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**THE ECONOMIC CRISIS AND DEATH BY SUICIDE IN SPAIN:
EMPIRICAL EVIDENCE BASED ON A DATA PANEL AND
THE QUANTIFICATION OF LOSSES IN LABOUR
PRODUCTIVITY**

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The economic crisis and death by suicide in Spain: Empirical evidence based on a data panel and the quantification of losses in labour productivity

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Abstract

In 2013, the suicide rate in Spain went up by more than 9% with respect to the previous year. Suicide thus became the first cause of death between the ages of 15 and 44. This increase could be related to the serious economic recession that Spain has been experiencing in recent years. In this study, the panel data technique used demographic-type variables and those related to the economic cycle. We also used the suicide rates for the Spanish regions in the period between 2002 and 2013. Moreover, there is a lack of evidence to help assess to what extent these suicides have a social cost in terms of losses in human capital. Consequently, an estimate is made of the losses in labour productivity owing to these suicides. The results provide a strong indication that a decrease in economic growth and an increase in unemployment negatively affect suicide rates. Due to suicide, 37,250 potential years of working life were lost in 2012. This has an estimated cost of over 534 million Euros. The economic crisis endured by Spain in recent years has played a role in the higher suicide rates one can observe from the data in official statistics. From a social perspective, suicide is a public health problem with far-reaching consequences.

Keywords: Suicide rates; economic crisis; unemployment; lost labour productivity, Spain.

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1. Introduction

In Spain, suicide is the number one external cause of death. According to data from the *National Statistics Institute (Instituto Nacional de Estadística- INE)*, there were 3,870 deaths from suicide in 2013, an increase of more than 9% from the previous year (INE, 2014a). In 2013, the suicide rate was 8.2 for every 100,000 inhabitants, the highest rate since 2005. These data are even more noteworthy if one considers that suicide is the number one cause of death in the population aged between 15 and 44, making up 12.6% of the total number of deaths in this age bracket. At the same time it is within this age bracket that the greatest proportion of an individual's working life takes place

Both the economic crisis endured by European countries since 2008 and its possible impact on the population's health have been in the spotlight of recent studies. On the whole, this impact was particularly felt in Southern European countries like Greece, Portugal, Italy and Spain. These countries are more vulnerable and have low social investment (Ruiz-Ramos et al., 2014; De Vogli et al., 2013). Spain has been among the most severely affected by unemployment and austerity policies during the present economic crisis, which has come to be considered the most far-reaching and long-term crisis in its modern history.

To a certain extent, it is possible to attribute the increased suicide rates in Spain to the fierce economic crisis the country has experienced in recent years. Some reports confirm that suicide rates have risen since 2008, with the most marked increases in those countries most affected by the economic recession (WHO, 2013). Changes in suicide rates coincide with changes in unemployment and the insecurity caused by anticipating job loss. This trend has negative repercussions on the various indicators for the mental health of those affected.

Suicide is not a mental illness in itself, but a serious potential consequence of mental conditions such as major depression and schizophrenia as well as bipolar, post-traumatic stress, borderline personality, substance use disorders and those related to anxiety, like bulimia and anorexia nervosa. Suicide is one of the more serious psychological complications, representing a public health problem that has a major cost for all elements within society as far as the potential years of working life that are lost. Moreover for those closest to the suicide victim, there are also emotional and social economic costs.

In this study, steps have been taken to find the relationship between the economic crisis and the suicide rate in Spain. To do so, a panel data model is used to consider different variables related to the economic cycle. Demographic variables and the suicide rates for regions across Spain from 2002 to 2013 also come into play. On the other hand, there is a shortage of literature that assesses the social cost of suicides in Spain. Therefore, a second objective here has been to estimate lost productivity caused by suicide-related deaths in 2012. This was the last year in which data had been available to carry out the calculation. A cost analysis of the illness is done by means of a human capital model (Becker, 1964; Grossman, 1972, 2000).

With this two-pronged objective, the article takes on the following format. Firstly, there is an overview of the main findings from articles that deal with the relationship between the economic crisis and suicides. Section 3 describes the nature of suicide in Spain and its current economic context. The next section provides the estimations done through a data panel methodology. Quantifying the economic cost of deaths by suicide in Spain in 2012 is the focus of Section 5. The article finishes by providing the main conclusions and explaining how public policy could embrace some of these concepts.

