

Unemployment, Global Economic Crises and Suicides: Evidence from 21 OECD Countries

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Abstract

This study explores age- and gender-specific suicide mortality due to unemployment and economic crises, for 21 OECD countries over the period 1960 to 2011. The findings indicate that a higher unemployment rate leads to an increase in suicides in almost all age groups. Further, using dataset on economic/financial crisis events, results show that, in general, these crises increase suicide rates. However, the evidence also shows that economic crises have no effect on those in the 45 to 64 years age group in terms of suicides. Further, we assessed whether suicide mortality can be attributed to a ‘crisis effect’ beyond that of unemployment. For males, we found a significant joint effect between crises and unemployment. Finally, we investigated the possible nonlinear threshold response of suicides to unemployment. We found that suicides among young males (< 45 years) are due to marked increases in unemployment in association with global economic crises.

Keywords: economic crises; suicide mortality; panel data; unemployment; threshold model

JEL Classification: C33, E24, G01, I10

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Introduction

Several studies present the negative consequences of unemployment in terms of suicides (e.g., Oswald [1997] and Noh [2009]). Nordt et al. (2015) show that one out of five suicides is related to unemployment. Blakely, Collings, and Atkinson (2003) report that being unemployed is associated with a two-to-threefold increase in the relative risk of suicide, compared with being employed. In Spain, suicide was the first cause of death for those between the ages 15 and 44, in 2013 (Rivera, Casal, and Currais 2017). Kentikelenis et al. (2011) show that when Greece experienced severe unemployment after the 2008 financial crisis, the number of suicides rose by almost 60%.

The impact of economic crises on suicides has also been addressed in many studies (e.g., Barr et al. [2012] and Stuckler et al. [2011]). Evidence shows that over 10,000 suicides across Europe and North America, between 2008 and 2010, were due to the Great Recession (Reeves, McKee, and Stuckler 2014).

Despite the increased incidence of suicides during the most recent recession, we know surprisingly little about the effects of unemployment on suicides during economic crises. Some studies argue that unemployment has a direct causal influence on suicidal behaviour and that this is independent of the overall economic environment (see e.g., Mäki and Martikainen [2012] and Blakely, Collings, and Atkinson [2003]). A recent study by Norström and Grönqvist (2015) used a fixed-effects model to explore the unemployment-suicide relationship in 30 countries, between 1960 and 2012. The findings show that the impact of unemployment on suicide during the Great Recession was no stronger than that during previous economic downturns. However, Nordt et al. (2015) estimated the nine-fold difference between the number of excess suicides that were specifically attributable to unemployment relative to the number of excess suicides that were attributable to economic recessions, in general, across 63 countries during period 2000 to 2011. Laanani et al. (2015) note that the amplitude of an association between

unemployment rates and suicides rates varied across countries during the 2008 to 2009 economic crisis.

In this study, we provide new evidence on the relationship between unemployment and suicides during economic crises. The novelty of our study is that we are able to reveal whether unemployment *per se* caused excess suicides during the period under review, or whether suicides increased in conjunction with the economic crises that occurred across developed countries from 1960 to 2011. Our panel estimation framework allows us to take into account not only the separate effects of unemployment and economic crises on suicides but also their joint effects on this phenomenon. In previous studies, these effects were modelled in distinctive ways that did not take into account the joint effects of unemployment and an overall economic crisis. Further, we utilize a threshold-effects panel model (Hansen 1999). This approach allows us to examine whether a significant global economic crisis such as the Great Recession 2008, changes the effect of unemployment on suicides. To our knowledge, this is the first study to use threshold analysis in determining the relationship between economic hardship and suicide.

We offer several insights on the relationship between unemployment, economic crises and suicides. First, we observe that arising unemployment rate has an increasing effect on male suicides in almost all age groups across OECD countries. This evidence is in line with Noh (2009) and Breuer (2015), among others, who find that the implied effect of unemployment on suicide rates is positive for higher-income OECD countries. We find that for young males (aged 15 to 24 years), in particular, unemployment seems to lead to relatively large increases in suicides, compared to that of males in other age groups.

Second, we show that economic crises have highly significant effects on suicides. Here, we used the global aggregate crisis index (Reinhart and Rogoff 2009) as a proxy for global economic recessions across countries. To our knowledge, no previous studies used crisis indices to explore the incidence of suicides. A notable finding is that economic crises did not have similar impacts on all individuals. In the age group of those 45 to 64 years old, there is no

significant relationship between any economic crises and suicides. This result suggests that unemployment seems to be the more probable reason, than an economic crisis, for suicides among middle-aged adults.

