and its coverage might also decline because of the adverse effect that economic downturns have on the spending capacity of the government. The consequence is then a positive association between unemployment and mortality, especially for causes of deaths with high stress-related attributable fraction like cardiovascular diseases, mental and behavioural disorders, suicide, and other illnesses related to alcohol and tobacco consumption. The evidence in support of this view is voluminous (Backhans and Hemmingsson, 2011, Lundin, Falkstedt, Lundberg and Hemmingsson 2014, Garcy, and Vagero, 2012, Browning and Heinesen, 2012, Montgomery, Udumyan, Magnuson, Osika, Sundin, and Blane 2013, Davalos, Fang and French, 2012, Deb, Gallo, Ayyagari, Fletcher and Sindelar, 2011, Strully, 2009). The counter view emphasizes how individual's health can deteriorate in time of economic expansion because of job-related stress (and associated risk of cardiovascular diseases and unhealthy behaviours), fatigue and physical exertion of employment, and accidents due to increased traffic. Moreover the increase in the opportunity cost of leisure reduces the time available for health preserving activities such as sport and general exercise. Since economic expansions are typically characterized by declining unemployment, the prediction in this case is that lower unemployment is associated with higher mortality or, equivalently, that the relationship between unemployment and mortality is negative. Starting with the seminal work of Ruhm (2000) this prediction has also received some considerable empirical support (Tapia Granados, 2005, Rhum, 2005, Neumayer, 2004, Tapia Granados and Ionides, 2011). Somewhere in between these two views lies a group of papers that substantially find no evidence of a robust and systematic effect of unemployment on mortality (Gerdtham and Johannesson, 2005, Svensson, 2007, 2010, Stuckler, Basu, Suhrcke, Coutts and McKee, 2009).

For a given level of per-capita income and government expenditure on health and social welfare, the fundamental difference between the two views rests with individuals' psychological and behavioural response to economic downturns and worsening labour market conditions. If this response is "negative", meaning that individuals suffer from increased stress and develop unhealthy behaviours, then the mortality risk increases and the aggregate relationship between unemployment and mortality rate is upward sloping. Conversely, if the response is "positive", meaning that individuals benefit from reduced job-related stress and fatigue and use the extra leisure time to undertake health-producing activities, then unemployment reduces mortality risks and the aggregate relationship between unemployment and mortality rate is downward sloping. Both responses can co-exist in the same sample and the observed sign of the empirical relationship depends on which of the two responses dominates. Our hypothesis is that the negative response is likely to dominate at higher levels of unemployment, while the positive response dominates at lower levels of unemployment. This is because in a situation of high unemployment, slimmer chances to find a new job and a longer expected duration of the unemployment spell make it more difficult for individuals to cope with the unemployment status (if already unemployed) or with the risk of becoming unemployed (if currently employed). The implication is higher levels of anxiety and stress among both the employed and the unemployed. There is indeed some evidence that the duration of unemployment rather than the job loss itself is an important health risk factor (Classen and Dunn, 2012). On the other hand, when unemployment is low, re-employment prospects are less negative and the expected duration of unemployment is shorter. These circumstances alleviate the strain of being or becoming unemployed and hence encourage individuals to invest time in healthier activities. If our hypothesis is correct, then at aggregate level we should observe a U shaped relationship: when the initial level of unemployment is low, then an increase in unemployment will reduce mortality; but when the level of unemployment is sufficiently high, then a further increase in unemployment will increase mortality. To the best of our knowledge, no previous paper has considered this potential non-linearity in estimating the relationship between unemployment and mortality at macro level.

2. Method

2.1. Data collection

In our analysis we use a panel of annual observations for 265 territorial units within 23 European countries over the period 2000-2012. Data are sourced from Eurostat, which defines territorial units as "basic regions for the application of regional policies". We focus on European countries because in Europe more than elsewhere the economic crisis of these last few years has resulted in a sharp increase in unemployment rates. At the same time, excessive debt in many countries has led to the implementation of fiscal austerity programmes that have resulted in significant public budget cuts, thus triggering a sharp change in social welfare models. In this context, the question of how unemployment relates to mortality appears to be particularly important. The use of regional data serves three purposes. First, with regional data, we can exploit the significant variation in unemployment distribution within countries to increase the precision of our estimates. Second, given the low degree of labour mobility in Europe compared to the US, local labour market conditions are likely to be a relevant determinant of individual's health status. Third, by setting the unit of observation at the regional level, we obtain a much larger number of observations, and hence degrees of freedom, to be used for estimation. We use standard definitions for both the dependent variables and the regressors. Mortality is expressed in number of deaths per 100,000 population and separately computed for twelve causes of death. The unemployment rate is defined as the number of unemployed persons in percentage of the labour force .

2.2.Statistical model

Our empirical model is written as:

$$y_{it} = \alpha + \beta_1 x_{it} + \beta_2 x_{it}^2 + \sum_{j=1}^{n} \gamma_j z_{j,it} + \eta_t + \mu_i + \varepsilon_{it}$$

where *i* denotes a generic region, *t* is a generic year, *y* is mortality, *x* is the unemployment rate, z_j is a generic control variable, *n* is the total number of control variables in the model, η_t is a time fixed effect, μ_i is a region-specific fixed effect, ε is a purely stochastic disturbance, and α, β_1, β_2, $\gamma_1 \dots \gamma_n$ are all coefficients to be estimated. The key difference with respect to the equation estimated in previous studies is the inclusion of the square term on unemployment, x^2. This term accounts for the non-linearity discussed in the previous section: according to our hypothesis, β_1 should be negative and β_2 should be positive. The time and regions-specific fixed effects capture unobserved heterogeneity over time and across regions, respectively. In addition, we control for education level, per-capita GDP, population age and density, and health expenditure. All of these controls are observed at regional level, with the exception of health expenditure, which is observed at national level.