2. The economic crisis and suicide: background and previous findings

Since the end of the XIX century, there has been an extensive amount of theoretically sound literature dealing with how economic and social changes have an impact on suicide rate trends. One of the pioneering works in this field was carried out by Durkheim (1897). According to this author, a lower degree of social integration and regulation can be seen in periods of economic depression. A possible result of this is an increase in the suicide rate. In this sense, having a job leads to financial and social resources, which in turn provide greater integration, self-esteem and social relations. Similarly, authors like Dublin and Bunzel (1933), Henry and Short (1954) or Ginsberg (1966) relate the rise in suicides with a recessive economic cycle or a drop in suicides with an expansive cycle.

Hamermesh and Soss (1974) broke new ground by dealing with the relationship between suicide and the economy by developing an economic model. Conditions such as level of income, unemployment and life expectancy are key in determining if individuals adopt suicidal behaviour. The authors conclude that income produces negative variations in suicidal tendencies, while an individual's age causes direct variations. As an individual grows older, his or her cost of living increases and suicidal tendencies go up as well. Yeh and Lester (1987) analysed demand and supply in relation to suicidal behaviour. Their main finding is that demand for suicide is linked to the relationship between the probability of a person committing suicide and the psychological level of suffering he or she is willing to tolerate. A higher cost means individuals are less likely to kill themselves. When conditions are balanced, the authors include the possibility of intervention in their model so that suicide can be prevented.

The relationship between suicide and economic instability was examined in the periods of economic crisis preceding the present one. One such period under study took place in Southeast Asia in the late 1990's (Chang et al., 2009). Covering a series of extended time frames, *the Center for Disease Control and Prevention* analysed the suicide rates between 1928 and 2007. They found that suicides rise and fall in accordance with economic cycles, particularly among people of working age (Luo et al., 2011).

As for the more recent empirical studies that examine that effects of the 2007 economic recession on the population's state of health, authors like Stuckler et al. (2011), Economou et al. (2011), Reeves et al. (2012) and Sullivan et al. (2013) show how, since the start of the crisis, the population's state of health has declined, while the suicide rate have gone up. Among others, Mckee et al. (2012), or Antonakakis

(2013) provide evidence for this rise in suicides in those European countries experiencing the harshest financial reforms. Madianos et al. (2014) studies the effect of Greek economic on suicide rates. Focusing on the effect from 1990 to 2011, they reach the conclusion that the austerity measures imposed on their country, such as restrictive public health policies, lead to a higher risk of depression and suicides. To be more specific, they found that job losses and other variables, like the public debt as a percentage of the Gross Domestic Product (*GDP*), have directly and significantly affected suicide rates.

Unemployment plays a role in the relationship between a situation of economic crisis and suicide. Since the study done by Breed (1963), many other authors have made the positive link between unemployment and suicide: Sutckler et al. (2011) or Reeves et al. (2012) in the United States (*US*), Andrés et al. (2011) in Japan, Tapia (2005) in Spain and Browning and Heinesen (2012) in Sweden. Chen et al. (2009) compares the characteristics and determinants of suicide in Japan with those found in 21 *OECD* countries from 1980 to 2000. Their main finding is that the incidence of suicide is lower in the countries that enjoy the best economic conditions and a uniformly distribute income.

Milner et al. (2013) systematically review studies that cover the problem of long-term unemployment. The authors show how people who have been unemployed for over five years may be at a high risk of suicide. Along similar lines, Chen et al. (2012) carry out an extensive overview of the economic literature on suicide that confirms a positive correlation between high unemployment rates and suicide.

In terms of analyses based on panel data, Breuer (2014) studies the influence of economic activity on suicides within 275 European regions between 1999 and 2010. The results provide sound evidence to back the hypothesis that unemployment has a significant and positive impact on the number of suicides. Moreover, the interval of working age is the collective at greatest risk. Between 1979 and 2010, Defina and Hannon (2014) use panel data from US states to study the relationship between unemployment and suicides. The data show that the impact of unemployment on how many suicides are committed is insignificant during the first half of the period under study. However, there is a very marked impact in the second half, especially when the recent recession began.

As for studies carried out in Spain, one of the most noteworthy is the one done by López et al. (2014). In this study, time series analyses are employed to examine the relationship between the current economic crisis and the suicide rates registered in Spain between 2005 and 2010. The authors found that a rise of around 8% in the suicide rate could be associated with the financial crisis racking the country. This effect was felt most in northern communities and in the Mediterranean region, as well as among young people of working age. Using a regression analysis, Córdoba-Doña et al. (2014) examined an excess of suicide attempts in the region of Andalucía from 2008 to 2012, with respect to the historical trend observed in the previous five years. The results indicated there had been an increase in suicide attempts since the economic crisis began. This was especially the case in the age interval between 35 and 54 years old.

