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Abstract

We examine the economic and social determinants of suicide mortality in a panel of 25 OECD countries over the period 1970 – 2011 and explicitly analyze the effects of unemployment and labor market institutions on suicide rates. In line with a large body of literature our results suggest that unemployment increases suicide mortality, while real economic growth tends to decrease suicides. The results also indicate that unemployment benefits decrease suicides of males, while relatively strict employment protection regulations have a positive influence on suicide mortality. These findings indicate that labor market institutions may influence job satisfaction and the quality of life in industrial countries. We suggest taking into account the role of labor market institutions when analyzing the effects of institutional and economic determinants on health.

JEL-Code: C230, E240, I100, J650.

Keywords: panel data, suicide, employment protection, unemployment benefits.

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1. Introduction

The empirical literature on the determinants of suicide mortality indicates that economic cycles affect suicide rates. Evidence presented for the United States (Ruhm, 2000), Japan (Kuroki, 2010), and Europe (Brainerd, 2001, Stuckler et al., 2011, and Breuer, 2014) show that unemployment increases suicide mortality.[1] One stream of literature analyzes the correlation of macroeconomic variables on suicide mortality over time to discover the economic and social determinants of suicide mortality with fixed-effects panel regressions (Ruhm, 2000, Brainerd, 2001, Andrés, 2005).

While a large share of literature confirms the positive relationship between unemployment and suicide mortality, the question of how unemployment affects suicide rates remains ambiguous. Hamermesh and Soss (1974) provide an early theoretical model of how economic factors may influence individual lifetime utility and the likelihood of suicide. According to them, it is conceivable that unemployment implies a decrease in lifetime earnings and utility to the unemployed share of the population. This negative influence of unemployment on utility would be particularly painful in the absence of a welfare system and in particular, without unemployment benefits. Following this theoretical consideration, it would be possible that strict labor market institutions dampen the influence of unemployment on suicide mortality. In this regard, it would be worthwhile to analyze the role of labor market institutions (e. g. unemployment benefits and employment protection) when analyzing the socio-economic determinants of suicide. Despite the growing literature on the relation between unemployment and suicide mortality, there is little evidence that institutions influence this relationship. To the best of our knowledge no study so far has analyzed the influence of labor market institutions on suicide rates. In this paper, we reexamine the

[1] See Platt (1984) and Milner et al. (2013) for a review of the literature.

economic and social determinants of suicide mortality in a large panel of 25 OECD countries over the period 1970 - 2011. We contribute to the literature by explicitly analyzing the effects of labor market institutions on suicide rates. As compared to earlier analyses on suicide rates in OECD countries, we use an extended sample and considerably increase the number of observations.[2] The enlargement of the sample size is particularly reasonable for the application of fixed-effects panel regression models.[3] Flaig and Rottmann (2013) stress the importance of using longer time series in analyses on the effects of labour market institutions to get more reliable estimates of the effect of employment protection, in particular by increasing within-country variations of employment protection (which was more pronounced in the seventies than in the eighties and nineties). In line with a large body of literature our results suggest that unemployment increases suicide mortality, while real economic growth tends to decrease suicides. The results also indicate that unemployment benefits decrease suicides of males, while relatively strict employment protection regulations has a positive influence on suicide mortality. The influence of labor market institutions on suicide mortality indicates that labor market rigidities might play a role for job satisfaction or for adverse effects on labor market outsiders. We suggest taking into account the role of labor market institutions when analyzing the effects of institutional and economic determinants on health.

2. Labor Market Institutions and Job Satisfaction

From a theoretical perspective, unemployment benefits (in terms of net replacement rates) as well as employment protection legislations (EPL) may influence the effect of unemployment on suicide rates in different ways. First, it is conceivable that stricter labor market regulations

[2] For the majority of countries we exploit data over more than 35 years. By comparison, related studies rely on relatively small samples. See e.g. Neumayer (2004), Andrés (2005) and Noh (2009) on the determinants of suicide mortality in cross country panel studies.

[3] Under the assumption that the independent variables are weakly but not strictly exogenous, the inconsistency shrinks to zero at the rate *1/T*, where *T* is the number of observations (Wooldridge, 2002 and Vogelsang, 2012).

and higher replacement rates would compensate workers for the income-loss in case of unemployment and would dampen the income-loss (or the risk of unemployment) during an economic crisis. In this case, the loss in utility might be small, what could influence the probability of suicides.

Unemployment benefits and employment protection regulations are comparable to a public insurance system for employees against the risk of unemployment in a private market. Because of moral hazard and adverse selection problems, private markets do not offer sufficient safety in the face of unemployment. Therefore, industrialized countries established more or less strict regulations on employment protection as well as unemployment benefits. Unemployment benefits provide, firstly, direct income to the unemployed, and secondly, insure the employed share of the population against the risk of income losses in case of unemployment. Employment protection rules, however, only offer safety and job security for the already employed. Both institutions might help mitigating the risk of income losses in the face of unemployment for the employees and tend to smooth consumption over time. Accordingly, labor market institutions affect both, the unemployed as well as the employed.

On the one hand, unemployment benefits offer safety against the risks associated with unemployment. Given a generous unemployment insurance system, the disutility of unemployment decreases and jobholders as well as unions increase their reservation wage. This leads to a reduction of job search intensity. Search unemployment and the duration of unemployment is therefore higher (Boeri and van Ours, 2008, as well as Cahuc and Zylberberg, 2004). Many studies confirm that generous unemployment benefits increase the average unemployment duration (e.g. Katz/Meyer, 1991, Hunt, 1995, Lalive et al. 2006). In this line, the macroeconomic literature finds that long-term unemployment increases when unemployment benefits rise (Nickell, 1997 and 2003, Blanchard and Wolfers, 2000, and Bassanini and Duval, 2006).