The empirical model is estimated by panel Least Squares (LS) with fixed effects. However, two potential difficulties must be considered. First, observations are likely to be correlated across regions within the same country. This violates the requirement that the observations be independent and might result in biased standard errors. To correct for this problem, we cluster errors by country and compute robust standard errors that allow for intra-country correlation of observations. Second, the empirical model is essentially static, in the sense that it does not account for the dynamic adjustment of mortality over time. In order to integrate adjustment dynamics, the model should be extended to include the lagged dependent variable y_{it-1} on the right hand side. This however complicates estimation because the lagged dependent variable is necessarily endogenous and hence the standard panel LS estimator is biased. Our approach is to use the panel LS estimates of the static model as a benchmark and then check the robustness of results by estimating the dynamic model with a difference-GMM estimator to address the endogeneity problem (Arellano and Bond, 1991). This involves taking first differences of the equation with lagged mortality (so to remove the region-specific fixed effect) and then using lagged values of the variables in levels as instruments for the first differences. The difference-GMM procedure therefore automatically generates instruments from lagged values. The problem is that the relatively long dimension of our panel will result in a very large number of instruments being generated. By being numerous, instruments can overfit instrumented variables and this biases coefficient estimates towards those from panel LS estimates. To address this further problem, we limit the number of periods used to create instruments to three and we collapse instruments by combining them through addition into smaller sets (Roodman, 2009).

3. Results

Baseline results are reported in Table 1. The dependent variable in all regressions is mortality due to all causes of death. For each explanatory variable in the model, the table reports its estimated coefficient and the robust standard error of the estimate (in brackets). In what follows we focus our comments on the relationships between unemployment and mortality. A discussion of the evidence on the effect of the control variables is provided in the on-line Appendix.

The first two columns of Table 1 reproduce a linear specification of the type commonly estimated in the previous literature. The effect of unemployment on mortality appears to be negative, but the estimated coefficient fails to pass a zero restriction test at usual confidence levels. In fact, this finding is consistent with our hypothesis: if the true relationship between unemployment and mortality is U shaped, then the best fit that a linear specification can provide is likely to be a flat line; that is a line with a non-significant slope coefficient. The non-linear (quadratic) specification is presented in columns III and IV. The estimated coefficient of the linear term is still negative, but now highly significant in statistical terms. The coefficient of the squared term is positive, and again significant. This is exactly the pattern that we would expect if our hypothesis were correct: at low levels of unemployment, the relationship between unemployment and mortality slopes downward; but at higher level of unemployment, the relationship becomes upward sloping. The point estimates of the two coefficients imply that when unemployment is low, say 3%, an increase in the unemployment rate by one percentage point decreases average mortality by 0.7%. As unemployment increases, the effect decays: when the unemployment rate is 8% a further increase by one percentage point decreases average mortality by 0.4%. Eventually, the effect turns from negative to positive when unemployment reaches 17%. When unemployment is 25%, a further increase by one percentage point raises average mortality by 0.4%.

The specification with lagged mortality is reported in column V of Table 1. Estimates are qualitatively similar to those shown in the previous two columns and confirm the existence of a non-linearity in the relationship with a somewhat lower turning point at 13%. The diagnostics shown at the bottom of the table indicate that from a purely statistical point of view, the dynamic model estimated by difference-GMM is robust. First of all, the tests of autocorrelation (AR(1) and AR(2)) show that there is no second order autocorrelation in the first difference of the error term. Second, the Hansen test statistic is never significant at usual confidence levels, meaning that the overidentifying restrictions implied by the use of lagged values as instruments cannot be rejected. Taken together, these two tests support the identification procedure underlying the difference-GMM estimator. As an alternative to the difference-GMM estimator, we could have used a system-GMM estimator. The system-GMM estimator combines the equations in level and the first differences into a system to generate more efficient coefficient estimates. However, this greater efficiency is achieved only to the extent that lagged first differences are valid instruments for the level equation. To check whether this is indeed the case, we performed a difference-in-Hansen test, but we were not able to reject the null hypothesis at usual confidence levels. Therefore, we opted for the difference-GMM estimator.

The last two columns of Table 1 report estimates of the dynamic model with a one-year lagged effect of unemployment. More specifically, in column VI, the contemporaneous values of unemployment and unemployed squared are replaced by their one-period lagged values. Estimated coefficients increase, but the implied turning point of the U shaped relationship remains close to 17%. The main concern in this case is that the exclusion of the contemporaneous values of unemployment amounts to the omission of significant variables. As well known, omitted variables can bias coefficient estimates. A more suitable approach is therefore to include both contemporaneous and lagged values and hence estimate a parsimonious distributed lag model. This is done in column VII. The U-shaped relationship is still evident, even though the coefficients of the lagged variables are not precisely estimated. This lack of precision might be partly due to the high persistency of unemployment which introduces a collinearity between contemporaneous and lagged values.

INSERT TABLES 1 AND 2 ABOUT HERE

Table 2 disaggregates the results distinguishing among different causes of death. In column I, mortality includes deaths due circulatory, mental, and nervous diseases. These are the causes of death with the highest stress-related attributable fraction that the literature documents having the strongest relation with economic conditions. The U shaped relationship is clearly identified. Results do not qualitatively change when we add deaths due to self-harm and accidents (columns II and III). When instead we consider other causes of death (columns IV-VI), we find that the non-linear relationship is not statistically significant. This is not a surprise since causes of death such as neoplasm are not documented to have any relation with the economic cycle. In the last two columns, we report estimates generated from different assumptions on the structure of the error term. In particular, in column VII, errors are not clustered by country while in column VIII the region-specific fixed effect is replaced by a country-specific fixed effect. The evidence in support of a non-linear effect of unemployment on mortality is unchanged. It is worth stressing that the regression in column VIII accounts for time-invariant differences across countries, which might include differences in welfare systems of the type modelled by Gerdtham and Ruhm (2006).