3. Characteristics of suicide in Spain and its social economic context

Current situation of suicide-related deaths in Spain

World Health Organization (WHO) estimates place the average global suicide rate for 2012 at 11.4 out of 100 000 people (15.0 for men and 8.0 for women). In Europe, it is 12.0 out of 100 000 people (20.0 men and 4.9 women). The difference observed for the sexes in the suicide rate is most marked in countries with high incomes and in the age group between 15 and 29 years old (*WHO*, 2014).

In Spain, the suicide rate in 2013 was 8.2 out of 100 000 people, while the break down by gender was 12.5 for men and 4.0 for women. Suicide-related death for that year was the thirtieth cause of death in Spain, representing 1.0% in the total cause of death distribution. Nevertheless, the incidence of this cause of death is greater when the age of individuals is considered. The vast majority of these deaths involve young people and middle aged adults. In 2013, about 31% of suicide victims in Spain were aged between 15 and 44 years old (1 198 people), representing 12.6% of the total number of causes of death produced in this age interval (Table 1).

2013 was the second consecutive year since the registers had been codified according to cause of death that “suicide and self-inflicted injuries” took first place among the young Spanish population. It even exceeded deaths caused by “motor vehicle traffic accidents”, thus representing 26.5% of the top ten causes of death in the population between 15 and 44 years old.

Table 1. Top ten causes of death among the population between 15 and 44 years old in Spain (2013).

CAUSE OF DEATH	Number of Casualties
1. Suicide and self-inflicted injuries	1,198
2. Motor vehicle traffic accidents	707
3. Malignant breast tumour	425
4. Other illnesses affecting nervous system and sensory organs	385
5. Other heart conditions	376
6. Malignant tumour in the trachea, bronchia and lungs	307
7. Heart failure, death in the absence of medical assistance, other unknown causes	306
8. Acute myocardio infarction	286
9. Accidental ageing through psycho-pharmaceutical or recreational drugs	271
10. Malignant brain tumour	257
Total deaths top 10 causes	4,518
% top 10 causes out of the total for causes	47.60%
% suicides out of the top 10 causes	26.52%
% suicides out of the total for 15-44 year olds	12.62%

Source: Authors' own based on *INE* data (2014a)

Since 2007 the weighting for this cause of death on the total number of deaths within this age range went up by four percentage points. This datum coincides with a far hard-hitting economic crisis in Spain. Due to this crisis, severe cutbacks had been made in the country's budget. In turn, these measures directly affected how state money was spent in public services and health, among other areas. Health service workers were laid off or had their salaries reduced; pharmacy prescription policies were changed; health centres were closed and the social safety net had shrunk (Gene-Badia, 2012; Houston et al., 2011).

Socio-economic context in Spain

From that year, 2007, onwards, the economic dynamics of Spain and other European countries have been characterised by a sharp fall in economic activity. This has led to negative trends in the *GDP* per capita, thus marking the 2007-2014 period as a depression. Since the time records had started to be kept through the *Spanish National Accounts*, this was the first time in six consecutive years that the real *GDP* per capita continued to fall. Thus, this crisis could be characterised as the longest and most serious one in modern Spanish history (Maluquer, 2014).

This drop in economic activity had repercussions on the job market. The number of people out of work rose, going from just over 1.8 million in 2007, with an unemployment rate of 8.2%, to 6.5 million in 2013, with a rate of 26.09%. The only *European Union (EU)* country that exceeded these figures was Greece, whose unemployment rate was 27.5%. Long-term unemployment trends were particularly alarming in Spain. In 2013, the rates for these were 12.5% among men and 13.5 among women. These numbers were well above *EU-28* averages (5.2 for men and 5.1 for women).