Unemployment benefits as well as employment protection asymmetrically affect the

composition of the workforce by pricing out woman, youth and older workers (Bertola et al., 2007). Empirical studies find mixed results with respect to the effects of employment protection on unemployment rates, however, many studies show a positive relationship between the strictness of employment protection and the duration of unemployment (Boeri/van Ours, 2008, Cahuc/Zylberberg, 2004). It is conceivable that long-term unemployment has a particular detrimantal effect on life satisfaction, which might also increase the rate of suicides. These findings are consistent with the theoretical argument that high firing costs reduce both job finding as well as the separation of employment, and therefore have an ambiguous impact on unemployment rates. The reduced job creation leads to smaller unemployment outflows and a longer average duration of unemployment. Additionally, strict employment protection might influence the composition of unemployment. Working-age males are usually seen as insiders in the labor market, while females as well as young people are more often considered to be outsiders and hence are more vulnerable to the adverse effects of strict employment protection regulations.[4]

Additionally to their negative consequences on outsiders, it is possible that strict labor market institutions even might harm people who are employed. Employment protection, for instance, is offered only to one fraction of the workforce, so that the risk of unemployment is particularly concentrated on those who are not covered by protection rules. Employment protection might thus have different effects on temporary and permanent employment. Beyond this, although the risk of unemployment declines for those who are protected, they are aware of the increase in the duration of unemployment under strict employment protection legislation. It is further conceivable that employers might use mobbing as a strategy to force their employees to leave the firm under strict EPL (Wasmer, 2006, and Boeris and van Ours, 2008). Agents with limited horizons could adhere to non-satisfying jobs to avoid the short-run

[4] See e. g. Agnello et al. (2014) on the effect of labor market flexibility on youth employment and long-term unemployment.

risk of unemployment. The adverse effects of strict labour market institutions can possibly be mitigated if EPL protects workers against arbitrary dismissals and therefore creates a more stable and trusty relation, making workers more willing to invest in firm- specific human capital. To sum up, strict labor market institutions theoretically may have positive as well as negative effects on job satisfaction and, thus, a person's inclination to commit suicide in times of unemployment or even in employment. It could be true that strict labor market regulations may dampen the positive relationship of unemployment and suicide mortality. Nevertheless, it is conceivable that strict labor market institutions tend to establish long-term unemployment and decrease job satisfaction. The true relationship between labor market institutions and suicide behavior is thus an empirical question.

3. Data and Empirical Strategy

In the present study, we rely on cross-country data for a panel of 25 OECD countries over the period 1970 – 2011. The source of the data one suicide rates is the OECD Health Statistics Database. Table 1 shows descriptive statistics for our dependent variables, gender-specific suicide rates (suicides per 100.000 inhabitants) for each country during the observation period. Data are not available for every country in each year, so that we show the numbers of observations for every country in column (2). For some countries (Austria, Denmark, Finland, Netherlands, Norway), data is available over the entire sample period 1970-2011, while some countries provide data only for a shorter period of time. The panel is unbalanced to exploit the full information available for every country and year. The table shows the mean, minimum, as well as the maximum for male and female suicide rates for every country, respectively. From the descriptive statistics, two statements can be established: first, suicide rates are considerably higher for men than for women; and second, suicide rates vary across countries.

For male as well as for female suicide rates, the standard deviation across countries is bigger than the within-country standard deviation. Despite this, suicide rates show considerable variations within countries over time (see maximum and minimum in table 1). For instance, the average ratio between maximum and minimum for male (female) suicide rates is 1.7 (2.1). There are, obviously, clear differences in suicidal behavior of males and females. It would thus be appropriate to analyze the determinants of suicide rates for both genders separately and to try to identify the determinants of the cross-country distribution of suicide rates or to use cross-section fixed effects to exploit the variance of suicide rates over time.

Table 2 shows descriptive statistics for the explanatory variables. Data on fertility rates (children per women aged 15 to 49) are obtained from the OECD family database, divorce rates (number of divorces per 1,000 inhabitants) are provided by the OECD social indicators. Population and population shares (65 years age and above) are obtained from the OECD labor force statistics. GDP per capita, unemployment, price indices and real GDP growth is taken from the OECD economic outlook no. 94. We compute comparable figures of normalized real GDP per capita for all OECD countries by dividing the value of nominal GDP per capita in US $ (purchasing power parity) by the price index for the United States. Thus, income is measured in 100 $ per capita. As discussed before, we are particularly interested in the relationship between unemployment, labor market institutions and suicide rates, so we attach more importance to the discussion of these factors.

Our main indicator for employment protection legislation (EPL) is obtained from the OECD (version 1 or EPLv1). Until 2012, the OECD constructs the overall indicator (EPLv1) as a weighted sum of sub-indices, with a weight of 7/12 for employment protection for regular contracts and 5/12 for employment protection for temporary contracts. Since 2012 the OECD provides only data on employment protection either for regular employment, or for temporary employment.

Economic studies that rely on OECD labour market indicators suffer from a relatively low number of observations – annual data is available starting in 1985 – limiting the empirical research on the effects of employment protection over time.

Another measure for employment protection legislation is obtained from Allard (2005). The Allard indicator includes annual data between 1950 and 2003[5]. This work is based on the OECD methodology and extended by reviewing the ILO's International Encyclopedia for Labor Law and Industrial Relations. Like the OECD indicator, the Allard measure takes into account regulations concerning individual dismissals and the employment forms such as fixed-term employment and the supply of labour by temporary employment companies.

