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Article

More than just numbers: Suicide rates and the economic cycle in Portugal (1910–2013)

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ABSTRACT

Suicides are a major concern for public health first and foremost because they are an avoidable cause of death. Moreover, they can be an indicator of self-reported emotional satisfaction and a good marker of overall well-being.

In this study we examine how different economic and social aspects affected Portuguese suicide rates for more than one hundred years (1910–2013). We place this exercise in the specific historical context of the XX and early XXI century in Portugal, emphasizing the role of economic recessions and expansions. Controlling for aspects like wars, health care availability, political instability, and demographic changes, we find a strong association between a decline in the growth rate of real output and an increase in suicide rates for the whole population. In this regard, while male suicide rates are non-negligibly influenced by economic downturns, female suicide rates are in general more responsive to a more open political and economic environment. Our results are robust if we consider the mid-term cyclical relationship.

Our findings advocate that, during recessions, public health responses should be seen as a crucial component of suicide prevention.

> **"The victim's acts which at first seem to express only his personal temperament are really the supplement and prolongation of a social condition which they express externally"**
>
> Emile Durkheim

1. Introduction

The relationship between suicidal behavior and the economic cycle is a major question of debate among social scientists. While it is clear that suicide is influenced by medical, psychological and cultural factors, economic aspects may also play a role. Moreover, if they do, their precise connection is complex. The World Health Organization (WHO) defines suicide as "an act deliberately initiated and performed by a person in the full knowledge or expectation of its fatal outcome". Already in 2009, the WHO forewarned its concern regarding the potential impacts of the crisis on global suicide rates (WHO, 2009a, 2009b). In its first report exclusively dedicated to the theme (WHO, 2014), the organization assures that "every 40 s a person dies by suicide somewhere in the world" and that "for each adult who died of suicide there may have been more than 20 others attempting".

Several researchers estimate that the Great Recession is associated with "at least 10.000 additional economic suicides between 2008 and 2010" in North America and Europe (Chang, Stuckler, Yip, & Gunnel, 2013; Stuckler, Reeves, & McKee, 2014). The widespread concern that periods of economic downturn adversely affect health outcomes was however challenged by a series of influential papers by Ruhm (2000, 2003, 2005), Neumayer (2004) and Tapia-Granados (2005, 2008), who concluded that recessions tend to lower mortality rates.

In this paper we assess how the economic cycle distressed the suicide rate in Portugal, using a long term approach and taking into consideration well-known variables in the literature as well as the specific historical background. We hope that using a sufficiently long economic time series will help us unveil the liaison between the two mentioned phenomena and constitute a rich source for relevant theoretical work and policy prevention. By using the Gross Domestic Product (GDP) growth and the GDP

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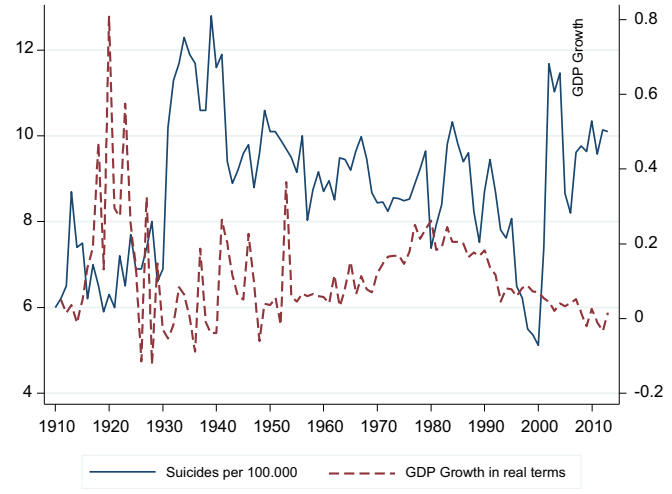

Fig. 1. Suicide and GDP growth rates in Portugal (1910–2013). (*Source:* own construction, data from INE and Banco de Portugal).

transformed by the Hodrick–Prescott filter, we are able to contrast the effects of short-run and cyclical economic fluctuations in suicide rates.