We performed a number of robustness checks on our estimates. First, we replaced the time dummy variables with a linear time trend. Second, we added a time-variant measure of welfare systems to the set of regressor. Third, we split the population variable to separate female and male. Fourth, we re-estimated the baseline model dropping all the controls, the fixed effects, and the time effects to make sure that the non-linearity is not an econometric artefact. We also re-estimated the model for 31 different specifications of the set of controls. Fifth, we estimated the model on various sub-samples: (i) excluding very large and very small regions, (ii) excluding the four large EU countries (Germany, France, Italy, and the Uk), (iii) excluding the years associated with the Global Financial Crisis, and (iv) dropping each country and each year at the time to ensure that results are not driven by a specific subset of observations. All these checks validate the evidence from Table 1 on the existence of a non-linear U shaped effect of unemployment on mortality. Further details and the full set of robustness checks are provided in the on-line Appendix. Two further points concerning the interpretation of our results are worth a mention. The baseline model in columns I to IV of Table 1 includes fixed effects by regions, meaning that we are capturing a non-linearity within-region. However, in columns V to VII the model is estimated after re-moving the regional fixed effect through first-differencing. Moreover, in column VIII of Table 2 the model includes country fixed-effect instead of fixed effects by regions. Finally, as just noted, we have also estimated the model without any fixed effect. In all these cases, we still find the effect of unemployment to be non-linear, suggesting that the non-linearity is not just within-region, but also across regions within-country, and across countries.

The second point relates to the duration of unemployment, which we regard as a crucial factor in determining individual's response to economic hardship. Ideally, we would like to test for the relationship between unemployment level and unemployment duration at regional level. Unfortunately, information on the duration of unemployment at regional level is scarce. However, information is available on long-term unemployment; that is, the number of individuals that have been unemployed for more than 12 months. We can therefore calculate the share of long term unemployment in total unemployment and add it to the set of regressors in the baseline model. We find that our results are, once again, unchanged. We also find that when we replace the standard rate of unemployment with the rate of long-term unemployment, the effect on mortality continues to be U-shaped. In this case, however, the turning point of the relationship shifts to the left, implying that when unemployment duration is longer, the mortality-increasing effect of unemployment kicks-in at lower rates. This would be consistent with our theoretical interpretation of the non-linear effect. We report the full set of results using the long-term unemployment variables in the on-line Appendix.

4. Discussion and conclusion

We argue that the effect of unemployment on mortality is likely to be non-linear. Using regional data for a sample of European countries, we show that at initially lower levels of unemployment, an increase in unemployment reduces mortality. However, when unemployment is sufficiently high, a further increase in unemployment increases mortality. The intuition underlying this result is that the level of unemployment influences the psychological and behavioural response of individuals to worsening economic conditions. A high unemployment rate means that finding a new job will be difficult and hence that unemployment will last longer. Under those circumstances, individuals (both employed and unemployed) tend to be more stressed and to develop unhealthy behaviours, like drinking and smoking. Conversely, when unemployment is low, individuals worry less about the job market implications of the economic slowdown and might actually benefit from reduced job-related stress and increased leisure time to invest in health-producing activities.

Our paper significantly contributes to both academic research and policymaking practice. In previous research, the relationship between unemployment and mortality was assumed to be linear. However, a linear model can capture only one side of a U-shaped relationship and this could explain why some papers report a positive effect of mortality on unemployment, some report a negative effect, and some report no effect at all. In other words, we suggest that the conflicting findings reported in the literature are in fact part of the same bigger picture. The problem is that by fitting linear models, previous papers might have failed to fully capture this bigger picture. The non-linearity emerges also thanks to our data-set which allows us to exploit within country heterogeneity of local labour market conditions that are inevitably hidden by national aggregate data.

In terms of policy practice, the turning point in the unemployment-mortality relationship occurs at an unemployment rate of 17%. While average unemployment in our sample is significantly lower (8.5%), about ¼ of the observations lie to the right of this turning point. For example, at the height of the European crisis in 2012 all Spanish and Greek regions had an unemployment rate higher than 17%. This means that a relatively large part of European population is potentially exposed to the mortality-increasing effect of unemployment. Hence, the challenge for policymakers is real. We flag two policy options. One is to identify areas at risk; that is, regions that are likely to be located on the upward-sloping part of the U-shaped curve, and direct there resources to sponsor active labour market policies that alleviate the strain of unemployment. The other is to make a more effective use of macroeconomic policy to stabilize the business cycle and thus prevent unemployment from rising too sharply in time of economic crisis.

To conclude, we acknowledge some possible limitations of our work. Regional data allow us to exploit within country heterogeneity, but their time-series dimension is relatively short. We are therefore unable to undertake a longer-term analysis that looks at changes in mortality trends over few decades (Rhum 2013, Teking, McClellan and Minyard, 2013). Our analysis of age classes is admittedly crude and can be improved with the availability of more comprehensive data. Our parametric approach to modelling the non-linearity via a quadratic function might be too restrictive and hence future work might need to consider semi-parametric or non-parametric approaches. Finally, future work using micro-level data is certainly desirable..