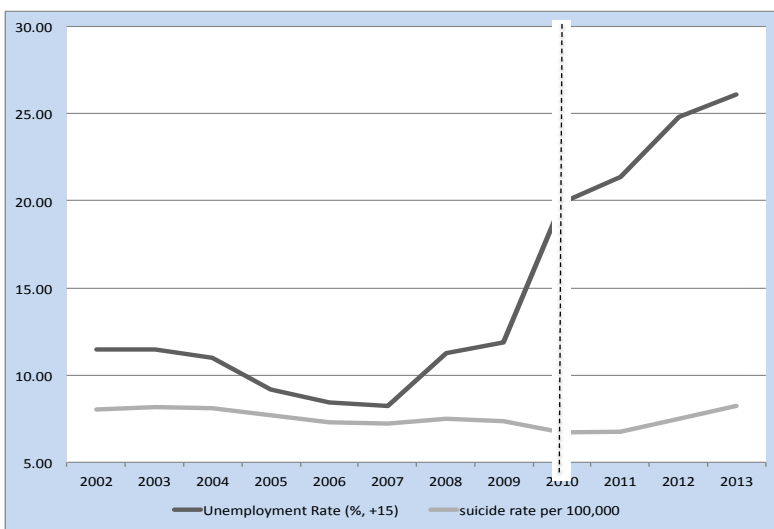
The consequences of long-term unemployment burden individuals and their families. For example, the protection of the welfare state is slowly eroded and unemployment benefits dwindle. On the one hand, the skills of the workforce become obsolete. On the other, the long-term unemployed feel unmotivated to look for work. Moreover, youth unemployment, which has always been a concern in the Spanish labour market, has become much worse since the crisis started. In 2013, 55.5% of the active workforce between 16 and 24 years old found themselves without work. The unemployment rate in 2007 for that age group was 18.1% (*INE*, 2014b). As a result of this situation, living conditions for many Spanish were altered with family incomes decreasing and salaries and pensions reduced. The welfare state provided fewer handouts and coverage in terms of support. The rates for those at risk of poverty went from 19.7% in 2007 to 20.4% in 2013 (*INE*, 2014c).

Graph 1 represents how the unemployment rate has evolved alongside the suicide rate in Spain between 2002 and 2013. From the mid-1990's onwards, the Spanish job market had been extremely dynamic and this trend was boosted between 2003 and 2007 with a spurt in economic growth. The real *GDP* exceeded 3%. Nevertheless, from 2007, that trend began to experience a point of inflection. Although, the unemployment rate climbed steadily, there was a certain delay in the unemployment rate's impact on suicide figures. Not until 2010 did this increase in job losses coincide with an increase in global suicide

rates. In part, this delay may be explained by the fact that the jobless could rely on the safety net of state benefits in the period after they had lost their jobs.

These results seem to support the hypothesis that there is a direct relationship between the variables on which the economic crisis has an impact and the observable increase in deaths by suicide in Spain over the recent years. Nevertheless, these determinants also require a more specific analysis and attention must be given to each of the Spanish regions. It is necessary to look at how the main economic variables considered to have a significant influence on an individual's decision to end his or her life evolve over time. For this purpose, a data panel may be used.

Graph 1. Evolution of the unemployment and suicide rates (Spain, 2002-2013)



Source: Produced by the authors with *INE* data (2014b, 2014c)

4. Methodology

This study examines the relationship between the suicide rate and the economic cycle. It makes use of a data panel for the 17 regions of Spain based on the 2002-2013 period. Information about suicide rates are collected, along with the different variables presented in the literature as potential precursors to this cause of death.

Data

The suicide rates are modelled in accordance with the literature that has been consulted. As variables that approximate the economic cycle, the unemployment rates and the regional growth rate for the gross domestic product have been gathered. The former is calculated as the percentage of jobless with respect to the active working population, while the regional growth rate for the *GDP* is expressed as the interannual variation for the *GDP* per capita.

Other variables, such as life expectancy, are taken into account. Earlier results show how an increase in life expectancy reduces the suicide rate in the reference population (Hamermesh and Soss, 1974). This figure is defined as the average number of years those belonging to a certain generation would live; within each age range these individuals are subjected to the observed mortality pattern. Earlier studies also indicate that age is another determining factor in suicide rates. Abellán (2005) points out that suicide rates grow as people get older; this trend is more marked with the population over 65. The models proposed in this study collect age structure data for the regions with the average age variable.

Fertility rates are also included as an explanatory variable in the estimates. Their use has recurred in literature as an indicator of the individual's integration into society. This rate can be defined as the total number of births per 1 000 women of fertile age. The presence of children heightens an individual's ties to his or her family and to society, making it less likely for that person to commit suicide (Durkheim, 1951). Various studies demonstrate that there is a negative relationship between fertility rates and suicide (Yang and Lester, 1992; Andrés, 2005). A final consideration is that suicide rates are higher among men. Therefore, differences between the sexes are also collected in the analysis by means of the sex ratio for each region during that time period (Andrés et al., 2011).

Table 2 provides the descriptive statistics for the set of variables used in the estimations.