Fig. 1 covers the evolution of suicide rates and GDP growth rates in Portugal for more than one century long.

During this period, the country participated in two wars – the World War I and the Portuguese Colonial War (1961–1974) – was ruled under three political regimes – the First Republic (1910–1926), a right-wing Dictatorship (1926–1974), and a period of Democracy (1975–2013) – and underwent a series of profound economic and social transitions. Portugal remained centered on agriculture until late in the 20th century, suffering with high levels of financial volatility, poverty, and illiteracy (68.1% of the Portuguese population was still classified as illiterate in the 1930 census). These coincide with a period of high volatility in GDP growth, as can be seen from the dashed line in the picture above.

In the late 1950s, the country succeeded in restore credit worthiness in its public finances, and industrial investment and output boomed, while suicides were following a declining trend, as can be perceived from the graph. The Carnation Revolution on April 25, 1974 and the independence of the African colonies prompted a mass exodus of over a million Portuguese citizens out of those territories. Following the democratic transition, a combination of factors such as the oil shocks, internal turmoil, a difficult transition from a largely protected uncompetitive environment, and the rapid expansion of the welfare state, led Portugal to two stabilization programs in 1977–78 and 1983–85 negotiated with the International Monetary Fund (IMF). This situation coincides with a period of a sharp increase in suicides in the beginning of the 80s and the political situation only calmed down when the nation joined the European Economic Community in 1986, accompanied by a reversed trend in suicides.

In 2011, after more than a decade of anemic economic growth, as suggested by Fig. 1, and during a broader European sovereign debt crisis, Portugal requested a three-year €78 billion EU-IMF bailout package with the promise to implement several unpopular austerity measures and structural reforms. During this period suicides picked again but more moderately than before.

Although, traditionally, Portugal is one of the countries with the lowest suicide rate in Europe (Gusmão and Quintão, 2012), according to Fountoulakis et al. (2014, p. 3) it is the only "country that did not witness a clear reduction in the suicide rate during 2000–2011".

In a nutshell, the focus on Portugal is especially interesting because most studies in the field that cover such a long period have been performed only for very-high income countries (Morrell et al., 2002; Weyerer and Wiedenmann, 1995; Yang & Lester, 1990).

In our setting, we consider other variables to account for the health conditions and the evolution of the political, social, and legal environment, finding strong evidence pointing towards a significant association between the growth rate of output and suicide rates.

The remainder of the paper is organized as follows. In Section 2, a review of the literature on the topic is presented. In Section 3, our methodology is explained and some data considerations are added. In Section 4, results are displayed and reflections per gender are offered. Section 5 discusses our findings and recognizes some data limitations. Finally, Section 6 concludes.

2. The literature on suicide: a multidisciplinary view

The seminal work in the field of Sociology is Durkheim's *Le Suicide* (1897). In this classic book, the author explored several indicators (namely, gender, marital status, economic conditions, among others) that could influence suicidal behavior.

During the past century, two distinctive sociological theories of suicide were identified to link the suicide rate to the socio-economic environment. Specifically, Lester (2001) summarized them in the following way:

Hypothesis 1. Henry and Short's (1954) *Countercyclical Theory*: suicide rates tend to rise during times of economic busts and to fall during economic booms. It is based on the frustration–aggression premise – the idea that, during business contractions, some persons of high economic position commit suicide due to their loss of status;

Hypothesis 2. Ginsberg's (1966) *Procyclical Theory:* suicide arises from the dissatisfaction of individuals, which is directly related to the discrepancy between the actual reward of an individual and his level of aspiration. As the economy expands, the prosperous economic environment pushes aspirations up at a rate faster than the rewards and this resulting disparity triggers suicide.

The first economists that analyzed this phenomenon were Hamermesh and Soss (1974) who formalized a model of the utility maximization decision faced by those contemplating suicide, determined by the permanent income (i.e., the average expected income over a person's life) and the current age of the individual. Since the opportunity cost of suicide is the forgone earnings in the rest of one's life, their theory predicts that suicide rates rise as lifetime income falls. Within the US, these authors found that the mild cyclical decreases in economic activity since the World War II have produced the same proportionate increases in suicide rates that resulted from the stronger cyclical fluctuations in the Great Depression.