Table 1: Baseline results

	I	II	III	IV	V	VI	VI
Unemployment	-1.956 (1.682)	-2.012 (1.609)	-8.321*** (2.559)	-8.892*** (2.584)	-13.970** (6.952)	..	-13.087** (5.572)
Unemployment squared	..	..	.232** (.114)	.251** (.120)	.528** (.271)	..	.424** (.217)
Unemployment lagged	..	..	..	..	..	-23.601** (11.428)	-10.441 (8.327)
Unempl. squared lagged	..	..	..	..	..	.670* (.408)	.339 (.289)
Education	-2.566 (2.015)	-2.358 (1.451)	-2.352 (1.957)	-2.034 (1.385)	-.272 (6.079)	-.029 (5.095)	-.101 (4.987)
GDP per capita	82.643 (73.949)	54.623 (59.561)	70.083 (73.046)	40.958 (58.348)	195.831* (107.611)	71.339 (97.358)	138.696* (82.429)
Population < 60	-12.975** (5.659)	-10.619* (5.805)	-13.921** (5.759)	-11.775** (5.702)	-35.661 (26.667)	-31.696 (25.076)	-36.289 (27.497)
Population density	..	-.262** (.097)	..	-.257** (.096)	-.086 (.145)	-.114 (.147)	-.092 (.153)
Health expenditure	..	-15.322* (8.720)	..	-15.968* (8.398)	-11.160 (8.581)	-10.520 (9.717)	-9.722 (8.160)
Causes lagged	..	..	..	..	.082* (.050)	.003 (.091)	.032 (.072)
			Diagnostics				
AR(1)	..	..	..	..	-4.80***	-4.44***	-4.48***
AR(2)	..	..	..	..	1.84	1.17	1.09
Hansen	..	..	..	..	2.42	2.46	1.39
N. of instruments	..	..	..	..	34	34	36
N. observations	2206	2124	2206	2124	1782	1769	1769
Turning point			18%	17%	13%	17%	15%

Notes: The dependent variable is the number of deaths due to all causes per 100,000 population. Columns I to IV show estimated coefficients from panel fixed effects regressions with year dummies; robust standard errors adjusted for clusters by country are reported in brackets. Columns V to VII show estimated coefficients from one-step difference-GMM estimation of the dynamic panel model; Windmeijer robust standard errors are reported in brackets. Estimates of the constant term and time dummies are not reported, but they are available from the authors upon request. AR(1) is the test statistic of the Arellano-Bond test for first order autocorrelation in first differences. AR(2) is the test statistic of the Arellano-Bond test for second order autocorrelation in first differences. Hansen is the test statistic of the Hansen test of overidentifying restrictions. The procedure described in Roodman (2009) is applied in difference-GMM estimation to prevent instrument proliferation. *, **, *** denote statistical significant of the estimated coefficient at 10%, 5%, and 1% confidence level respectively.

Table 2: Further results and robustness checks

	I	II	III	IV	V	VI	VII	VIII
	Deaths due to circulation, nervous and mental	Deaths due to circulation, nervous, mental and self-harm	Deaths due to circulation, nervous, mental, self-harm and accidents	All causes of death less causes in column I	All causes of death less causes in column II	All causes of death less causes in col. III	All causes of death	All causes of death
Unemployment	-3.991** (1.695)	-3.98** (1.623)	-4.622*** (1.603)	-4.78** (2.056)	-4.791** (1.971)	-4.149** (1.946)	-8.892*** (1.555)	-5.413*** (1.54)
Unemployment sq.	0.114** (0.054)	0.112* (0.054)	0.126** (0.057)	0.128 (0.088)	0.131 (0.085)	0.116 (0.082)	.251*** (0.054)	.159*** (-0.054)
Education	-0.13 (0.766)	-0.082 -0.767	-0.301 -0.83	-1.881** (0.878)	-1.929** (0.880)	-1.71* (0.864)	-2.034*** (0.727)	-3.792*** (0.549)
GDP per capita	40.195 (38.331)	38.892 -38.371	31.406 -37.666	1.67 -24.702	2.974 (24.374)	10.459 (25.236)	40.958*** (14.9)	-12.995 (12.245)
Population < 60	-3.67 (3.75)	-3.57 (-3.75)	(-4.95) (-3.89)	-7.89* (4.51)	-8.01* (4.49)	-6.61 (4.47)	-11.775*** (2.567)	-38.667*** (1.181)
Population density	-0.105 (0.069)	-0.11 (-0.071)	-0.102 (-0.071)	-0.153*** (0.052)	-0.149*** (0.051)	-0.157*** (0.052)	-.257*** (0.04)	.013*** (0.004)
Health expend.	-10.295* (5.003)	-9.554* (4.977)	-8.131* (4.597)	-5.62 (6.933)	-6.36 (6.91)	-7.784 (7.179)	-15.968*** (-2.568)	-21.807*** (2.663)
N.observations	2118	2118	2118	2118	2118	2118	2124	2124
Turning point	17%	17%	18%	18%	18%	18%	17%	17%

Notes: Columns I to VI show estimated coefficients from panel fixed effects regression with year dummies; robust standard errors adjusted for clusters by country are reported in brackets. Column VII shows estimated coefficients from panel fixed effects regression with year dummies; non cluster-adjusted standard errors are reported in brackets. Column VIII shows estimated coefficients from panel fixed effects regression with year and country dummies; non cluster-adjusted standard errors are reported in brackets. Estimates of the constant term and time dummies are not reported, but they are available from the authors upon request. *, **, *** denote statistical significant of the estimated coefficient at 10%, 5%, and 1% confidence level respectively.

Table 3. Variables Description and summary statistics

Variable name	Definition	Average	Standard Deviation
unemployment	unemployed persons as a percentage of the economically active population	8.361	4.731
education	persons aged 25-64 with tertiary education attainment (percentage rate)	22.537	8.979
GDP per-capita	Logarithm of per-capita GDP at constant PPP adjusted prices	9.793	0.676
population < 60	population under 60 years of age in percent of total population	78.706	3.867
population density	ratio of the (annual average) population of a region to the (land) area of the region	324.402	814.728
health expenditure	total expenditure on health in percent of GDP	6.217	1.233
mortality	crude death rate per 100,000 inhabitants	1003.428	169.808

All variables are sourced from Eurostat

List of countries included in the analysis (number of regions in brackets): Belgium (11), Bulgaria (6), Czech Republic (8), Germany (38), Estonia (1), Ireland (2), Greece (13), Spain (16), France (22), Italy (21), Hungary (7), Netherlands (12), Austria (9), Poland (16), Portugal (5), Romania (8), Slovenia (2), Slovakia (4), Finland (5), Sweden (8), UK (37), Norway (7), Switzerland (7).