The Allard indicator shows sharp increases in employment protection during the seventies. For this reason it would be particularly interesting to extend the sample and to include the 70s. Using the definition of the OECD indicator (version 1), we predict the missing values of the OECD indicator with the help of the Allard indicator, as follows: For the overlapping period (1985 to 2003), we estimate regressions between both indices with country dummies and a linear trend. Using the estimated regressions and the indicator proposed by Allard (2005), we predict the values for the EPLv1 for years before 1985. The correlation coefficient between the predicted values and the OECD indicator is 0.99 over the period 1985 to 2003.[6]

Gross replacement rates (GRR) are obtained from the OECD labor market statistics database and serve as a proxy for unemployment benefits[7].

Our empirical strategy is straightforward: As frequently applied in the literature (i.e. Ruhm,

[5] For the period between 1985 and 2000, the correlation between the Allard indicator and the OECD indicator (Version 1) is 0.92. Version 2 and 3 of the OECD indicator are available only for years starting in 1998, which is why we rely on version 1 of the OECD indicator.

[6] In a test for robustness, we use only the official OECD data over the period 1985 to 2011 and do not rely on predicted values. The results of the tests are provided in the appendix.

[7] The indicator is given in two versions (GRRAPW von 1961 to 2005 und GRRAW during 2001 and 2011). Version 1 considers only workers, while version two incorporates total employment. (GRRAPW: Gross replacement rates calibrated to the average production worker / GRRAW: Gross replacement rates calibrated to the average worker). Both indicators are only given for uneven years. We compute values for even numbered years through linear interpolations. Afterwards, we combine both indices on gross replacement rates by calculating the ratio of GRRAPW/ GRRAW for every country and extrapolate the GRRAPW series multiplying the GRRAPW by the observed ratio for the year 2005.

2000, Brainerd, 2001, Breuer, 2014), we use fixed-effects panel regressions to analyze the determinants of suicide rates over time:

$$s_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it} \qquad (1)$$

, where s_{it} is the gender-specific suicide rate in country i at time t, and X_{it} are the variables of interest, which include unemployment, GDP per capita, GDP growth, variables that measure the influence of labor market institutions, as well as control variables, such as life expectancy and fertility. Since s_{it} may vary across countries because of unobserved country-specific factors (α_i), the model is estimated using country-specific fixed effects. In principle, however, we can apply both, random as well as fixed effects models. The advantage of using a random-effects model is that we can account for variations of the data within as well as across groups. This allows us to derive efficient estimators under particular circumstances. The random-effects model hinges on the assumption that the country-specific effects are independent from the explanatory variables. In contrast to the random effects model, the fixed effects model makes inferences based only on the within-country variation of the data, implying that unobserved time-invariant differences across firms have no effects on the results.

4. Results

Table 3 shows the results for the fixed-effects and the random-effects model for both males and females. In line with the literature, we estimate the effects using log suicide rates as the dependent variable. We multiply the log-value with 100 so that an estimated coefficient of 1 indicates an increase in the explanatory variable of one unit coincides with an increase in the suicide rate of 1 percent. For instance, an increase in divorce rates by 1 case per thousand

inhabitants increases the expected male suicide rate by 7 percent. If the unemployment rate increases by four percentage points, suicides increase by approximately 5 percent for males, and 9 percent for females, respectively.[8] The estimated parameters and their standard errors are very similar in both specifications. The χ^2-statistic of the Hausman test with 8 degrees of freedom is 14.07 with a p-value of 0.079. This implies that we can reject the hypothesis that the regressors are uncorrelated with the unobserved country-specific effects. In case that the idosyncratic errors ε_{it} are not iid, however, the Hausman test might be biased, because then the random-effects model is inefficient. Arellano (1993) provides an alternative regression based test, using heteroskedastic- and cluster-robust error terms. The χ^2-statistic of this test with 8 degrees of freedom is 36.40 with a p-value smaller than 0.001, which now clearly rejects the random effects assumptions. The results are quite similar for regressions using suicide rates of females[9].

In the following regressions we thus rely on the fixed-effects model, however, these results are not very different from those obtained with the random-effects models that use within- as well as cross-country variations in the data.

The different levels of significance (fixed effects regressions in table 3 vs. table 4) point to the presence of non-independent and / or heteroskedastic errors.[10] Therefore, it is indicated to calculate robust standard errors. In that case, the micro-econometric literature on panel regressions applies cluster robust standard errors as proposed by Arellano (1987). Their validity, however, depends on the assumption of cross-sectional independence. While this assumption might be meaningful in the case of micro-econometric panel data for households or enterprises, it is controversial in the case of macroeconomic data, e. g. because of the presence of common macroeconomic and political shocks (Urbain and Westerlund, 2006,

[8] The standard deviation of the unemployment rate amounts to four percent (see table 2).

[9] For females, the Hausman test indicates a p-value of 0.09, whereas the robust version of Arellano reveals a p-value smaller than 0.001.

[10] For example, the test for serial correlation in the idiosyncratic errors proposed by Wooldridge (2002) clearly rejects the null hypothesis of no serial correlation.

Hsiao, 2007). Ignoring correlations of disturbances over time and between countries causes biased statistical inferences, because the relevant information decreases if observations are inter-correlated (Cameron and Trivedi 2005, Hsiao 2007).

The cross-sectional dependence (CD) test proposed by Pesaran (2004) tests the null hypothesis of zero dependence across the countries using an average of all pair-wise correlations from country-specific regressions. The average absolute correlation coefficient is 0.41 (0.38) for males (females) and the null hypothesis of cross-sectional independence can be rejected at the 1% (5%) significance level.[11] Therefore we use the nonparametric covariance matrix estimator proposed by Driscoll and Kraay (1998), which produces heteroscedasticity-consistent standard errors that are robust to very general forms of spatial and temporal correlations.