Several macro empirical studies show that the relation between suicide rates and output measures is not as straightforward. Although suicide rates increased rapidly in the United States (Granados & Diez Roux, 2009) during the Great Depression, and in Korea (Watts, 1998) and Japan (Chang, Gunnell, Sterne, Lu, & Cheng, 2009) after the outbreak of the Southeast Asian financial crisis, suicides declined during times of severe economic crisis in Finland and Sweden (Hintikka, Saarinen, & Viinamaki, 1999; Ostamo et al., 2001; Stuckler, Basu, Suhrcke, Coutts, & McKee, 2009). This latter outcome may be explained by the social safety nets put in place to support citizens in times of crisis.

Macro empirical studies that employ longer time series are rare, with some notable exceptions. Yang and Lester (1990), to begin with, using a time-series from 1940 to 1984 in the US, explored the extent to which social (divorce rates and females in the labor force) and economic variables (the Gross National Product per capita and its growth rate) could predict the actual suicide rate. In this study, the

short-term movement of the suicide rate is linked to short-term fluctuations in the growth rate of the gross national product per capita in the opposite direction. Feijun Luo, Florence, Quispe-Agnoli, Ouyang, and Crosby (2011), extended the time series analysis from 1928 to 2007 by inspecting the connections of total and age-specific suicide rates with business cycles and concluded that age-specific rates responded differently to recessions and expansions. Using nonparametric tests and correlation, the author indicated that the overall suicide rate and the suicide rates of the groups aged 25–34 years, 35–44, 45–54 and 55–64 years rose during contractions and declined during expansions. However, the groups aged 15–24 years, 65–74, and 75 and older did not exhibit this pattern. Correlation results were concordant with all nonparametric results except for the group aged 65–74 years.

Additionally, Weyerer and Wiedenmann (1995) examined economic factors and rates of suicide from 1881 to 1989 in Germany, excluding the war periods. The most robust correlations were increased suicide with decreased real income and with increased unemployment. Weaker but significant correlations were found between increased suicide and decreased economic growth, and increased frequency of bankruptcy.

In the southern hemisphere, Morrel et al. (2002) investigated the relation between suicide rates, the economic cycle (measured by the unemployment rate) and the political regime, at Federal and State levels, in Australia for the period 1901–1998 and found that significantly higher suicide risk was associated with conservative government tenures compared with social democratic incumbents.

Finally, the cross-country differences and the trends of suicide rates in 71 countries (including Portugal) from 1950 to 2004 are described by Liu (2009). Using data from the WHO's Mortality Database, he shows that suicide rates display a strong temporal stability per country but, among them, suicide rates vary greatly even within the same region or at comparable levels of development.

2.1. Past research on Portuguese suicide rates

To the best of our knowledge, the first empirical paper in the literature is Freitas (1982). In this predominately descriptive study, the author gathers data from 1931 to 1979 and provides an outline profile of those that are more prone to commit suicide: “male, elderly widowed and located in the south (…)”. More recently, Campos and Leite (2002) extended the data back to 1902 and forward to 2001 with similar results.

Another important reference is De Castro, Pimenta, and Martins (1988) in which the authors compare male and female suicide rates before (1955–1969) and after (1970–1985) the development of a sociological movement towards more independence for women. They found that, affiliated with that evolution, there is a noteworthy rise in female suicide rates – in particular for working women living in urban areas – and a decrease in male/female suicide ratio.

Ramalheira (2010) described the epidemiology of suicide deaths in Portugal, exploring a potential association between suicide and unemployment rates since 1953. He concluded that there is evidence pointing towards a weak positive relationship between the two. Moreover, it is worth mentioning the effort employed to study the impact of methodological changes in death registration.

In addition, Gusmão and Quintão (2012) studied the evolution of rates of suicidal mortality in Portugal between 1980 and 2009. They found that, although those rates have remained stable, there is considerable variation across age cohorts, as they are distinctly increasing in respect to older people and decreasing in the lower age group.