References

Arellano, M., Bond, S. (1991). “Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations.”, *Review of Economic Studies*, 58(2), 277-297.

Backhans, M., Hemmingsson, T. (2011). “Unemployment and mental health – who is (not) affected?”, *European Journal of Public Health*, 22(3), 429-33.

Browning, M., Heinesen, E. (2012). “Effect of job loss due to plant closure on mortality and hospitalization.” *Journal of Health Econonomics*, 31(4), 599-616.

Classen, T., Dunn, R. (2012). “The effect of job loss and unemployment duration on suicide risk in the United States: a new look using mass-layoffs and unemployment duration.”, *Health Economics*, 21(3), 338-50.

Davalos, M., Fang, H., French, M. (2012). “Easing the pain of an economic downturn: macroeconomic conditions and excessive alcohol consumption.”, *Health Economics*, 21(11), 1318-1335.

Deb, P., Gallo, W., Ayyagari, P., Fletcher, J., Sindelar, J. (2011). “The effect of job loss on overweight and drinking.”, *Journal of Health Economics*, 30(2), 317-27.

Eurostat (2013) http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

Garcy, AM., Vagero, D. (2012). “The length of unemployment predicts mortality, differently in men and women, and by cause of death: a six year mortality follow-up of the Swedish 1992–1996 recession.”, *Social Science and Medicine*, 74(12), 1911-20.

Gerdtham, U.G., Ruhm C.J. (2006), “Deaths rise in good economic times: Evidence from the OECD,” *Economics & Human Biology*, 4(3), 298-316.

Gerdtham, U.-G., Johannesson, M. (2005). “Business cycles and mortality: Results from Swedish microdata.”, *Social Science and Medicine*, 60(1), 205-218.

Lundin, A., Falkstedt, D., Lundberg, I., Hemmingsson, T. (2014). “Unemployment and coronary heart disease among middle-aged men in Sweden: 39243 men followed for 8 years.”, *Occupational Environmental Medicine*, 71(3),183-8.

Montgomery, S., Udumyan, R., Magnuson, A., Osika, W., Sundin, P., Blane D. (2013). “Mortality following unemployment during an economic downturn: Swedish register-based cohort study.”, *British Medical Journal Open*, 3(7). pii: e003031. doi: 10.1136/bmjopen-2013-003031.

Neumayer, E. (2004). “Recessions lower (some) mortality rates:Evidence from Germany.”, *Social Science and Medicine*, 58(6), 1037-1047.

Strully, KW. (2009). “Job loss and health in the US labor market.”, *Demography*, 46(2), 221-46.

Rhum, C. J. (2000). “Are recessions good for your health?”, *The Quarterly Journal of Economics*, 115(2), 617-650

Rhum, C. J. (2005). “Healthy living in hard times”, *Journal of Health Economics*, 24(2), 341-363.

Rhum C.J. (2013). “Recession, Healthy No more?” *NBER Working Paper No. 19287*

Roodman, D. (2009). “A note on the theme of too many instruments”, *Oxford Bulletin of Economics and Statistics*, 71(1), 135-158.

Tapia Granados, J. A., Ionides, E. L. (2011). “Mortality and Macroeconomic Fluctuations in Contemporary Sweden”, *European Journal of Population*, 27(2), 157-184.

Tapia Granados, J. A. (2005). “Increasing mortality during the expansions of the US economy, 1900–1996.”, *International Journal of Epidemiology*, 34(6), 1194-1202.

Tapia Granados, J. A., Ionides, E. L. (2011). “Mortality and Macroeconomic Fluctuations in Contemporary Sweden”, *European Journal of Population*, 27(2), 157-184.

Svensson, M. (2007). “Do not go breaking your heart: Do economic upturns really increase heart attack mortality?”, *Social Science and Medicine*, 65, 833-841.

Svensson, M. (2010). “Economic upturns are good for your health but watch out for accidents: A study on Swedish regional data 1976–2005.”, *Applied Economics*, 42(5), 615-625.

Stuckler, D., Basu, S., Suhrcke, M., Coutts, A., McKee, M. (2009). “The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis”, *The Lancet* , 374, 315-23.

Teking, E., McClellan, C., Minyard, K.J. (2013). “Health and Health Behaviors during the Worst of Times: Evidence from the Great Recession”, *NBER Working Paper No. 19234*.

Appendix

This Appendix contains some additional material and estimation results for the paper “Addressing the unemployment-mortality conundrum: Non-linearity is the answer”.

1. Commentary on the effect of the control variables

In the benchmark model of column IV (Table 1), a larger share of younger population, a higher density of population, and greater health expenditure all significantly contribute to reducing mortality. While the effect of population age and health expenditure is clearly unsurprising, the one of population density might require some further consideration. On the one hand, an increase in population density might be indicative of congestion in the use of public health services and infrastructure, which in turn should increase the risk of mortality. On the other hand, higher density could be associated with easier (e.g. less costly) access to health care facilities. Our estimates show that this second effect prevails, at least in our sample of European regions. The other two controls (share of population with higher education and per-capita GDP) are not significant. This finding might be surprising, particularly for per-capita GDP. We suspect that to some extent the inclusion of several income-related factors on the right hand side (e.g. education, health expenditure, per-capita GDP, and unemployment itself) might be generating some collinearity. This could also explain why the coefficient of income is positive (at least in some regressions). Interestingly, when we remove the region-specific effect and/or use non-robust standard errors, the statistical significance of most estimated coefficients increases. We interpret this finding as evidence that a significant proportion of the variation in unemployment across regions is due to unobservable heterogeneity. We do note, however, that our interest is in the assessment of the effect of unemployment on mortality and not in providing a full explanation of all the determinants of mortality. Hence, we have to make sure that the model does not omit relevant variables and accounts for the likely dependence of observations within the same country. This means that including fixed effects and/or correcting standard errors for clustering is the best statistical approach given the nature of our panel.