Third, we investigate whether unemployment affects suicides similarly during economic crises compared to periods when there are no crises. More specifically, we explore whether suicide mortality can be attributed to a ‘crisis effect’ beyond the unemployment effect. However, we were unable to find any joint effect of an economic crises and unemployment when measuring the ‘crisis effect’ using the global aggregate crisis index for females under 65 years of age and for males aged 45 to 64 years. Our results suggest that the national unemployment rate is a distinct economic-hardship factor that affects suicides for people in these groups. For males under 45 years old, we find a strong association of unemployment and a global economic crisis as explaining suicides.

Fourth, we provide a novel contribution to the literature by exploring the possible nonlinear response of suicide rates to unemployment. The results suggest that, especially for young males (under 45 years old), the unemployment effect on suicides markedly increases when the global economic crisis level is high. However, when we excluded those in the older age groups (over 65 years of age), we found that there were no similar effects for the other age groups.

This paper proceeds as follows. Section 2 gives a theoretical context and a literature review on unemployment, economic crises and suicides. Section 3 presents the data, and Section 4 lays out the empirical framework. Section 5 gives the empirical results, Section 6 discusses the results, and Section 7 concludes.

Unemployment, economic crises and suicides

Unemployment and suicides

Unemployment causes several economic problems for individuals, including financial losses,

lower expected income, and a decline in economic opportunities. Furthermore, job loss leads to a reduction in social networks and mental health problems, and it weakens self-esteem and reduces the possibility of using one's skills in employment. Using a meta-analysis of 237 cross-sectional and 87 longitudinal studies, Paul and Moser (2009) found that 34% of the unemployed suffered from psychological problems, while only 16% of the employed suffered from similar problems. In particular, economic downturns are likely to have the greatest negative effect on young people's labour market security. Morrell et al. (1999) show that the relative risk of becoming psychologically disturbed after a job loss is over 50% higher for young people (aged 15 to 24 years) than for those who do not become unemployed.

Unemployment is also a key economic factor in explaining suicides. Nordt et al. (2015) estimate that suicide is associated with unemployment in about 20% of all cases. Platt and Hawton (2000) show that unemployed individuals are almost three times more likely to commit suicide than those who are employed. In a study of 12 developed countries, Yang and Lester (1995), found a strong positive and statistically significant relationship between unemployment and suicide. Hammermesh and Soss (1974) also identified unemployment as one of the main determinants of suicide. Koo and Cox (2008) considered the loss of human capital due to no on-the-job training. This lack of opportunity due to no investment in human capital implies that not only does the current period's income decrease, but the next period's income also declines, leading to an increased risk of mental problems and suicidal behaviour. Chang et al. (2013) note that job loss among young people, in particular, is closely related to suicide rates.

The literature on the economics of suicide (Hammermesh and Soss 1974) predicts that the probability of committing suicide monotonically increases with age.¹ A typical feature is that people can rationally weigh the costs and benefits of committing suicide similarly to how they weigh the costs and benefits of other decisions. Koo and Cox (2008) found that those in

¹ see also Durkheim (1897)

the middle-aged group suffer the most when economic conditions worsen and unemployment increases. Their reasoning is that for the middle-aged it takes relatively longer to adjust to new economic conditions because of the significant drop in their human capital during economic recessions and periods of unemployment. In recent decades, however, the monotonic relationship between suicides and age has vanished. Cutler, Glaeser, and Norberg (2001) show that, between 1950 and 1990, suicide rates among young males tripled while suicide rates among older people vanished.

Joint effects and non-linearities

Unemployment and economic crises cause similar types of economic hardship for individuals. In a study of 63 countries, Nordt et al. (2015) found that suicide rates associated with unemployment increased from 2.75% in 2007 to 3.03% in 2009, indicating an increase of almost 5000 unemployment-related suicides, compared with the pre-crisis level. Since an increase in unemployment typically occurs simultaneously with an economic crisis, it is natural to presume that there might be a close interaction between these two factors. Epidemiologists present two basic theories that might explain the increase in the association between unemployment and suicide during an economic crisis. Causal theory predicts that job loss increases depression, especially during bad economic times, thereby precipitating suicide. Selection theory predicts that individuals who are more likely to commit suicide are also those with a higher probability of losing their jobs during an economic crisis (Mäki and Martikainen 2012).

Laanani et al. (2015) argue that, while unemployment explains a large part of the increase in the suicide rate during the 2008 economic crisis, it is also crucial to identify the other factors that explain this increase. They argue that the high correlation between the impact of unemployment and the impact of the other features of the economic crisis (or the 'crisis effect') makes it difficult to study them independently. For policymakers, however, it is

important to differentiate the reasons for this phenomenon in order for prevention policies to target the right factors.