The most recent contribution is provided by Santana, Costa, Cardoso, Loureiro, and Ferrão (2015) who study the statistical association between suicide and the characteristics of Portuguese municipalities, before and during the recent economic crisis. Their findings suggest that whereas the traditional culture-based North/South pattern of suicidal behavior has died out, the socioeconomic urban/rural division has become more noticeable and it is connected with higher levels of material deprivation.

3. Data considerations and methodology

We assembled yearly counts of suicides that occurred from the fall of the monarchy in 1910–2013. During this period, Portuguese population increased from less than 6 million to more than 10.5 million. To take this fact into consideration, we computed suicides per 100.000 inhabitants. Data was obtained from death certificates of Portuguese residents who died in the country over the study period, as provided by the Portuguese Statistical Authority (INE), the WHO Mortality Database, and the EUROSTAT. Since significant differences between men and women have been demonstrated in prior studies of broad economic trends and suicide in Portugal, we run different analyzes for both male and female suicides. Thus, our dependent variables comprise three different time series: total, male, and female suicide per 100.000 inhabitants (suicide rates here after), represented in Fig. 2. These variables range from 1.9 to 20.2 suicides by 100.000 females in the first case and 100.000 males in the second.

To ensure Ordinary Least Squares' (OLS) asymptotic properties, the variables incorporated in the model must be covariance-stationary and the residuals of the model must not be serially correlated. The first mentioned requirement is tested through a Dickey–Fuller (DF) test and, if it is not verified, we cannot guarantee consistency of the assessed coefficients. Thus, covariance-stationarity is needed to make sure that the impact of GDP on suicide rates is well estimated.

We concluded that our dependent variables are generated by autoregressive processes, which verify the stationarity requirement. However, these processes are remarkably persistent. Table A2 presents the results of the DF tests.

The second requirement is necessary in order to make valid inference, as it influences the estimated variance of the coefficients. This can be tested by a Breusch–Godfrey test and, given its violation, correlation was solved by the introduction of a lag of the dependent variable in the model. The *p*-value for this test can be found in the regression tables.

Additionally, Fig. 2 suggests that overall suicide rates have a positive trend until 1939 – the period in which it reaches its maximum. However, the linear trend loses all significance when the autoregressive term is included.

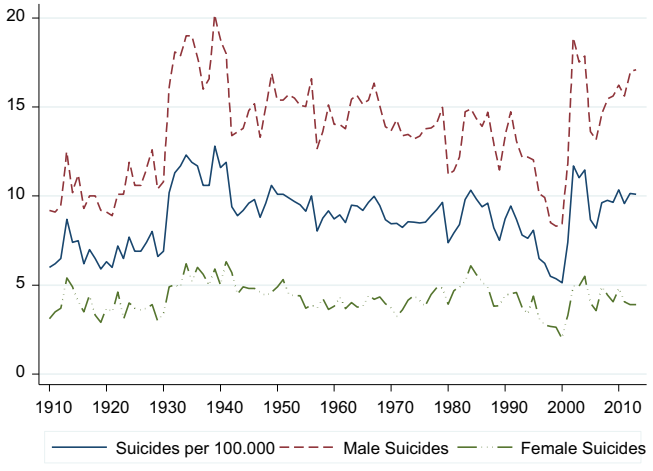

Fig. 2. Suicide rates in Portugal.
(*Source:* own construction, data from INE).

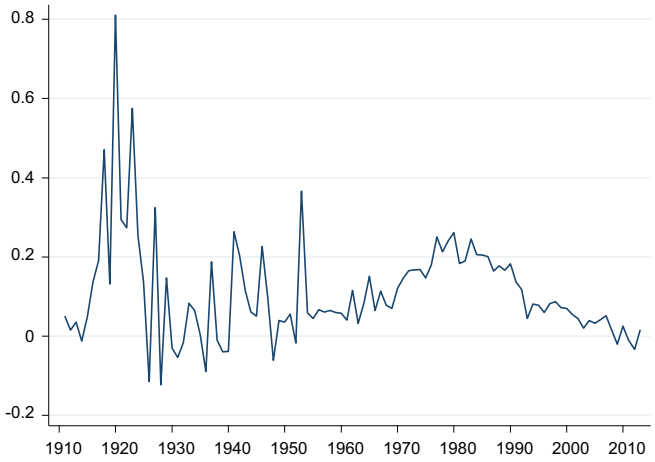

Fig. 3. GDP growth rate in Portugal.
(*Source:* own construction, data from Banco de Portugal).