We show the results with robust Driscoll-Kraay (1998) standard errors in table 4, whereas we have used a maximum lag in the autocorrelation structure of 3.[12] The literature often estimates the correlates of suicide rates using log suicide rates as the dependent variable. Less common are studies that use suicide rates in levels (absolute values) as the dependent variable (i.e. Ruhm, 2000). To test the robustness of the results, table 4 contains estimations using both, absolute values as well as log of suicide rates as the dependent variables.

Our benchmark regressions reinforce most of the earlier findings in the literature on the economic determinants of suicide mortality. Particularly, unemployment tends to increase the incidence of suicides, while GDP growth is negatively associated with suicide mortality (table 4). The role of GDP per capita is particularly interesting. It turns out to influence suicides positively, which is contrary to theoretical considerations (See Hammermesh and Soss, 1974). However, the literature points to a nonlinear relationship between income and suicide

[11] The CD tests are computed using the Stata routine "xtcsd" as proposed by De Hoyos and Sarafideis (2006).

[12] Hoechle (2007) discusses the optimal lag length selection. His program xtscc uses the formula floor $\left(4(T/100)^{2/9}\right)$ as the maximal lag length. This would be 3. The standard errors with three lags increase on average by 5 percent, as compared to those calculated with two lags. The standard errors with four lags are very similar to those based on a maximum lag of three.

mortality.[13] Other social determinants of suicide mortality turn out to be statistically significant, as indicated in table 4. Higher life expectancy and fertility decrease suicide rates, whereas higher divorce rates and a higher share of the population in the age group 65 (and above) tend to increase suicides. While most of these effects are statistically significant for both gender groups, life expectancy and the demographic structure turn out not to be statistically significant for suicide rates of women.[14]

After reinvestigating the socio-economic determinants of suicide mortality in OECD countries, we show the results after incorporating the effects of labor market institutions in table 5. Therefore, we include the indicators for employment protection and for gross replacement rates (column no. 1 and 3 for males and females, respectively) on the right-hand side of equation (1). It turns out that employment protection appears to have a positive effect on suicide rates for both gender groups. If the indicator for EPL increases by one unit, suicide rates increase by approximately 13 percent for males, and 12 percent for females, respectively. The results are statistically significant at the 1 percent level. Further, an increase in the gross rate of unemployment benefits of ten percentage points decreases male suicide rates by somewhat more than two percent, while the effect is positive for females, but only significant at the 10 % level. According to our theoretical considerations made above, it would be possible that the influence of labor market institutions vary with the level of unemployment. Therefore we investigate whether the interaction of labor market institutions and unemployment affects the results. In column no. 2 and 4 we include the interaction of unemployment and labor market institutions, both for employment protection and the gross

[13] GDP per capita tends to negatively affect suicides in developing countries, however, has a positive influence on suicides at particularly high levels of GDP per capita. Kenny (1999 and 2006) suggests that there is no positive relationship between happiness and growth in rich countries. It is however conceivable that suicide rates are particularly high in societies with relatively large GDP per capita and/or happiness (Daly et al., 2011). See also Millner (2013) for a review of the literature.

[14] The literature points to significant differences in the determinants of suicidal behavior for the male and female share of the population. See e. g. Andrés (2005) for differences in gender specific suicide mortality and Kuroki (2013) on the influence of sex ratios on suicides.

replacement rate. The effect of employment protection (without interaction) remains statistically significant in all specifications. The interaction term of employment protection and unemployment also has a positive parameter for female suicide rates, indicating that strict employment protection in connection with high rates of unemployment tends to increase suicide rates of women, a results that would be in line with the hypothesis that employment protection has a particularly negative effect on outsiders (in this case: the female population when unemployment is at high levels). The results for the effect of unemployment benefits (gross rate of replacement) is, however, negative and robust for men. Increasing unemployment benefits tend to decrease suicide rates of men. The interaction of unemployment and gross replacement rates, however, is positive and statistically significant for the male population, so that the negative effect of unemployment benefits on suicide rates decreases with rising unemployment. For women, the results indicate that the gross rate of replacement has a weakly significant positive effect. However, the effect disappears after incorporating the interaction term of unemployment and gross replacement rate. The different findings for both gender groups may reflect the different behavior in terms of labor market participation of husbands and wives in our sample (Cahuc/Zylberberg, 2004).

5. Robustness

We test whether our findings are robust using alternative definitions of the data. We use other specifications of the dependent variable, as well as alternative data on labor market institutions and rely only on data provided by the OECD. The results of the modified definitions are provided in the appendix.

Table A1 shows the results of equation (1), with suicide rates measured in levels, not in log levels. The results remain robust and in particular the estimated effects of unemployment

(positive), GDP per capita (positive) and GDP growth (negative) on suicides remain statistically significant in all equations.

Table A2 depicts the results of equation (1) for males and females (column 1 and 2), where we use an alternative definition of the indicator for the gross replacement rate[15]. This variable is only available until 2005, so that the number of observations decreases. In column (3) and (4), we additionally include only the indicator of employment protection as provided by the OECD. This leads to another significant reduction in the sample size, since the OECD indicator is only available after 1985. The number of observations decreases to approximately 50% of the benchmark sample (table 3 and 4). The results are robust to these alternative definitions of our data and also to the sample adjustments. The interaction of labor market institutions and unemployment is, however, not statistically significant, which is why we do not take into account interaction effects in the regressions. Employment protection remains to be positively associated with suicides and statistically significant for both, men and women. Unemployment benefits reduce the suicide rate of men and in some specifications the negative influence of net replacement rates on female suicide rates is significant as well. The influence of other determinants (unemployment, life expectancy, fertility, GDP per capita, GDP growth) does not vary, as compared to the benchmark results.