Overall, the relationship between unemployment and suicide is unclear. Chen et al. (2012) presents a meta-analysis on almost 200 regression results and finds that the relationship between unemployment and suicide is mixed. Their study also emphasizes that there is a publication bias that favors a positive relationship between unemployment and suicide. Andrés (2005), among others, notes that the specification of the empirical model might have a crucial impact on the relationship between unemployment and suicides. While unemployment is a factor that most likely affects suicides, the important question arises as to whether the increase in the number suicides that occur during periods of economic crises is due to unemployment or solely to the crisis or both.

Ruhm (2015) notes that if the unemployment effect on mortality is treated only as being linear, then we might reach false conclusions. Nordt et al. (2015) argue that whether the unemployment level is high or low before an economic crisis markedly affects the impact of unemployment on suicides. Chang and Chen (2017) found that there is asymmetry in the relationship between unemployment and suicide. They note that the effect of an economic expansion on a decrease in the suicide rate is higher than the effect of an economic recession on an increase in the suicide rate for individuals aged over 45 years. Further, Laliotis, Ioannidis, and Stavropoulou (2016) used data on Greece for the period 1999 to 2013 and found that suicide mortality responds non-linearly and asymmetrically to unemployment in the context of economic crises.

Data and measures for economic/financial crisis

We used data on suicides and economic/financial crises, for the period 1960 to 2011, for the following 21 OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal,

Spain, Sweden, Switzerland, the UK, and the US. The suicide data were obtained from the World Health Organization (WHO) Mortality database (2018). This database is a compilation of annual mortality by age, sex and cause of death. We extracted from the database the number of sex-specific suicides by age and country, classified according to International Statistical Classification of Diseases (ICD-9 and ICD-10). We also extracted sex- and age-specific mid-year population figures that were used in calculating suicide rates. The country-specific suicide rates for the total, male, and female suicides were calculated as suicide mortality per 100,000 persons.

We utilized a data set on economic crises that is rarely used in the economic-health literature. This data is provided in Reinhart and Rogoff's (2009) highly cited book, *This Time is Different: Eight Centuries of Financial Folly*.² In addition to crisis measure obtained from Reinhart and Rogoff (2009), country-specific annual unemployment rates are used as for the explanatory variable. The unemployment data were obtained from OECD.Stat (2018).

Some important features of the variables used to represent relative economic hardship should be noted. We argue that the national unemployment level can be seen as a local risk factor for a single country's well-being, but that economic crises are probably more global phenomena as they affect well-being across countries. Hence, in our empirical analysis, we use country-level unemployment rates and the global-aggregate-crisis index, which is a composite index that shows crises in the banking sector, currency valuations, sovereign defaults, inflation, and stock market crashes in 66 countries,³ weighted by their share of world income. This index was obtained from an earlier publication of Reinhart and Rogoff (2009).

² The crises data set is continuously updated and it is freely downloadable from the web page reinhartandrogoff.com/data.

³ The banking, currency, default (domestic and external), inflation, and stock market crash composite index can take a value between 0 and 6 (for any country in any given year), depending on the number of crises occurring in a particular year. For instance, when a country experiences currency, stock market and banking crises simultaneously, the index gets a value 3.

For illustrative purposes, we also formed overall unemployment rates and gender-specific suicide rates for 21 OECD countries, in similar manner than global crises index is computed. In Figure 1, overall male and female suicide rates are plotted together with the global aggregate crises index and the overall unemployment rate for the period 1960 to 2011. All of the variables have been de-trended (with a linear trend) and standardized to have a mean of zero and a standard deviation of one. We can see that the male suicide rate, in particular, seems to have a positive relationship with global crises and the composite unemployment rate. Figure 1 also clearly shows that the global recession of 2008 was the most severe crisis in terms of its magnitude during the entire sample period. Some apparent peaks are distinguished from the figure, especially in the years 1974, 1982, 1997, and 1998. In the mid-1970s, the world encountered its “first oil shock”; whereas in the early 1980s, recessions in the US and Japan were associated with low inflation. The early 1990s was a period where various states experienced turbulence, including severe banking crises in the Nordic countries and Japan, and Mexico’s peso crisis. The Asian financial crisis took place during 1997 and 1998; and was partly paralleled by troubles in the Russian economy, among others. (For a more complete discussion of economic/financial crises, see Reinhart and Rogoff [2009].)

[Figure 1 near here]

We can also distinguish certain peaks in suicide rates over the period. In particular, there were huge increases in male suicides in the mid-1980s and in 1997 to 1998. The unemployment rate was the highest during the oil crisis of 1974 to 1975, during the mid-1980s, around 1994 and, most recently, in the 2009 to 2010 financial crisis.