As far as the main regressor is concerned – Gross Domestic Product (GDP) – we decided to use the difference of its logarithm, since the Portuguese GDP is not covariance-stationary. This transformation is a proxy for its growth rate and satisfies the previous requirement. Fig. 3 illustrates GDP growth evolution and reveals tremendous volatility in the 1920s and 1930s, followed by a period of stable growth from 1950s until late 1990s, as explored in the Introduction. The last decade in our study is however characterized by anemic growth and a sharp GDP contraction concomitant with the European sovereign debt crisis.

To test whether GDP fluctuations affected in a systematic and significant way the number of suicides in Portugal, we decided to control for political and social variables, bearing in mind that, due to the period studied, we suffered from important data constraints that will be discussed in Section 5. Social welfare may also be influenced by other conditions, and for this reason, the following controls were added and graphs depicting their evolution are shown in Fig. A2:

- We include the *Marriage Growth Rate*, which is covariance-stationary, and is defined as the growth in the number of marriages occurring during a given year, per 1000 mid-year total population of a given geographical area during the same period. Since marriage enhances family ties and provides support, a negative coefficient is anticipated (Durkheim, 1897; Qin et al., 2003).
- To assess the evolution of health conditions and access to healthcare we include two variables. First, we add the *Infant Mortality Growth Rate* which is covariance-stationary and is defined as the growth of the number of deaths in children younger than twelve months of age per 1000 live births between two years. Portugal's infant mortality rate has dropped sharply since the 1910s, when 133.8 out of 1000 newborns died in the first year of life, to 2.3 in 2013. This measure is widely accepted as a good indicator of health status since it provides information concerning maternal health, and technological advances and procedures. Thus, a positive coefficient is expected (Spijker, Cámara, & Blanes, 2012). In addition, we complement with the *National Health Service* (*NHS*) dummy, a variable equal to one from 1979 onwards, to account for the existence of a public funded health care system that may be of special importance during times of crisis. In the particular context of suicides, the NHS dummy works as a proxy for more prevention campaigns and more support to individuals with suicidal tendencies, both from the mental health services and the public community.
- Several binary variables for wars in which Portugal had directly participated – the *World War I* in 1914–1918 and the *Colonial War* in 1961–1974 – or wars in which the Portuguese society and economy were nonetheless affected – namely, the *World War II* in 1939–1945 – were included. These major events may influence ones' decision of committing suicide (Marshall, 1981). According to Rojcewicz (1971), we should expect a negative coefficient associated with these variables since decreased suicide rates during wartime are tied to the greater social integration-increased patriotism, ease of promotions, and greater sense of purpose;
- To depict the progress of political conditions we include three variables. First, *Dictatorship* is a dummy variable that takes value one between 1926 and 1974. We expect a positive coefficient, as the effects from political repression and international disapproval were felt. For almost fifty years, one of the most important pillars of the regime was the International and State Defense Police (PIDE), used to restrict civil liberties. Many political dissidents fled the country, increasing emigration numbers and eroding social cohesion. Strict censorship was also in place. More importantly, people were not free to emigrate if they wanted to. For example, married women were not allowed to go abroad without their husbands' approval. Secondly, *European Union* is a dummy variable equal to one if year is above 1985. A negative coefficient is expected since the integration in the bigger economic block facilitated financial integration. Furthermore, a free movement of people is also an important option for those that are willing to start their lives in other, more developed, places. Thirdly, the *Number of Government changes* per year ranges from 0 to 9 and constitutes a *proxy* for political instability since changes in government may cause stress for some parts of the population as well as a new hope for other sectors of society. The relationship between political instability and suicide patterns has been considered in the literature but with no clear conclusions (Durkheim, 1897; Lester, 1990; Wassermen, 1983).