Table 2. Variable labels, definitions and summary statistics for the full sample of observations

<i>Label</i>	<i>Definition</i>	<i>N</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
unemp	Unemp. rates: % of unemployed with respect to total active population	204	14.12	7.23	4.72	36.22
fertility	Fertility rate: total births per 1 000 women at fertile age	204	39.96	5.20	25.28	52.35
suicide	Total suicides per 100 000 inhabitants	204	7.86	2.13	1.46	13.86
av_age	Average age	204	41.35	2.25	36.83	46.53
gdp_growth	Annual percentage growth rate of GDP per capita	204	0.16	2.57	-6.97	4.90
life_expec	Life expectancy at birth	204	81.29	1.24	78.38	84.26
sex_ratio	Number of males per every 100 women	204	97.83	2.88	91.89	102.95

Source: INE (2014). Unemployment data are from the *Economically Active Population Survey (Encuesta de Población Activa - EPA)* (INE, 2014b); the variable that includes the annual percentage growth rate of GDP per capita has been taken from the *Spanish Regional Accounts (Contabilidad Regional de España - CRE)* (INE, 2014d); life expectancy at birth and fertility were culled from the *Vital Statistics (Movimiento Natural de la Población)* (INE, 2014e). Average age and the sex ratio came from the local governments' census, called *Continuous Register Statistics (Estadística del Padrón Continuo)* (INE, 2014f). Data on suicide come from the document that registers deaths by cause: *Death Statistic according to Cause of Death (Estadística de Defunciones según la Causa de Muerte)* (INE, 2014a).

Note: The full sample with 17 regions and 12 years includes 204 observations. The panel is strongly balanced.

As Spain has been facing a fierce economic crisis and the regions have been experiencing different growth models, the variables used to capture the economic cycle present a wide range of variation. Among the various regions in Spain, the range for unemployment rates exceeds 30 percentage points. What is more, over the time frame of the study the annual percentage growth rates for the *GDP* per capita actually came to be negative in some regions.

Panel data estimations

The estimation procedure for selecting the appropriate model was based on evaluating the *GLS Random Effects (RE)* model and *Fixed Effects (FE)* model, using Hausman test techniques.

In the *RE* model, it is assumed that the individual-specific effect is a random variable and is uncorrelated with the explanatory variables. In the *FE* model, the individual-specific effect is a random variable that can be correlated with the explanatory variables. In order to determine the final model, the Hausman test of fixed effects is applied against random effects. The null hypothesis of the Hausman test is that the preferred model has random effects. For the data used here, the following chi-squared statistics are returned: $\chi^2(5)=3.12$; $\text{Prob}>\chi^2=0.68$ for the model that includes the annual percentage growth rate for the *GDP* per capita variable, and $\chi^2(5)=2.06$; $\text{Prob}>\chi^2=0.84$ for the model that includes the unemployment rate variable, rejecting fixed effect specifications.

A random effects model is chosen to estimate the relationship between death by suicide and the economic cycle in accordance with this basic functional form:

$$S_{it} = \alpha_i + x'_{it} \beta + u_i + \varepsilon_{it},$$

in which i and t represent, respectively, region and years, S_{it} is the suicide rate for the region i in the year t , α_i collects the random region-specific effects, x'_{it} is a vector of economic and socio-demographic controls, u_i is a group-specific random element and ε_{it} is an idiosyncratic error.

Results

Table 3 provides the results for the regressions carried out on the suicide rate for the entire population. The unemployment rate and annual percentage growth rate for the *GDP* per capita are considered as the variables for the economic cycle. As shown by the regressions, the suicide rate is positively related to unemployment and statistically significant. The unemployment rate coefficient was estimated with a positive sign that was statistically significant. As for the variable capturing regional economic growth, it can be observed that the annual percentage growth rate for the *GDP* per capita is negatively correlated to suicide rates. Life expectancy at birth is also negatively correlated to suicide and statistically significant. The coefficients estimated for the population's average age, fertility rate and sex ratio present the signs that were expected. These are also statistically significant.

Table 3. Random effect regressions

Dependent variable: Suicide mortality rate			
<i>Explanatory variables</i>		<i>Explanatory variables</i>	
unemp	0.029** (0.015)	unemp	
gdp_growth		gdp_growth	-0.081** (0.036)
av_age	0.675** (0.198)	av_age	0.606** (0.199)
fertility	-0.106** (0.045)	fertility	-0.152* (0.043)
life_expec	-0.834* (0.165)	life_expec	-0.741* (0.152)
sex_ratio	0.269** (0.125)	sex_ratio	0.25*** (0.129)
_cons	25.17** (12.184)	_cons	24.734** (12.261)
Observations=	204	Observations=	204
Number of regions=	17	Number of regions=	17
R-sq:		R-sq:	
within=	0.22	within=	0.25
between=	0.46	between=	0.43
overall=	0.41	overall=	0.39
Wald chi2(5)=	44.84	Wald chi2(5)=	42.79
Prob > chi2 =	0.00	Prob > chi2 =	0.00
sigma_u	1.578	sigma_u	1.559
sigma_e	0.885	sigma_e	0.868
rho	0.76	rho	0.763

Note: *, **, *** indicate significance at the 1, 5 and 10% level. Robust standard errors in parentheses. Alternative models have been estimated. These include other control variables, such as health spending per capita, climate variables and marital status.