Empirical specifications

In our empirical analysis we use the following standard panel fixed-effects regression,

$$\ln(sui_{it}) = \alpha_1 + \alpha_2 une_{it} + \alpha_3 crisis_t + \alpha_4 (une_{it} \times crisis_t) + \mu_i + \lambda_i t + e_{it}, \quad (1)$$

where the dependent variable $\ln(sui_{it})$ is the natural logarithm of the suicide rate in country i and year t , and une_{it} is the country level unemployment rate in year t . The variable $crisis_t$ is a measure of the world aggregate crisis index. Using panel data allows us to control for omitted, unobserved, time-invariant and time-varying country-specific effects. Including controls for country fixed effects, μ_i , enables us to fully account for factors that differ across countries but that do not vary over time. In addition, the inclusion of country-specific time trends, $\lambda_i t$, in the model accounts at least for some of the confounding factors that are not time-invariant within countries. Thus, the fixed effects and trends capture biases that are related to the influence of some omitted variables (Tapia Granados and Ionides 2017), such as alcohol consumption, divorce rates and fertility rates. Further, our study differs from many others as we do not use in our analysis covariates that are related to economic activity, such as gross domestic product (GDP) per capita, economic growth and the gini-index. We argue that these measures are not good covariates since they probably explain the same features as do unemployment and measures of economic crises (see e.g., Ionides, Wang, and Tapia Granados [2013] and Tapia Granados and Ionides [2017]).

We begin by separately exploring associations between global economic crises and unemployment, and gender-specific suicide rates for each age group (15 to 24, 25 to 44, 45 to 64, 65+ years, and the total). When analyzing the joint effect of unemployment and economic crises, our key interest is the term $une_{it} \times crisis_t$. More specifically, the interaction term presents the joint effect of economic/financial crises, together with each country's own unemployment rate.

A specific research question that we address is whether the relationship between unemployment and suicide mortality remains stable during recessions, or whether economic crises magnify the effects of unemployment on suicidal behaviour. The interaction term is included to capture the possible excess effect of unemployment during the years of economic

crises. If this variable's coefficient is significantly positive, then we provide evidence that the joint effect between economic crises and unemployment is an increase in the suicide rate.

Empirical results

Table 1 presents the results from the linear panel fixed-effects specification when the effects of unemployment and a global economic crisis are each estimated separately in terms of their effects on suicides. First, we observe a clear positive and statistically significant relationship between unemployment and male suicides for almost in all age groups at the conventional 5% level of significance. The only exception is for males in the over 64 years age group. Unemployment has its highest impact on suicides of males who are from 15 to 24 years old. For females, the association between unemployment and suicide is significant only for those over 65 years old.

[Table 1 near here]

From the lower part of Table 1, we found that as the global aggregate composite crisis index increases, so does the incidence of suicides, especially among males, at the 5% level of significance. However, it is notable that, for males in the 45 to 64 years age group, the crises effect is not significant. For females, the relationship between the global economic crisis index and suicide is only significant for those over 65 years old. When comparing the effects of unemployment and economic crises on suicides, we found some important differences. For both genders in the 45 to 64 years age group, and for females in the 15 to 24 and 25 to 44 years age groups, our results show that only unemployment increases suicides. This result implies that, for people in these groups, only unemployment seems to affect suicides.

As stated earlier, it is crucial to take into the consideration both the unemployment rate and the "crisis effect", when assessing whether unemployment causes an increase in suicide rates. Table 2 shows the regression results for the effects of both factors on suicides, including the interaction term for the global composite aggregate crises index and each country's own

unemployment rate, $une_{it} \times crisis_t$, as presented in Eq. (1). We found that the effect of a global economic crisis does not change the significance of the pure unemployment effect. The pure crises effect is significant only for females over 65 years of age.

Our results also show, however, that the unemployment parameter estimates are higher compared to those presented in Table 1. This probably reflects some connection between unemployment and global economic crises. Hence, we formally tested whether unemployment and economic crises have distinct effects on suicides. The association between suicide and unemployment under a significant interaction term is tested with hypotheses $H_0: \alpha_1 = \alpha_4 = 0$ for equation (1).

[Table 2 near here]

For males in the 15 to 24, 25 to 44 and over 65 years age groups, we found that when high unemployment and a global economic crisis are contemporaneous, this is associated to higher levels of suicides. For females, evidence shows that national unemployment has a joint effect with global economic crises in terms of their affecting suicides across countries, but only for those in the over 65 years age group. For males in the 45 to 64 years age group and for females under 65 years old, there is no joint effect between these economic-hardship variables. For these groups, we can see that the effect of economic hardship on suicides comes solely from unemployment. Since in these models the crises and interaction variables can be regarded as redundant variables, one should only read the unemployment effects on suicides in Table 1.