We also include time fixed-effects, to control for unobserved macroeconomic shocks at any given time. The results are very similar to the benchmark regressions. Only the inclusion of time- and country fixed-effects, however, results in a R^2 of 0.88 for the suicide rates, so that the share of variation used to estimate the effects of the social, economic and institutional determinants of suicide mortality decreases substantially. Nevertheless, the results remain robust, even after including time-fixed effects, and even with the random effects model. The estimated coefficients as well as the levels of significance are relatively similar to those in the

[15] In this table we show the results only for the original data provided by the OECD (GRRAPW) and do not rely on the extended data using GRRAW.

benchmark regressions, with the exception that the estimated effect of the interaction of employment protection and unemployment for women turns out to be statistically not significant. The size of the coefficient remains comparable to the one shown in table 5.[16]

6. Conclusion

Empirical research on the determinants of suicide mortality use fixed-effects panel regressions to examine the relationship of social and economic variables and suicide mortality. The literature indicates a robust and statistically significant positive relationship between unemployment and suicide mortality. According to Hamermesh and Soss (1974), it is conceivable that unemployment decreases income, consumption, as well as utility and, thus, might lead to an increasing rate of suicides in the aftermath of an economic recession. A number of studies provide evidence showing that the recent economic crisis in southern Europe goes along with an increase in suicide rates.[17] In this context, it is conceivable that some institutional factors might also influence the suicide mortality. Higher unemployment benefits could, for instance, compensate workers in times of rising unemployment rates. The automatic stabilization of the social security system might mitigate the social consequences of economic cycles and help to smooth the impact of recessions on health. Additionally, employment protection could decrease the risk of unemployment in an economic recession, but it can also reduce the chance of finding a job for the unemployed. Accordingly, high unemployment benefits or strict employment protection might be detrimental to outsiders. Beyond their effects on unemployment and its composition, it is, thus, conceivable that labor

[16] Results of further tests for robustness are available from the authors.
[17] See Economou et al. (2011 and 2012) and Fountoulakis et al. (2012 and 2013) on the dynamics of suicide mortality in Greece after 2008. Reeves et al. (2012) show that the financial crisis starting in 2008 positively influenced suicide mortality in the United States. Stuckler et al. (2009 and 2011), as well as Breuer (2014) discuss this relationship for the case of Europe.

market institutions influence suicide mortality. No study so far, however, has analyzed the effect of labor market institutions on suicide mortality.

In this paper, we have reexamined the economic and social determinants of suicide mortality in a large panel of 25 OECD countries over the period 1970 to 2011. We contribute to the literature by extending the size of the panel and increasing the number of observations considerably. We explicitly analyze the influence of labor market institutions on suicides. In line with a large body of literature, our results suggest that unemployment increases suicide mortality while real economic growth tends to decrease suicide rates. Our results also indicate that the net replacement rate tends to decrease suicides of the male population, while employment protection has a significant positive effect on suicide mortality. This result is in-line with earlier analyses on the relationship between social expenditures and well-being (e. g. Hessami, 2010). We suggest taking into account the role of labor market institutions when analyzing the consequences of economic and social determinants on mortality and health. Additionally, it would be recommendable to extend the focus of studies on the effects of labor market institutions, by analyzing their effects on mental health. This research could help answering a number of recent questions, e. g. on how to reform labor market institutions in the aftermath of the Euro crisis (Bentolila et al., 2012, and OECD, 2013). Since the financial crisis, policy-advisors suggest to liberalize labor markets in countries, such as in Greece, Italy and Portugal. In view of our results, to liberalize labor markets, a reduction in employment protection would be more recommendable, as compared to decreasing unemployment benefits.[18]

[18] In an international comparison, the countries in Southern Europe showed relatively low values of unemployment benefits already in 2011, while the employment protection regulations in these countries was relatively restrictive. Accordingly, starting in 2010, particularly Greece, Portugal and Spain reduced their employment protection regulations (Bentolila et al., 2012, and OECD, 2013).

References

Agnello, L., Castro, V., Jalles, J. T. and R. M. Sousa (2014), "Fiscal adjustments, labour market flexibility and unemployment", *Economics Letters*, 124, 231–235.

Allard, G. (2005), "Measuring Job Security over Time: In Search of a Historical Indicator for EPL (Employment Protection Legislation)", IE Working Paper 05-17.

Andrés, A. R. (2005), "Income Inequality, Unemployment, and Suicide: A Panel Data Analysis of 15 European Countries", *Applied Economics*, 37, 439–451.

Arellano, M. 1987, "Computing Robust Standard Errors for Within-Groups Estimators", *Oxford Bulletin of Economics and Statistics* 49, 431–434.

Bassanini, A. and R. Duval (2006), "The Determinants of Unemployment across OECD Countries: Reassessing the Role of Policies and Institutions". OECD Economic Studies, 42, 7-86

Bentolila, S., Dolado, J. J. and J. F. Jimeno 2012, "The New Labour Market Reform in Spain:

Objectives, Instruments, and Shortcomings", *CESifo DICE Report* 2/2012, 3-7.

Bertola, G., Blau, F. D. and L. M. Kahn (2007), "Labour Market Institutions and demographic employment patterns", Journal of Population Economics, 20, 833-867.

Blanchard, O. and J. Wolfers (2000), "The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence". Economic Journal 110, C1-C33

Boeri, T. and J. van Ours 2008, The Economics of Imperfect Labor Markets, Princeton University Press.