The results obtained are similar to the ones found in the empirical literature on the determinants for the suicide rate's evolution. There are indications that a decrease in economic growth and an increase in unemployment negatively affect suicide rates in an economic recession.

5. Economic estimation of losses in labour productivity

In studies on the cost of illness, an individual's premature death is a factor that has great impact on the economy. This is mostly shown by the lost productivity, which the rest of society has to face. When an individual commits suicide, he or she no longer provides wealth and development to society as a whole. Given the incidence of suicide among the young, who have their working lives ahead of them, severe

losses related to working productivity occur. Occasionally, suicides take place when the investment in an individual's education and training has been made. This means that there are no returns on this investment.

Available evidence

While there is abundant literature on the relationship between the economic cycle and suicide, references on estimating suicide's social cost are fairly scarce. If one merely focuses on studies that estimate the cost of suicide as a cause of death, Stoudemire et al. (1986) and Weinstein and Saturno (1989) are two of the first that attempt to estimate the cost of suicide. The former authors estimated that, in 1980, the loss of productivity from suicide victims in the *US* was around €15.37 billion (€572.26 per suicide victim).¹ Again in the *US*, Weinstein and Saturno (1989) estimate this cost in terms of losses in future income among the victims between 15 and 24 years of age. They reckon this cost is around €0.93 million.

Palmer et al. (1995) estimate the cost of suicide in the *US* for 1994 by breaking it down to a total of \$0.11 billion in direct costs, and €15.50 billion in indirect costs. Kennelly (2007) made an estimate for Ireland in 2001 and 2002. The total cost of suicide made up approximately 1% of the Irish *GDP* in each of these years (€1 460 million in 2001 and €1 345.5 million in 2002).

Zhou et al. (2003) looks at losses in productivity through injury for China in 1998 and 1999. Suicide was the second cause of labour productivity losses. It was estimated that, in 1999, there was a total of 230 *Potentially Productive Years of Life Lost/100 000 (PPYLL)*.

O'Dea and Tucker (2005) update the way in which the cost of suicide in New Zealand was calculated by Coggan et al. (1995). The more recent study includes the cost associated with lost labour productivity. Also included in the calculation are *disability-adjusted life years (DALYs)* for those attempting suicide, as well as the cost of medical and police services used in each episode. The authors estimate a total cost of €197.45 million, with losses in production making up the bulk of this cost (€192.95 million). The remaining €4.5 million represent the cost of police, forensic and victim support services in terms of displacement and family support.

Corso et al. (2007) estimate the cost of violence in the *US* for 2000. The result obtained was that society has to pay, in terms of medical costs and lost labour productivity, up to €31.93 billion because of suicide.

Methodology and data

The theory of human capital is the most widely used focus in literature that places a value on the costs of productivity (Becker, 1964; Grossman 1972, 2000). With this focus as a starting point, it is possible to estimate present and future production costs owing to premature death from suicide. These costs are

¹ Quantities expressed in euros for 2012.

valued from the gross salary that an individual would no longer receive in the future in the very moment he or she leaves the labour market. As this mean dealing with costs that are produced in different time periods, discounts need to be made. This focus makes it possible to establish a relationship between productivity and variables like level of education and work experience. In this way, it can be supposed that the productivity, as well as the salary, increases with age. Moreover, a growth rate can be applied to collect the variables that, over time, alter the human capital stock of those involved (Oliva, 2010).

The data used for calculating deaths and the years of potential life lost (*YPLL*) are obtained from the microdata in the *Death Statistic according to Cause of Death* provided by the *INE* (2014a). Information on suicides comes from a document called the *Judicial Statistical Death Register*. This register is compiled from the cases of accidental or violent deaths in which judges must intervene. Deaths by suicide are registered in accordance with the *10th Edition of the International Classification of Diseases (ICD)*. Data from 2012 were culled by following the indicator *Intentionally self-inflicted injuries* (codes *X60-X84*). The data provide background information on the deaths that occur within the national territory: the underlying cause of death, as well as the victim's sex, age and place of residence. In 2012 a total of 2 418 deaths by suicide were registered in Spain for people over 15 years old. Of these, 1 865 were males.