Threshold effect of unemployment on suicides

In this section, we explore whether the relationship between unemployment and suicides depends on the level of the global economic crisis. We consider the following fixed-effects panel single-threshold model:

$$\ln(sui_{it}) = \beta_0 + \beta_1 une_{it} I(crisis_{it} < \gamma) + \beta_2 une_{it} I(crisis_{it} \geq \gamma) + \theta_i + \delta_i t + u_{it} \quad (2)$$

where $crisis_{it}$ is the threshold variable, and the threshold parameter γ divides the equation into two regimes (high and low) with coefficients β_1 and β_2 . The parameter θ_i is the country-specific effect, whereas u_{it} is the disturbance term. The model also includes country-specific linear trends, δ_{it} .

Table 3 summarizes the estimation results for the threshold regression. We test whether it is more appropriate to use the nonlinear threshold specification, to explain the association between unemployment and suicides, than the linear specification, i.e., $H_0: \beta_1 = \beta_2$. This hypothesis can be tested by using the likelihood ratio test $F = (S_0 - S_1)/\hat{\delta}^2$, where S_0 is the sum of the squared residuals of the linear model; S_1 is the sum of the squared residual of the threshold model; and $\hat{\delta}^2$ is the residual variance of the panel threshold estimation.

We reject the linearity of the null hypothesis (stability of the estimate of the unemployment parameter) in the 15 to 24 and 25 to 44 age groups for males and in the over 65 years age group for females. Evidence suggests that, for these age groups, the unemployment effect significantly increases when the global economic crisis is a high-level one. In the 25 to 44 age group, the unemployment effect on suicides almost doubles when the global economic crisis level moves from the lower regime (under 29.4% of maximum) to the higher regime (above 29.4% of maximum). This finding reflects the severity of the unemployment effect among those in this age group during a severe economic crisis. We also observe that, for these cases, both regimes consist of relatively large numbers of observations, implying the consistency of our estimates. When a global economic crises is used as a threshold variable, we confirm the results of the previous section, which show that, for young males, the unemployment effect responds markedly differently on suicides in the context of a high-level global economic crisis compared to working-aged males.

[Table 3 near here]

For robustness, we excluded the recent global crisis (2008 to 2009) to be sure that our results

do not depend on a single peak in the global economic crisis index. The results are in line with the analysis of the whole data set. However, the threshold level is now higher than the maximum, reflecting the severity of the 2008 to 2009 crisis. To save space, we have not reported these results but they are available upon request.

Discussion

Our study indicates that the most important variables of economic hardship—unemployment and economic crises—seem to have somewhat different impacts on suicides. In line with the previous literature, we show a positive relationship between unemployment and suicides across genders and age groups. Evidence shows that unemployment is probably the most robust single economic-hardship factor in terms of increasing suicides in developed countries. The effect of economic/financial crises on suicides is more mixed. When compared to the impact of unemployment, we found that the impact of economic crises distinctively differs for males aged 45 to 64 years and for females under 65 years of age. Among those in these age groups, only unemployment seems to be associated with suicides.

We also found that unemployment and economic crises seem to have relatively large adverse joint effects, especially on suicides among young men. Particularly striking is the high association between unemployment and suicides during economic crises for males under 45 years old. A high-level global economic crisis will double the effect of unemployment on young males' suicidal behaviour, relative to that during more normal economic times. It seems that young men are largely not resilient against severe economic downturns. A young individual who loses his/her job would be in a particularly harmful situation during an economic crisis, since they face poor prospects in finding a new job. Evidence indicates the need for tailored policy responses to young people's economic hardships, especially during economic crises.

Our study also offers important methodological insights regarding the relationship between unemployment and suicide. Using panel-interaction-regression and threshold panel

fixed-effects models, we found robust evidence that the level of the global economic crisis affects the relationship between unemployment and suicides among males under 45 years of age. Although it is difficult to establish the mechanism that underlies the threshold effects without the benefit of more specific national data on indicators, such as health expenditures, social safety nets, unemployment benefits and related factors, we argue that threshold models shed more light on issues that concern economic hardship and suicides.

We also emphasize the importance of the definition of economic crises. Ruhm (2015) argues that there is no clear-cut definition of an economic crisis, thus, the results might be sensitive to the recession criteria selected. Many studies take an arbitrary approach to identifying an economic/financial crisis, especially with respect to their start and end periods. In addition, there are several different definitions for an economic recession. Most studies describe it as a sustained reduction in economic productivity, which is often measured by a negative change in GDP or an increase in unemployment. A recession can also be defined within an economic business cycle in which there are cyclical upturns and downturns. For example, the National Bureau of Economics Research (NBER), in the US, defines an economic recession as a contraction that occur within an economy cycle. We argue that the global crisis index, as it was adapted for Reinhart and Rogoff (2009), is more trustworthy for several reasons. First, the index presents clear global-level starting and ending periods for each crisis. Second, this aggregate index is a continuous variable that allows us to use it as an explanatory variable (not as dummy-variable) in a panel-estimation framework. Third, since the global economic crisis index is compiled using a sample of 66 countries and accounts for about 90 percent of the world's GDP, this index truly proxies the world's economic turbulence.