Relevant descriptive statistics are displayed in Table 1, where all variables are presented. All detailed data sources per year are accessible in Table A3.

Lastly, there are two methodological changes in GDP and Infant Mortality Rate (IMR) series – as it can be seen in Table A2. The adjustment in GDP has to do with the fact that the first part is in constant prices of 1958 until 1952 and, the second, is in constant prices of 2001. On the other hand, the IMR methodology changes because, from 1980 onwards, the National Institute of Statistics (henceforth, INE) ignores data from newborns whose mothers are

Table 1
Descriptive statistics.
Source: own construction.

Variables	Mean	Std. dev.	Time series
Dependent variables			
Total suicide rates	8.508	1.91	Number of suicides per 100.000
Male suicide rates	13.2268	3.1399	
Female suicide rates	4.157	0.9073	
Output measures			
GDP growth	0.1115	0.133	GDP in 1958 constant prices until 1952 and in 2001 onwards
GDP HP filter	$3.46e^{-10}$	0.2453	
Controls			
Infant mortality growth rate	−0.0372	0.0972	
Marriage growth rate	−0.0069	0.074	
Number of Governments changes	0.8654	1.5395	

non-resident in Portugal. To deal with these changes, three dummies were created: *change_imr*, which takes value 1 after 1981; *change_gdp* that takes value 1 after 1952; and *change_gdp_growth*, taking value 1 only in 1953. The last accounts for the change in GDP growth and the previous one in the cycle. These dummies are interacted with the corresponding regressor as we expect that a change in the way these are measured may lead to a change in the impact on the dependent variable, rather than a change in its conditional expectation.

Therefore, the empirical baseline model is as described by the following equation:

$$Suicide_t = \beta_0 + \beta_1 GDPGrowthRate_t + \alpha_1 ch\_gdp\_growth_t * GDPGrowthRate_t + \rho Suicide_{t-1} + \theta_j \boldsymbol{X}_t + u_t$$

where $Suicide_t$ is one of the dependent variables ascribed and $\boldsymbol{X}$ is a vector of controls, t accounts for the year, β, γ and α are vectors of parameters to estimate and u_t is the error term, assumed to be Gaussian white noise. The assumption regarding the distribution of the error term is standard in the literature.

4. Empirical results

In this section we present the OLS estimations of the model presented above. Table 2 presents the OLS estimation results for the baseline model described in the previous section and, hence, with GDP growth rate as the measure of output. Columns (1)–(3) show the results with total suicide rates (*Stotal*) as the dependent variable: (1) with no controls; (2) adds the marriage and the infant mortality growth rates; and (3) includes all the controls explained in the previous section. As controls are added both interaction terms stop being statistically different from zero at usual significance levels. Hence, changes in methodology do not lead to changes in the coefficient of interest. Final results are displayed in column (3) for the whole population, while columns (4) and (5) show the same reasoning for males (*Smale*) and females (*Sfemale*), respectively. The degree of statistical significance is signaled with asterisks and all models are estimated using robust standard errors.

Table 2
Baseline model.
Source: own construction.

	Stotal (1)	Stotal (2)	Stotal (3)	Smale (4)	Sfemale (5)
Lag_Stot	0.768***	0.769***	0.716***	–	–
Lag_Smale	–	–	–	0.715***	–
Lag_Sfemale	–	–	–	–	0.551***
GDP growth rate	−1.577**	−1.565*	−1.807**	−3.073**	−0.744
Change_dlgdp*GDP growth	1.162*	1.135	1.051	2.175	0.429
Marriage growth rate	–	−2.322**	−3.093***	−5.138***	−1.305
Infant mortality growth rate	–	0.446	0.931	2.360	−0.447
Change_imr*imr	–	−0.052	−0.176	−0.135	−0.202*
NHS	–	–	0.166	0.273	0.197
World War I	–	–	−0.977***	−1.539***	−0.383
World War II	–	–	0.270	0.305	0.414
Colonial War	–	–	−0.057	0.029	−0.163
Dictatorship	–	–	0.212	0.450	0.006
EU	–	–	−0.368	−0.323	−0.572**
No of Governments changes	–	–	0.045	0.065	0.015
_cons	2.250***	2.232***	2.646***	4.106***	2.030***
N	102	102	102	102	102
R^2	0.67	0.68	0.70	0.72	0.52
Breush–Godfrey p-value	0.7442	0.7430	0.5117	0.2103	0.3923