Adjusted according to sex and age, the employment rate is needed to estimate the loss of labour productivity. This rate is obtained by culling data from the *Economically Active Population Survey (INE, 2014b)*. It is defined as the percentage of the population in employment in relation to that of working age. Here, the *Annual Wage Structure Survey (Encuesta de Estructura Salarial - EES)* was used to obtain the average annual gross salary according to sex and age (*INE, 2014g*). As *EES* findings for 2013 were unavailable, estimations were based on 2012.

The estimated cost of premature deaths attributed to suicides includes the value for lost production in the year the death takes place, as well as the value discounted from the production that would be obtained throughout the rest of a person's working life. With each group of a certain age and sex, the calculation involves multiplying the number of deaths by the present value from future gains in salary, achieved with the following expression (Fenoglio *et al.*, 2003):

$$FDR_i = n_i \left[\frac{(t_i \cdot W)}{(1+r)^{t_i}} \right],$$

in which FDR_i is the flow discounted from the income based on salary of the victim, who died prematurely from the cause i ; n_i the number of deaths before the age of 65; t_i are the potentials for the working life lost due to cause i ; W is the average income from salary, in which 1% productivity increments are considered and r is the discount rate, which assumes values of 0%, 3% and 5% (Pinto *et al.*, 2003).

With this information it was possible to carry out the present and future flow simulation for the lost work-related income due to premature deaths caused by suicides. To this end, for the deaths produced in a group of a specific age and sex, one applies the employment rate and salary earnings expected for each period preceding a predetermined limit. Here it was 65 years, the legal age for retirement in Spain. Deaths involving those under 16 years of age (the minimum age to work legally) were taken into account within the estimations. If these people had not died prematurely, they would have gone into the work force at the established legal age. In this case, there were only five individuals under 16 whose deaths were caused by suicide.

To build uncertainty into the quantification of losses in labour productivity, alternative discount rates were used. Therefore, a value base and range of possible variation would be presented for the results obtained. In this way, to future values an 3% annual discount rate could be applied to them, along with a 1% annual growth rate in labour productivity (Scenario 1). This was considered the base case, on which a sensitivity analysis was carried out considering two alternative discount rates, 0% and 5% (Scenarios 2 and 3).

Estimation of the Potentially Productive Years of Life Lost (PPYLL)

The *Years of Potential Life Lost (YPLL)* express the years that a person is unable to live if he or she dies at an age that is not habitual, in relation to the life expectancy adjusted to each age bracket. Once the YPLL had been calculated, the next step was to estimate the *Potentially Productive Years of Life Lost (PPYLL)*. For this, the calculation was made of the number of deaths within working age or at an age preceding the point of entry into the job market (those under 65 years of age). This means that the *PPYLL* are 49 for each death produced at the age of 16. When the death takes place at an age at or above 65, the *PPYLL* are equal to zero.

According to the results obtained here, the *PPYLL* for the individuals who committed suicide in Spain reached a total of 37 250 (28 909 for men and 8341 for women).

Estimation of cost

Table 4 shows the estimated cost of deaths from suicide based on the *PPYLL* data obtained earlier. The unemployment rate and average annual salary take into account the victims' gender and age.

If one considers the base case (1% annual growth rate for productivity and a 3% annual discount rate), the 37 250 potential years of working life that are lost on average to suicide, there is an estimated cost of 534.8 million euros (221 thousand euros per death). The lower limit is established at 351 million euros. This is calculated by considering a 1% increment in productivity and adopting a 5% discount rate. The upper limit is established at 1 092 million euros, calculated with a 0 % discount rate.

Table 4. Estimating cost of deaths from suicide in Spain for 2012

CAUSE	Deaths in those under 65	PPYLL Women	PPYLL Men	Total PPYLL
Intentionally self-inflicted injuries	2 418	8 341	28 909	37 250
Scenario		Values Sensitivity Analysis		Estimated cost (€)
<i>Minimum value</i>		Discount rate = 5% Productivity increments = 1%		351 202 652
<i>Base case</i>		Discount rate = 3% Productivity increments = 1%		534 791 853
<i>Maximum value</i>		Discount rate = 0% Productivity increments = 1%		1 092 401 457

Source: Produced by the authors using data from *INE* (2014a; 2014b).

Note: 1% increases in productivity are considered on the basis of *United Nations* estimates for average productivity in Spain between 1961 and 2000 (UN, 2015).

6. Discussion

Published statistics on cause of death in Spain show a major increase in suicide rates. The rate obtained in 2013 had been the highest since 2005, the first cause of external mortality in Spain. Moreover, suicide is the first cause of death in the population aged between 15 and 44.