Our study is not without its limitations. It is important to mention the possible role of omitted variables. For example, gun ownership, environmental effects, country-based suicide prevention programs and other relevant factors might affect to our estimates. Also, due to austerity policies that are brought in after severe economic crises, there is limited access to

social services and medical treatment in many countries (Norström and Grönqvist 2015). In general, the function of the welfare state can influence the economic consequences of unemployment and economic crises, in particular in the level of social benefits provided and access to social services. A severe crisis might also lead to a shielding effect, where the impact of a job loss might feel less severe or harmful because many others are also in the same situation (Huikari and Korhonen 2016).

The present study is not sufficient to a complete understanding of the directions and magnitudes of unemployment and economic crises on suicides. To shed more light on these issues, more individual-level data is required. In particular, we need a more comprehensive picture on how individuals' suicidal behaviours during times of economic hardship are related to mental illness, depression, and alcohol abuse, among other factors.

Conclusions

In this study, we analyzed the effects of economic crises and unemployment on suicides across genders and age groups in 21 OECD countries for the period 1960 to 2010. We used data that covers a longer time period than other similar studies, and included the unemployment effect in our analysis. Our findings show that unemployment has a robust positive association with suicides for both genders and almost all age groups but the effect of global economic crises is not as clear. We also indicate that economic crises have no effect on those in the 45 to 64 years age group.

We also explored the pure unemployment effect on suicides, relative to the effect of economic crises. Many previous studies had difficulties distinguishing between the impacts of unemployment on suicide rates and that of the 'crisis effect' because of their high correlation. However, we utilized both interaction and threshold regression models to separate these effects and found two key results. First, unemployment independently explains suicide mortality for females under 65 years old and for males in the 45 to 64 years age group in the developed

countries under review. Second, the unemployment effect on young males (under 45 years old) and suicides is markedly dependent on the seriousness of the global economic crisis.

One implication of our results is that policymakers should concentrate on the effects of unemployment on individuals' suicidal behaviour. During economic crises, however, policy should guard against crisis-specific effects. In addition, in order to try to alleviate the negative and possible fatal effects of economic crises, it is important to identify the most vulnerable groups of people. The well-being of young people, in particular, seems to be negatively affected by both the national unemployment level and global economic crises.

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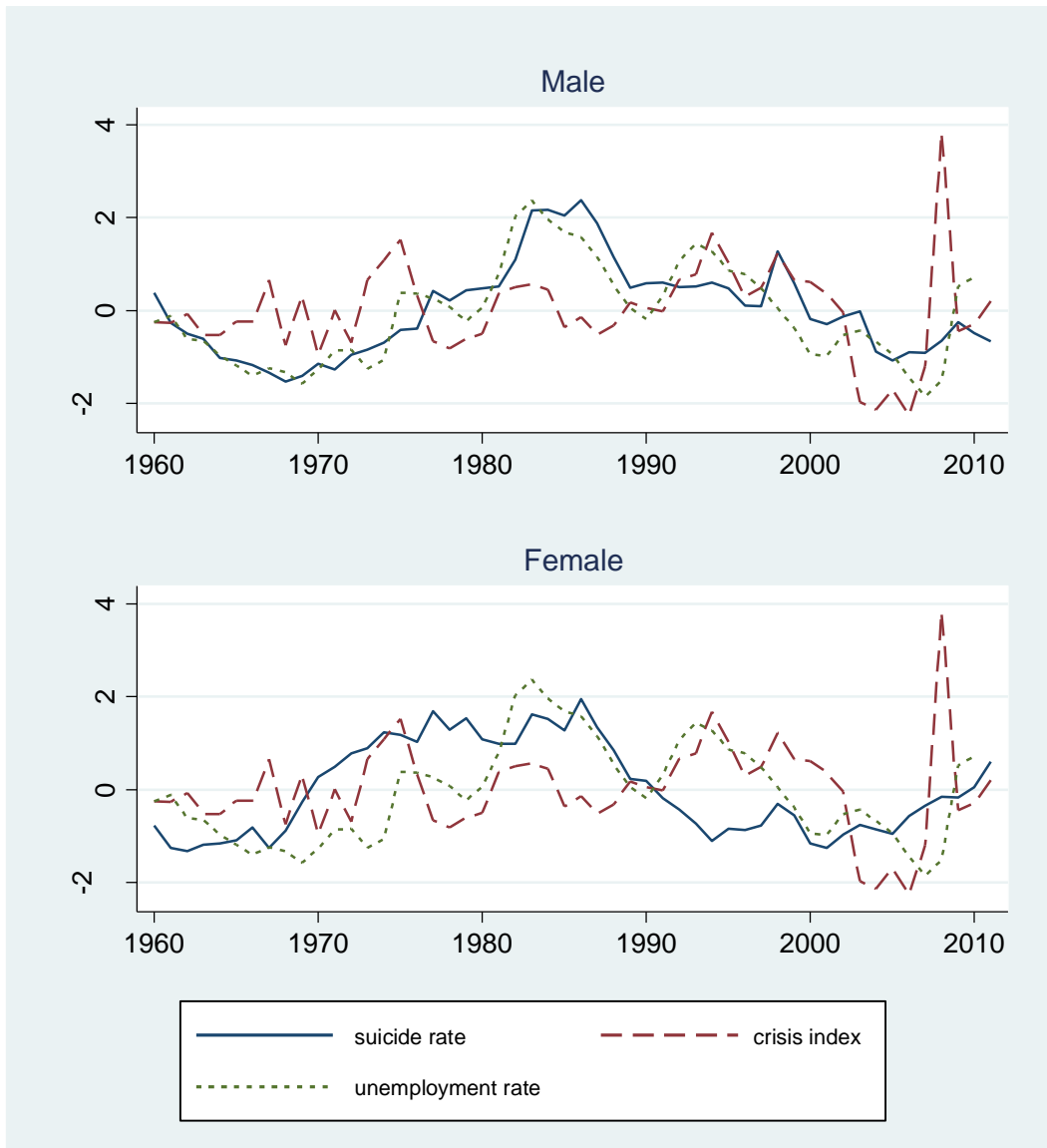
Acknowledgements