2. Accounting for differences in welfare systems

Differences in welfare systems may have an impact on the relationship between economic conditions and mortality. The key issue in accounting for this relationship is to obtain a good empirical measure of the welfare system. Gerdtham and Ruhm (2006) use the average level of public social expenditure as a percentage of GFP and treat it like a country fixed effect. Econometrically, this is equivalent to estimating a regression with country dummies, which is exactly what we do in column VIII of Table 2. In order to shed additional light on the issue raised by the referee, we add to our regression a measure of the width and depth of employment protection (EP) sourced from the OECD. This index, which is computed on a yearly basis since the beginning of the ‘90s, captures cross-country differences in welfare systems with specific emphasis on the labour market, periods of strictness of regulation on dismissals, and the use of temporary contracts. The index combines two subcomponents, one referred to regular contracts (EP_REG) and the other to temporary contracts (EP_TEMP).

Table A1 summarizes the results. First we add the measure of employment protection to our baseline equation. The first three columns show that results are unchanged when controlling for either the overall index or its individual subcomponents. Next we split the sample in two groups (high and low employment protection) by the modal value of the average index. In both cases the U shaped relationship is preserved, albeit the coefficient of the squared term is less precisely estimated in the high employment protection subsample. Note that in countries with lower employment protection the turning point is lower. This is consistent with our theoretical hypothesis. In time of economic downturn, lower employment protection (meaning reduced job security) increases individual's stress levels at any rate of unemployment. This in turn alters the relative strength of the positive and negative response to unemployment, lowering the threshold at which the latter dominates.

Table A1: controlling for employment protection

	I	II	III	IV	V
Unemployment	-8.447***	-8.499***	-8.546***	-7.895*	-7.049***
	(2.638)	(2.600)	(2.605)	(3.956)	(1.482)
Unemployment squared	.238*	.225**	.249*	.353***	.080*
	(.118)	(.106)	(.121)	(.093)	(.038)
Education	-1.790	-1.396	-1.740	-0.958	-2.108
	(1.368)	(1.307)	(1.302)	(1.605)	(1.321)
GDP per capita	56.065	54.317	58.336	134.636*	-45.779
	(60.380)	(46.479)	(59.321)	(67.773)	(50.606)
Population < 60	-12.256**	-13.730***	-13.154**	-25.715**	-5.154
	(5.407)	(4.543)	(5.582)	(10.871)	(4.022)
Population density	-.248**	-.219**	-.239**	-.082	-.448
	(0.093)	(0.089)	(0.092)	(0.093)	(0.168)
Health expenditure	-15.993*	-18.075***	-15.109*	-22.293**	-8.688**
	(8.383)	(5.025)	(8.064)	(7.097)	(6.158)
Emp. Protection	61.618*	-21.953***	69.522*		
	(31.256)	(6.147)	(31.510)		
N. observations	2044	2044	2044	984	1060

Notes: Panel fixed effects regressions with year dummies and robust standard errors in brackets. The dependent variable is the number of deaths due to all causes per 100,000 population. Employment protection is measured by the EP index of OECD in Column I and by the sub-components EP_TEMP and EP_REG in columns II and III respectively. The regression in Column IV is estimated on a subsample of countries with low EP and the regression in Column V is estimated on a subsample of countries with high EP

3. Adding a linear time trend

In all our regressions, we take the effect of time into account by including a full set of time dummies. This approach does not restrict the time effect to be linear because the year dummies absorb all time-specific variation (linear or non-linear). However, to confirm that results are unaffected by the inclusion of a linear time trend, we have re-estimated our baseline models (i.e. the model estimated in columns I-IV of Table 1 of the paper), replacing the year dummies with a linear time trend. Results are effectively unchanged. Table A2 reports coefficient estimates for the panel LS model.

Table A2. Baseline regressions with linear time trend.

	I	II	III	IV
Unemployment	-1.387 (1.455)	-1.405 (1.472)	-7.372** (2.790)	-7.815** (2.875)
Unemployment squared	..	..	.222** (.108)	.239** (.111)
Education	-2.110 (1.892)	-2.255 (1.407)	-1.858 (1.868)	-1.918 (1.421)
GDP per capita	26.151 (68.968)	-.173 (55.361)	15.281 (67.988)	-11.887 (53.847)
Population < 60	-21.016*** (7.108)	-19.917** (7.373)	-21.709*** (7.262)	-20.711*** (7.275)
Population density	..	-.251 (.105)	..	-.249** (.105)
Health expenditure	..	-9.216 (8.271)	..	-9.731 (8.093)
Time trend	-7.653** (3.391)	-5.521* (3.232)	-7.547** (3.355)	-5.373* (3.190)
N. observations	2206	2124	2206	984

Notes: Panel fixed effects regressions and robust standard errors in brackets. The dependent variable is the number of deaths due to all causes per 100,000 population.

4. Accounting for gender differences

To account for gender differences in mortality rates, we re-estimated our model splitting between male and female population. Results concerning the effect of unemployment are, again, unchanged. Results are reproduced for the baseline model with the full set of regressors in Table A3 below.

Table A3. Baseline regressions with gender split.