Brainerd, E. (2001), "Life and Death in Eastern Europe—Economic Reform and Mortality in the Former Soviet Union: A Study of the Suicide Epidemic in the 1990s", *European Economic Review*, 45, 1007–1019.

Breuer, Christian (2014), "Unemployment and Suicide Mortality: Evidence from Regional Panel Data in Europe", *Health Economics*, forthcoming.

Cameron, A. C. and P. K. Trivedi, 2005, Microeconometrics: Methods and Applications.Cambridge University Press.

Cahuc, P and A. Zylberberg 2004, Labor Economics, The MIT Press.

Daly, M. C., Oswald, A. J., Wilson, D. and W. Stephen. (2011) "Dark Contrasts : the Paradox of High Rates of Suicide in Happy Places", *Journal of Economic Behavior & Organization*, 80, 435-442.

De Hoyos, R. E. and Sarafidis, V. (2006), "Testing for crosssectional dependence in panel data models", *Stata Journal*, 6, 482–96.

Driscoll, J. C., Kraay, A. C. (1998), "Consistent Covariance Matrix Estimation With Spatially Dependent Panel Data", *Review of Economics and Statistics* 80, 549-560.

Economou, M., Madianos, M., Theleritis, Peppou, L. E., Stafanis, C. N. (2011), "Increased suicidality amid economic crisis in Greece", *The Lancet*, 378, 1459.

Economou, M., Madianos, M., Theleritis, Peppou, L. E., Stafanis, C. N. (2012), "Suicidality and the economic crisis in Greece", *The Lancet*, 380, 337.

Fountoulakis, K. N., Grammatikopolous, I. A., Koupidis, S. A., Siamouli, M., Theodorakis, P. N. (2012), "Health and the Financial Crisis in Greece", *The Lancet*, 379, 1001-1002.

Fountoulakis, K. N., Koupidis, S. A., Siamouli, M., Grammatikopolous, I. A., Theodorakis, P. N. (2013), "Suicide, recession, and unemployment", *The Lancet*, 381, 721-722.

Hamermesh, D. S., Soss, N. M. (1974), "Theory of Suicide", *Journal of Political Economy*, 82, 83-98.

Hessami, Z. (2010), "The Size and Composition of Government Spending in Europe and its Impact on Well-Being", *KYKLOS*, 63, 346-382.

Hoechle, D. (2007), « Robust Standard Errors for Panel Datasets with Cross-Sectional Dependence », *Stata Journal* 7, 281–312

Hsiao, C. 2007, Panel Data Analysis – Advantages and Challenges, TEST Vol. 16, 1-22.

Hunt, J. (1995), "The Impact of Unemployment Compensation on Unemployment Duration in Germany", *Journal of Labour Economics* 13, 88-120

Katz, L. F. and B. D. Meyer 1991, "Unemployment Insurance, Recall Expectations, and Unemployment Outcomes", *NBER Working Papers* 2594.

Kenny, C. (1999), "Does Growth Cause Happiness, or Does Happiness Cause Growth?", *KYKLOS*, 52, 3-26.

Kenny, C. (2006), "Were People in the Past Poor and Miserable?", *KYKLOS*, 59, 275-306.

Kuroki, M. (2010), "Suicide and Local Unemployment in Japan: Evidence from Municipal Level Suicide Rates and Age-Specific Suicide Rates", *Journal of Socio-Economics*, 39, 683–691.

Kuroki, M. (2013), "The Effect of Sex Ratios on Suicide", *Health Economics*.

Lalive R, Van Ours J, Zweimuller J. (2006), "How Changes in Financial Incentives Affect the Duration of Unemployment", *The Review of Economic Studies*, 73 (4), 1009 - 1038.

Neumayer, E. (2004), "Recessions Lower (Some) Mortality Rates: Evidence from Germany", *Social Science and Medicine*, 58, 1037–1047.

Nickell, S. (1997), "Unemployment and Labour Market Rigidities: Europe versus North America", *Journal of Economic Perspectives* 11, 55-74

Nickell, S. (2003), "Labour Market Institutions and Unemployment in OECD Countries", *CESifo DICE Report* 1(2), 13-26

Noh, J.-H. (2009), "Does unemployment increase suicide rates? The OECD panel evidence" *Journal of Economic Psychology*, 30, 575–582.

OECD (2013), "The 2012 Labour Market Reform in Spain: A Preliminary Assessment".

Pesaran, M. (2004), “General Diagnostic Tests for Cross Section Dependence in Panels”, *Cambridge Working Papers in Economics*, No. 0435, University of Cambridge.

Platt, S. (1984), “Unemployment and Suicide Behaviour: A Review of the Literature”, *Social Science and Medicine*, 19, 93-115.

Reeves, A., Stuckler, D., McKee M., Gunnell, D., Chang, S.-S., Basu, S. (2012), “Increase in state suicide rates in the USA during economic recession”, *The Lancet*, 380, 1813-1814.

Ruhm, C. J. (2000), “Are Recessions Good for Your Health?” *Quarterly Journal of Economics*, 115, 2, 617–650.

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, 315-323.

Stuckler, D., Basu, S., Suhrcke, M., Coutts, A., McKee, M. (Stuckler et al., 2011), “Effect of the 2008 recession on health: a first look at European data”, *The Lancet*, 378, 124-125.

Urbain, J. and J.Westerlund (2006), “Spurious regression in nonstationary panels with crossunit cointegration”, *METEOR Research Memorandum*, No. 057.

Vogelsang, T. J. (2012), “Heteroskedasticity, Autocorrelation, and Spatial Correlation Robust inference in linear panel models with fixed-effects”, *Journal of Econometrics*, 166, 303 -319.