This work was supported by the Finnish Cultural Foundation [00150254 to S.H.]. We thank participants of the XXXVX Annual Meeting of the Finnish Economic Association in Jyväskylä, Finland and the European Winter Meeting of the Econometric Society 2017, in Barcelona, Spain for their constructive comments. Huikari thanks the Finnish Cultural Foundation (personal grant #00150254) for its financial support.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Figure 1. Overall male and female suicide rates, world aggregate crisis index and overall composite unemployment rate for 21 OECD countries 1960 to 2011.



Note. All variables have been detrended (with a linear trend) and standardized to have mean of zero and standard deviation of one. Source of the data: WHO (2018), OECD.Stat (2018), Reinhart and Rogoff (2009), and authors' own calculations.

Table 1. Estimation results of models that explain suicide using unemployment and the world aggregate composite crisis index.

	<i>Male</i>	<i>Female</i>	<i>Male</i> <i>15-24</i>	<i>Female</i> <i>15-24</i>	<i>Male</i> <i>25-44</i>	<i>Female</i> <i>25-44</i>	<i>Male</i> <i>45-64</i>	<i>Female</i> <i>45-64</i>	<i>Male</i> <i>≥ 65</i>	<i>Female</i> <i>≥ 65</i>
<i>Une</i>	0.016** (0.007)	0.017** (0.007)	0.039** (0.015)	0.030* (0.016)	0.019** (0.009)	0.020* (0.011)	0.020*** (0.006)	0.015* (0.008)	0.011 (0.008)	0.014** (0.006)
\bar{R}^2	0.95	0.95	0.89	0.84	0.92	0.91	0.93	0.93	0.93	0.95
<i>N</i>	1063	1063	1059	1054	1062	1061	1062	1062	1059	1059
<i>Crisis</i>	0.089*** (0.027)	0.074** (0.030)	0.241*** (0.066)	0.060 (0.061)	0.121*** (0.032)	0.042 (0.037)	-0.008 (0.021)	0.025 (0.039)	0.111*** (0.026)	0.163*** (0.030)
\bar{R}^2	0.93	0.92	0.83	0.82	0.90	0.89	0.91	0.89	0.91	0.92
<i>N</i>	1063	1063	1059	1054	1062	1061	1062	1062	1059	1059

Note: The dependent variable in all of the regressions is the natural logarithm of the suicide rate.

Estimations that use unemployment (*Une*) as the explanatory variable include country-specific fixed effects, year-specific period effects, and country-specific linear trends. Estimations that use the crisis index (*Crisis*) as the explanatory variable include country-specific fixed effects and country-specific linear trends. All estimations are weighted by the square root of the population. Robust standard errors, clustered at the country level, are presented in parentheses under the coefficients. *** Statistically significant at 1% significance level. ** Statistically significant at 5% significance level. * Statistically significant at 10% significance level.