	I	II	III
Unemployment	-9.503*** (.281)	-8.619*** (2.637)	-9.219*** (2.542)
Unemployment squared	.281** (.119)	.232* (.122)	.268** (.119)

Education	-2.179 (1.465)	-2.118 (1.389)	-2.033 (1.437)
GDP per capita	25.838 (56.667)	45.606 (56.183)	33.853 (59.075)
Male population < 60	12.014 (11.686)	-5.956 (4.942)	..
Female population < 60	-25.853 (15.778)	..	-15.413** (7.036)
Population density	-.242** (.089)	-.288*** (.093)	-.238 (.097)**
Health expenditure	-16.628** (7.552)	-15.065* (8.394)	-16.639** (7.943)
N. observations	2124	2124	2124

Notes: Panel fixed effects regressions with year dummies and robust standard errors in brackets. The dependent variable is the number of deaths due to all causes per 100,000 population.

5. The role of unemployment duration

In our interpretation of the relationship between unemployment and mortality, unemployment duration plays an important role as it determines individual's response to economic hardship. In order to test for the role of duration as a transmission mechanism, we would need to estimate the relationship between the level and the duration of unemployment. Unfortunately measures of the duration of unemployment at regional level for European countries are not available. However Eurostat publishes figures of long term unemployment, which can be considered a rough proxy for employment duration. With these data we can account for the role of long term unemployment in two ways.

First we have inserted the share of long term unemployment over total unemployment in the baseline equation. Columns I and II of table A4 show that our core results on the non-linear effect of unemployment still holds. Second we have estimated our baseline equation with a measure of long term unemployment rate instead of the standard unemployment rate (and its squared term) among the regressors. Columns III and IV show the findings. There is still evidence of a U shaped pattern, albeit the quadratic term is significant in the dynamic model only. Note that the turning point for long term unemployment is considerably lower (approx. 9-10%) than what measured with standard unemployment. This is consistent with the theoretical priors which suggest that when the duration of unemployment is higher the positive relation with mortality starts at lower rates.

Table A4: Accounting for long term unemployment

	I	II	III	IV
Unemployment	-7.453**	-11.32***	-13.64**	-29.62***
	(2.625)	(3.483)	(6.361)	(9.129)
Unemployment squared	0.233**	0.449***	0.634	1.498**
	(0.0988)	(0.152)	(0.501)	(0.662)
Education	-4.035***	-6.786	-4.227***	-4.526
	(1.414)	(5.540)	(1.417)	(5.494)
GDP per capita	-3.607	12.77	0.255	-25.23
	(60.68)	(87.42)	(67.43)	(100.9)
Population <60	-1484.1*	-3439.9	-1317.7**	-3162.2
	(744.3)	(2551.0)	(586.1)	(2647.8)
Population density	-0.259**	-0.146	-0.270***	-0.180
	(0.0969)	(0.128)	(0.0888)	(0.121)
Health expenditure	-13.65	-8.175	-12.87	-4.223
	(8.702)	(8.804)	(8.796)	(10.52)
Share of long term unemployed	-1.134	-1.851**	..	..
	(0.917)	(0.777)		
Causes Lagged	..	0.0394	..	0.0128
		(0.0463)		(0.0595)
Diagnostics				
AR(1)		-4.73***		-4.58***
AR(2)		0.17		-0.08
Hansen		0.57		3.64
N. Instruments		18		16
N. Obs	1824	1465	1862	1492

Notes: The dependent variable is the number of deaths due to all causes per 100,000 population. Columns I and III report estimated coefficients from panel fixed effects regressions with year dummies and robust standard errors in brackets. Columns II and IV report estimated coefficients from one-step difference-GMM estimation of the dynamics model, with robust standard errors in brackets. Estimates of the constant terms and time dummies are not report. AR(1) and AR(2) are the test statistics of the Arellano-Bond test for first and second order autocorrelation in first differences, respectively. Hansen is the test statistic of the Hansen test of overidentifying restriction. Instruments are reduced and collapsed following Roodman (2009) . *, **, *** denote statistical significant of the estimated coefficient at 10%, 5%, and 1% confidence level respectively.

6. Model specification

In principle the specification of the set of controls should be based on a fully-fledged theory of the determinants of mortality. However, developing such a theory is beyond the scope of our paper. Our pragmatic approach is to replicate the specification of existing papers that (like ours) study the effect of mortality on unemployment in panel data where the unit of observation is a state or a country (rather than an individual). These papers (see, inter alia, Gerdtham and Ruhm 2006, Neumayer, 2004, Rhum, 2000, Classen and Dunn, 2012) control for: (i) country or state specific effects and time/year effects, (ii) per-capita income, (iii) age structure, (iv) education status, and (v) lagged mortality (in dynamic settings). We do capture all of these factors in our specification, which in fact most closely resembles [4]. We provide some evidence of the robustness of our results to changes in the selection of controls in Table 1 of the paper (column III and column IV). In addition, in Table A5, we have re-estimated the baseline regression without controls. The results concerning the non-linear relationship (columns II, IV, VI, and VIII) appear to be robust. When instead the relationship is modelled as linear (columns I, III, V, and VII), the significance and size of the coefficient tends to change considerably depending on whether or not fixed effects and/or time dummies are included. Table A3 also provides evidence of robustness with respect to splitting population to separate male and female.

Table A5: Baseline regressions without controls (robust standard errors in brackets)

	I	II	III	IV	V	VI	VII	VIII
Unemployment	-1.667 (2.295)	-9. 692** (4.807)	-1.776 (2.452)	-11.153** (4.901)	-3.546* (1.653)	-10.587*** (2.973)	-3.415* (1.603)	-9.495*** (3.019)
Unemployment squared	..	.306* (1.666)	..	.356** (.167)	..	.263** (.118)	..	.228 (.120)**
Fixed effect	No	No	Yes	Yes	Yes	Yes	No	No
Country effect	No	No	No	No	No	No	Yes	Yes
Year dummies	No	No	No	No	Yes	Yes	Yes	Yes

Notes: The dependent variable is the number of deaths due to all causes per 100,000 population. Estimation is by panel least squares in all columns, robust standard errors are reported in brackets. Fixed effect refer to the inclusion/exclusion of fixed effects by region. Country effect refers to inclusion/exclusion of fixed effects by country. Year dummies refer to the inclusion of a full set of dummy variables by year. *, **, and *** denote statistical significant of the estimated coefficient at 10%, 5%, and 1% confidence level respectively.