Wasmer, E. (2006), “The Economics of Prozac: Do Employees Really Gain from Strong EmploymentProtection?”, *IZA Discussion Papers* 2460.

Wooldridge, J. M (2002), “Econometric Analysis of Cross Section and Panel Data” Cambridge, The MIT Press.

Tables

Table 1: Descriptive statistics, suicide rates

Country		Male			Female		
	Obs.	Mean	Min	Max	Mean	Min	Max
Australia	6	19.40	17.20	21.90	4.98	4.40	5.30
Austria	41	35.72	23.10	46.40	11.38	6.00	15.20
Belgium	36	29.97	25.00	36.20	11.77	9.10	16.40
Canada	30	20.86	16.30	25.00	6.00	4.80	8.20
Czech Republic	11	25.04	22.20	29.20	4.94	4.00	6.40
Denmark	41	28.78	14.60	45.40	13.97	4.70	23.60
Finland	41	40.15	26.30	50.80	10.32	7.10	12.30
France	38	30.66	25.20	38.00	10.33	8.00	13.30
Germany	22	21.07	16.50	26.70	6.62	4.80	9.60
Greece	15	5.46	4.60	6.10	1.14	0.80	1.50
Hungary	11	43.50	38.80	50.60	10.32	9.20	12.20
Ireland	14	18.99	16.40	23.50	4.51	3.80	5.60
Italy	36	11.54	9.10	14.00	3.66	2.40	4.70
Japan	36	28.85	22.50	35.60	14.00	10.30	19.30
Korea	7	39.79	27.90	45.10	15.99	10.30	19.30
Netherlands	41	14.04	11.60	17.50	7.29	4.80	10.20
New Zealand	36	20.24	13.80	24.80	6.57	4.30	9.10
Norway	41	18.99	13.70	25.40	6.83	4.40	9.50
Poland	11	27.37	24.20	29.50	4.25	3.60	5.00
Portugal	38	16.10	9.00	21.30	4.28	1.90	6.40
Spain	31	12.16	8.70	13.90	3.51	2.60	4.20
Sweden	40	24.01	17.30	31.20	9.58	6.10	13.00
Switzerland	40	31.52	18.10	39.60	11.82	6.50	15.80
United Kingdom	31	11.78	10.10	13.50	4.04	2.80	6.80
United States	37	20.97	18.50	22.90	5.54	4.10	7.90
All Countries							
Mean			23.68			8.14	
Std. overall			9.88			4.21	
Std. between			9.76			3.92	
Std. within			4.22			2.20	

Table 2: Descriptive statistics, explanatory variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Unemployment rate	731	6.32	3.64	0.00	21.64
Life exectancy, males	731	73.54	3.06	63.10	80.30
Life expectancy, females	731	79.83	2.54	69.70	85.80
Fertility	731	1.69	0.29	1.08	3.18
Divorce rate	731	2.07	0.93	0.00	5.30
Share of population in age group > 65	731	14.12	2.53	7.20	20.80
Real GDP per capita in 100 USD	731	253.96	74.43	85.85	564.85
Real GDP growth	731	2.03	2.59	-10.75	14.59
Gross replacement rate	731	27.61	14.42	0.00	65.00
Gross repacement rate (GRRAPW)	622	27.34	14.34	0.00	65.00
Employment protection	731	2.18	1.10	0.13	4.80
Employment protection (EPLv1)	514	2.08	0.95	0.25	4.32

Table 3: Random Effects and Fixed Effects Models: log Suicide

	(1) male RE	(2) male FE	(3) female RE	(4) female FE
Unemployment rate	1.216***	1.281***	2.162***	2.253***
	(0.239)	(0.239)	(0.297)	(0.298)
Life expectancy	-5.644***	-5.458***	-0.783	-0.734
	(0.789)	(0.809)	(1.093)	(1.107)
Fertility	-20.896***	-20.814***	-20.773***	-20.533***
	(2.921)	(2.922)	(3.865)	(3.871)
Divorce rate	7.039***	6.535***	7.025***	6.536***
	(1.471)	(1.488)	(1.869)	(1.889)
GDP per capita (in 100$)	0.047*	0.049**	0.196***	0.201***
	(0.024)	(0.025)	(0.030)	(0.031)
Real GDP growth	-0.448**	-0.446**	-0.516**	-0.514**
	(0.190)	(0.189)	(0.237)	(0.237)
Share of 65 years age	1.515***	1.659***	0.696	0.854
	(0.493)	(0.497)	(0.646)	(0.651)
Trend	-0.270	-0.336	-2.936***	-2.986***
	(0.252)	(0.263)	(0.272)	(0.279)
Constant	711.479***	698.166***	303.043***	298.523***
	(52.750)	(54.083)	(81.344)	(82.196)
N	731	731	731	731
rho	0.907	0.926	0.915	0.931
R^2	0.437	0.437	0.561	0.561

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Benchmark FE Regressions: Suicide and log Suicide

	(1) Male level	(2) Male ln	(3) Female level	(4) Female ln
Unemployment rate	0.218**	1.281***	0.131***	2.253***
	(0.094)	(0.410)	(0.044)	(0.543)
Life expectancy	-1.300***	-5.458***	0.067	-0.734
	(0.262)	(1.056)	(0.129)	(1.152)
Fertility	-5.314***	-20.814***	-1.882***	-20.533***
	(1.380)	(5.362)	(0.695)	(6.306)
Divorce rate	1.735**	6.535**	0.542	6.536**
	(0.824)	(2.774)	(0.381)	(2.724)
GDP per capita (in 100$)	0.017***	0.049**	0.017***	0.201***
	(0.005)	(0.024)	(0.003)	(0.032)
Real GDP growth	-0.136***	-0.446**	-0.044***	-0.514***
	(0.050)	(0.182)	(0.015)	(0.169)
Share of 65 years age	0.518**	1.659**	0.102	0.854
	(0.206)	(0.713)	(0.087)	(0.625)
Trend	-0.143*	-0.336	-0.281***	-2.986***
	(0.082)	(0.312)	(0.032)	(0.273)
Constant	116.598***	698.166***	7.826	298.523***
	(18.613)	(74.875)	(9.952)	(91.013)
N	731	731	731	731
rho				
R^2	0.419	0.437	0.465	0.561