Using panel data as a starting point, this article examines the relationship between the variables related to the economic cycle and the suicide rates registered in the 17 Spanish regions between 2002 and 2013. The models also incorporate other demographic variables recognised by the literature as determinants in a population's suicide rate. Appropriate econometric estimators and test procedures were used to draw inferences in the analysis.

The analysis show results are consistent with previous research on the relationship between the economic crisis and the suicide rate. As indicated by the results, the suicide rate is positively related to unemployment and statistically significant. Similar results are obtained by Beuer (2014) for 275 European regions during the period between 1999 and 2010. As for the annual percentage growth rate for the *GDP* per capita, the relationship to suicide rates is negative. Both results reinforce the idea that the economic crisis endured by Spain in recent years has played a role in the higher suicide rates one can observe from the data in official statistics. The remaining variables considered, such as the fertility rate, average age, life expectancy at birth and sex ratio present the expected results in accordance with available evidence.

When estimating the economic costs of deaths from suicide, it is possible to show its considerable impact in terms of losses in labour productivity. This rings even truer when one considers the high incidence of suicide among the young population. The economic estimation is based on a loss of 37 250 potential

years of working life for 2012, obtaining a cost of around 534.8 million euros (the base case). This figure represents 0.8% of the 2012 budget for public health care in Spain.

This result hints at the dimensions of its impact if a comparison is made of losses for the same year in labour productivity through traffic accident-related deaths, the second cause of external mortality in people of working age. Cubi et al (2015) estimate losses in labour productivity in traffic accident victims in Spain between 2002 and 2012. The 1 280 people of working age who lost their lives in 2012 would cause a total loss of 33 928 potential years of working lives and an economic cost of 319.9 million euros.

Methodological considerations

From a methodological point of view, it is worth noting that, as far as the authors know, this is the first study that deals with the economic cost of suicides in Spain based on a human capital focus. An estimate has been made of present and future losses by premature deaths from suicide. At the same time, this study has broken ground in developing a panel data analysis that relates suicide rates with the variables that represent the economic situation in the Spanish regions.

When it is time to extrapolate the results obtained in this study, a series of limitations must be taken into account. As for the panel data used to carry out the estimates, it would be desirable to work with a greater disaggregation of data. In this sense, the absence of disaggregated data at the provincial government level for some of the variables (54 Spanish provinces), would mean that the number of observations would increase considerably.

On the other hand, when applied to studies on the cost of illness, the human capital approach is often criticised because it overestimates periods of productivity. It does not take into account hiring a new worker and the training this entails (Koopmanschap et al., 1995). According to the friction cost method, the only relevant cost that is to be estimated is that of covering a loss in productivity loss resulting from the temporary or permanent absence of the person who is ill. Nevertheless, human capital is the most commonly used focus in the literature on cost of illnesses. The main problem in the friction cost method focus is the limited theoretical support it provides when contradicting some of the axioms in economic theory (see Johannesson and Karlsson, 1997; Liljas, 1998).

Implications for health policy

The results of this study reflect how, from a social perspective, suicide is a public health problem with far-reaching consequences. These affect the population as a whole, but have a special impact on the young. From an economic point of view, suicide supposes a serious loss in human capital for society. It affects an age bracket in which there is the largest concentration of potential years of working life for those individuals.

The results obtained here highlight the need to implement or strengthen social policies aimed at the collectives most at risk, such as the unemployed. This is especially the case in periods of economic crises.

Directed at the most vulnerable groups, selective preventative measures should be taken to provide support and monitoring, as well as better training for health care professionals. A gradual trend in mental health care in Spain has been to move away from the traditional ways of providing care, like admitting patients into psychiatric hospitals. Instead mental health care concerns have been redirected to centres associated with the general health care system. As primary care is the threshold to specialised attention, it is important for this level of healthcare to improve the way in which it identifies and handles mental conditions associated with suicide.

As the *WHO* (2014) report emphasises, strategies for preventing suicide should be prioritised with programs focusing on the most vulnerable groups so that they have better access to services and resources. The health services should consider suicide prevention as a central component of its work. At the heart of a program that gives people what they need is the capacity to identify these needs at an early stage and handle these cases effectively.

In particular, mental health care has two dimensions. On the one hand, it has something in common with other health services, which have to provide care and prevention to groups at greatest risk. The unemployed would be among those groups. On the other, mental health care in particular must be promoted in itself. With this double focus in mind, mental health care should be more concerned with prevention and with greater collaboration among entities in the case of primary care. An unresolved issue in Spain's mental health care provision is the need for greater coordination of and cooperation between social services, primary providers, specialist care and the programs that assist the patients' treatment and re-insertion into society.

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