To make sure that the findings concerning the non-linear relationship are not sensitive to the specific combination of regressors, we run a quasi-lower bound test. This involves estimating the model for all possible combinations of up to 5 controls (per-capita income, education status, population age, population density, and health expenditure) and deriving the distribution of the estimated coefficients of unemployment and unemployment squared. The total number of regressions estimated is 31 (5 regressions with one control, 10 regressions with combinations of two controls, 10 regressions with combinations of three controls, 5 regressions with combinations of four controls, and 1 regression with all the five controls).

The full set of results is available upon request. Table A6 reports the relevant summary statistics for the estimated coefficient of unemployment and unemployment squared. For the purpose of this exercise, we have used the panel fixed effect regressor, with year dummies and robust standard errors. In short, both the linear and the non-linear term are statistically significant at usual confidence level in all the regressions. This means that the significance of the non-linear term is robust to all possible changes in the combination of the five controls. Therefore, unemployment squared is robustly correlated with mortality and omitting it (i.e. estimating a linear relationship) would bias the estimates of the other coefficients of the model (including the coefficient of the linear term).

Table A6: Results of sensitivity analysis

	Mean	Standard deviation	Max	Min	Proportion of times the coefficient is significant at least at 10% confidence level
Estimated coefficient of					
- unemployment	-9.582	1.017	-7.906	-10.939	100%
- unemployment sq.	0.257	0.026	0.300	0.202	100%

Note: The table reports summary statistics of the distribution of estimates of unemployment and unemployment squared in 31 panel fixed effects regressions with year dummies and robust standard errors.

7. Additional robustness checks

As a further robustness test, we have estimated our model on various sub-samples. Results are summarised in Table A7 (which only reports the estimated coefficients of unemployment; the estimated coefficients of the other controls are available upon request).

- First, we have excluded very large and very small regions. We define size by region's population and exclude from the sample the observations in the first and last quintiles of the distribution of population. Estimates are reported for the linear and quadratic specification, with the baseline and extended set of controls (see notes to the tables) and using both the panel fixed effects and the difference-GMM dynamic panel estimators (rows 1 to 6).

- Second, we have excluded from the sample the four large EU countries: Germany, France, Italy, and the UK. We report estimates for the linear and the quadratic specification, with the baseline set of controls, using the panel fixed effects and the difference-GMM dynamic panel estimators (rows 7 to 9). Estimates obtained from the extended set of controls are qualitatively similar and can be obtained upon request.

- Third, we estimate the model excluding the years associated with the Global Financial Crisis, as that period might have involved some unusually strong psychological reactions to unemployment. Estimates are reported for the linear and quadratic specification, with both the baseline and the extended set of controls, using the panel fixed effect estimator. As we are excluding some years in the middle of the sample period, the dynamic panel estimator cannot be used (rows 10 to 13).

-

Table A7: Additional robustness checks

Row	Control variables	Sample	Estimation method	Unemployment (in linear specification)	Unemployment (in quadratic specification)
1	Baseline	excluding largest and smallest regions	Panel fixed effects, year dummies, robust errors	-1.738 (1.938)	..
2	Baseline	excluding largest and smallest regions	Panel fixed effects, year dummies, robust errors	-9.244** (3.969)	.269* (.141)
3	Baseline	excluding largest and smallest regions	Difference-GMM, dynamic panel	-11.540** (5.738)	.472*** (.160)
4	Extended	excluding largest and smallest regions	Panel fixed effects, year dummies, robust errors	-1.658 (1.713)	..
5	Extended	excluding largest and smallest regions	Panel fixed effects, year dummies, robust errors	-9.245** (3.419)	.272** (.131)
6	Extended	excluding largest and smallest regions	Difference-GMM, dynamic panel	-13.301*** (4.481)	.505*** (.164)
7	Baseline	excluding large EU countries	Panel fixed effects, year dummies, robust errors	-2.516** (.989)	..
8	Baseline	excluding large EU countries	Panel fixed effects, year dummies, robust errors	-10.164*** (2.919)	.274** (.103)
9	Baseline	excluding large EU countries	Difference-GMM, dynamic panel	-19.721** (9.635)	.633** (.330)
10	Baseline	excluding GFC years	Panel fixed effects, year dummies, robust errors	.214 (2.939)	..
11	Baseline	excluding GFC years	Panel fixed effects, year dummies, robust errors	-7.890*** (2.405)	.293** (.108)
12	Extended	excluding GFC years	Panel fixed effects, year dummies, robust errors	.321 (3.031)	..
13	Extended	excluding GFC years	Panel fixed effects, year dummies, robust errors	-8.685*** (2.277)	.328*** (.117)

Notes: the baseline set of regressors includes tertiary education, log of per-capita GDP and percentage of population under 60% of age. The extended set of regressor also includes population density and health expenditure in percent of GDP. Robust standard errors are reported in brackets. The dependent variable is always the number of deaths due all causes per 100,000 population. *, **, and *** denote statistical significant of the estimated coefficient at 10%, 5%, and 1% confidence level respectively.

As can be seen from the table, the coefficient of unemployment is generally insignificant when included in the linear specification, but it becomes significant whenever a quadratic specification is estimated. The only exception is the regression without the large EU countries, where unemployment has a significant coefficient in the linear specification. But even then, the coefficients of the quadratic specification are strongly significant. This suggests that the quadratic terms is indeed a relevant variable to be included in the model.

In addition we have re-estimated our baseline and extended specifications (i) dropping each country at the time and (ii) dropping each year at the time to ensure that estimates are not driven by a particular country/year. Results (available upon request) indicate that unemployment alone is never significant while unemployment and unemployment squared together are always significant.