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: FE Regressions: Labor Market Institutions and Suicide

	(1) male	(2) Male	(3) Female	(4) Female
Unemployment rate	1.484***	-0.032	2.346***	-0.290
	(0.435)	(0.963)	(0.552)	(0.923)
Life expectancy	-6.982***	-7.155***	-1.799*	-2.351**
	(0.826)	(0.833)	(1.028)	(0.953)
Fertility	-21.765***	-22.656***	-17.379**	-16.266**
	(3.999)	(4.303)	(6.776)	(7.440)
Divorce rate	7.377***	7.419***	6.514***	8.183***
	(1.904)	(2.004)	(1.820)	(2.491)
GDP per capita (in 100$)	0.054*	0.064**	0.194***	0.192***
	(0.031)	(0.030)	(0.030)	(0.024)
Real GDP growth	-0.460***	-0.445***	-0.475***	-0.453***
	(0.156)	(0.153)	(0.143)	(0.138)
Share of 65 years age	2.625***	2.622***	1.875***	2.296***
	(0.612)	(0.623)	(0.654)	(0.557)
Trend	0.193	0.193	-2.723***	-2.663***
	(0.254)	(0.275)	(0.299)	(0.261)
Gross replacement rate	-0.228*	-0.479***	0.281*	0.107
	(0.113)	(0.124)	(0.152)	(0.265)
Employment protection	12.751***	13.097***	11.878***	9.236***
	(1.488)	(1.818)	(1.850)	(2.697)
Interaction GRR		0.049**		0.036
		(0.023)		(0.026)
Interaction EPL		0.045		0.699*
		(0.228)		(0.397)
Constant	754.715***	772.565***	322.315***	364.704***
	(52.535)	(56.045)	(84.711)	(79.771)
N	731	731	731	731
rho				
R^2	0.512	0.522	0.588	0.598

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix

Table A1: Random Effects and Fixed Effects Models: level

	(1) male RE	(2) male FE	(3) female RE	(4) female FE
Unemployment rate	0.192***	0.218***	0.128***	0.146***
	(0.062)	(0.063)	(0.033)	(0.033)
Life expectancy	-1.395***	-1.300***	0.176	0.237**
	(0.203)	(0.212)	(0.108)	(0.111)
Fertility	-5.438***	-5.314***	-2.545***	-2.424***
	(0.762)	(0.765)	(0.372)	(0.375)
Divorce rate	1.846***	1.735***	1.077***	1.058***
	(0.381)	(0.390)	(0.199)	(0.207)
GDP per capita (in 100$)	0.015**	0.017***	0.020***	0.023***
	(0.006)	(0.006)	(0.003)	(0.003)
Real GDP growth	-0.136***	-0.136***	-0.087***	-0.087***
	(0.050)	(0.050)	(0.026)	(0.025)
Share of 65 years age	0.462***	0.518***	0.055	0.074
	(0.128)	(0.130)	(0.070)	(0.073)
Trend	-0.104	-0.143**	-0.323***	-0.352***
	(0.064)	(0.069)	(0.026)	(0.028)
Constant	124.079***	116.598***	0.463	-4.538
	(13.467)	(14.159)	(7.874)	(8.166)
N	731	731	809	809
rho	0.849	0.880	0.756	0.820
R^2	0.418	0.419	0.425	0.426

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2: Robustness with alternative Institutional Variables

	(1) Male_Iv1	(2) Female_Iv1	(3) Male_Iv2	(4) Female_Iv2
Unemployment rate	2.120***	2.950***	0.482*	1.108**
	(0.454)	(0.672)	(0.246)	(0.474)
Life expectancy	-7.126***	-2.413*	-4.383***	-4.953**
	(0.859)	(1.339)	(0.957)	(1.829)
Fertility	-21.105***	-20.804**	-12.973**	-25.646***
	(4.476)	(7.880)	(5.305)	(8.031)
Divorce rate	6.855***	4.580*	3.899	0.756
	(2.462)	(2.290)	(2.336)	(2.439)
GDP per capita (in 100$)	0.107**	0.211***	0.095**	0.208***
	(0.041)	(0.031)	(0.040)	(0.047)
Real GDP growth	-0.393**	-0.499***	-0.564***	-0.172
	(0.174)	(0.181)	(0.173)	(0.336)
Share of 65 years age	2.912***	1.924*	4.838***	4.762***
	(0.799)	(0.971)	(0.792)	(0.730)
Trend	0.080	-2.748***	-1.456***	-2.709***
	(0.358)	(0.270)	(0.323)	(0.313)
Gross replacement rate	-0.427***	0.279	-0.304**	-0.383**
	(0.106)	(0.241)	(0.122)	(0.142)
Employment protection	14.647***	12.283***	7.232***	15.590***
	(1.382)	(2.721)	(1.202)	(2.955)
Constant	750.333***	372.895***	593.161***	573.786***
	(59.055)	(108.463)	(57.568)	(144.090)
N	622	622	405	405
rho				
R^2	0.470	0.541	0.582	0.562

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$