Table 2. Estimation results for unemployment, the world aggregate composite crisis index and their interactions on suicide mortality.

		<i>Male</i>				
		<i>All</i>	<i>15-24</i>	<i>25-44</i>	<i>45-64</i>	<i>≥ 65</i>
<i>Une</i>		0.023** (0.008)	0.064*** (0.013)	0.031*** (0.010)	0.010 (0.008)	0.018* (0.009)
<i>Crisis</i>		0.013 (0.071)	0.197 (0.165)	0.060 (0.083)	-0.093 (0.057)	0.050 (0.069)
<i>Une*Crisis</i>		0.007 (0.009)	-0.007 (0.019)	0.003 (0.010)	0.011 (0.008)	0.006 (0.008)
<i>H₀: α_{crisis}=</i>	<i>α_{une*crisis}=0</i>	15.68*** (<0.001)	8.63*** (0.002)	18.62*** (<0.001)	1.53 (0.242)	27.46*** (<0.001)
	\bar{R}^2	0.944	0.862	0.913	0.919	0.917
	<i>N</i>	1063	1059	1062	1062	1059

		<i>Female</i>				
		<i>All</i>	<i>15-24</i>	<i>25-44</i>	<i>45-64</i>	<i>≥ 65</i>
<i>Une</i>		0.027* (0.013)	0.034** (0.013)	0.025 (0.016)	0.018 (0.016)	0.036** (0.014)
<i>Crisis</i>		0.101 (0.083)	0.087 (0.179)	0.076 (0.112)	0.062 (0.089)	0.185** (0.086)
<i>Une*Crisis</i>		-0.010 (0.011)	-0.012 (0.021)	-0.010 (0.015)	-0.009 (0.013)	-0.011 (0.012)
<i>H₀: α_{crisis}=</i>	<i>α_{une*crisis}=0</i>	1.53 (0.241)	0.20 (0.817)	0.24 (0.788)	0.27 (0.770)	9.94*** (0.001)
	\bar{R}^2	0.927	0.831	0.893	0.895	0.923
	<i>N</i>	1063	1054	1061	1062	1059

Note: The dependent variable in all of the regressions is the natural logarithm of the suicide rate. Unemployment rate (*Une*), crisis index (*Crisis*), and interaction term between unemployment rate and crisis index (*Une*Crisis*) are used as explanatory variables. The crisis estimates, the estimates of the interaction terms, and their standard errors are multiplied by 100. All of the estimations include country-specific fixed effects and country-specific linear trends. All of the estimations are weighted by the square root of the population. Robust standard errors, clustered at the country level, are presented in parentheses under the coefficients. A Wald test is used for testing hypothesis $H_0: \alpha_{crisis} = \alpha_{une*crisis} = 0$, and the associated *p*-value is presented in parentheses under the value of the test statistics. *** Statistically significant at the 1% significance level; ** Statistically significant at the 5% significance level; * Statistically significant at the 10% significance level.

Table 3. Results of the threshold estimations for the period 1960 to 2011.

<i>Male</i>	β_1	β_2	<i>Threshold</i>	<i>crisis</i>	$H_0: \beta_1 = \beta_2$	n_1	n_2
			<i>value (% of max)</i>	<i>p-value</i>			
<i>15-24</i>	0.026** (0.010)	0.051*** (0.008)	46.17 (29.02)		<0.001***	546	546
<i>25-44</i>	0.019** (0.008)	0.033*** (0.007)	46.17 (29.02)		0.007***	546	546
<i>45-64</i>	0.020* (0.010)	0.018** (0.007)	29.37 (18.46)		0.980	252	840
≥ 65	0.013* (0.007)	0.023*** (0.007)	54.39 (34.19)		<0.001***	672	420
<i>Female</i>							
<i>15-24</i>	0.006 (0.010)	0.016* (0.008)	26.73 (16.80)		0.703	189	903
<i>25-44</i>	0.016 (0.014)	0.024* (0.012)	29.37 (18.46)		0.450	252	840
<i>45-64</i>	-0.004 (0.018)	0.009 (0.015)	29.37 (18.46)		0.267	252	840
≥ 65	0.001 (0.017)	0.024 (0.015)	47.40 (29.80)		<0.001***	546	546

Note: β_1 and β_2 are estimates of the unemployment parameters in two regimes. The maximum value of the aggregate crisis index for the period 1960 to 2011 is 159.08. The F -test was used to test whether the unemployment coefficients are the same in both regimes. P -values were obtained by bootstrapping the critical values of the F -statistic to test the significance of the threshold effect. n_1 and n_2 are the sample sizes of the two regimes. **Statistically significant at the 5% significance level; *Statistically significant at the 10% significance level.