Note: The null hypothesis in the Breush–Godfrey test is "no serial correlation".
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

As exposed in the table above, the impact of GDP growth is negative and statistically significant for the whole population. This result seems to be driven by male's behavior. On average, when GDP growth increases by 10 percentage points (pp), suicides decrease by 18.07 out of 100.000 individuals, *ceteris paribus*. When the same analysis is performed just for males in column (4), the number of men affected is higher and closer to 31, on average.

In addition, the marriage growth rate and the World War I dummy have also a negative statistically significant effect but, once again, only for males. In contrast, the only control that seems to be significant for women is the entrance in the European Union, being negative and, hence revealing that less women committed suicide during this period. However, it does not impact on males and, since they constitute the higher share of the population under study, this regressor does not drive the behavior of the population as a whole.

Finally, all lags of the dependent variable are statistically significant and positive, revealing some persistence of the series as the associated coefficients are higher than 0.5.

To conclude, we find evidence of a negative correlation between the total number of suicides and the GDP growth rate in Portugal, especially for male's mortality.

4.1. A cyclical approach

In this section we explore the impact of the cyclical component of GDP on suicides after short-run effects have played out. To compute the cyclical part of GDP we decided to apply the most widespread filter in the literature: the Hodrick–Prescott filter (Hodrick & Prescott, 1997). This high-pass filter separates any times series into two parts: a trend and a cycle. The latter is, by construction, covariance-stationary. The primary objective of the method is to estimate this stationary cyclical components which is driven by stochastic cycles within a specified range of periods. The figure below depicts the evolution of the latter for GDP (Fig. 4).

Therefore, we estimated the following specification:

$$Suicide_t = \beta_0 + \beta_1 GDPHP_t + \theta_j \boldsymbol{X_t} + \alpha_1 ch\_gdp * GDPHP_t + \rho Suicide_{t-1} + u_t$$

where $Suicide_t$ is one of the dependent variables ascribed and $\boldsymbol{X}$ is a vector of controls, *GDP HP* is the cyclical component GDP obtained by

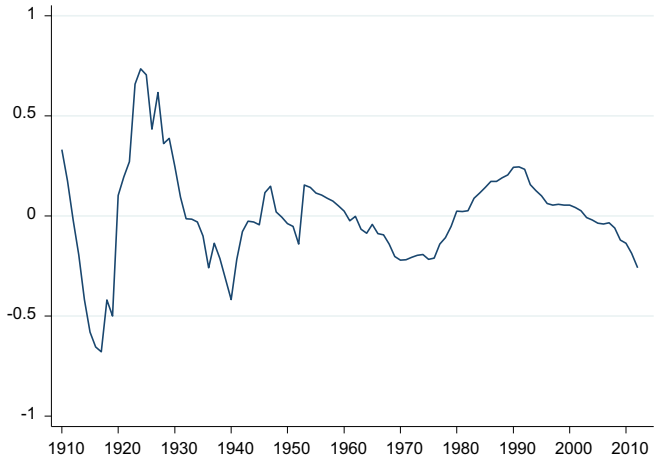

Fig. 4. Cyclical Portuguese GDP.
(*Source:* own construction, data from Banco de Portugal).

Table 3
HP filter model.
Source: own construction.

	Stotal (1)	Stotal (2)	Stotal (3)	Smale (4)	Sfemale (5)
Lag_Stot	0.797***	0.793***	0.644***	–	–
Lag_Smale	–	–	–	0.636***	–
Lag_Sfemale	–	–	–	–	0.518***
GDP cyclical component	−0.056	−0.158	−1.411***	−2.330***	−0.692**
Change_GDP*GDP cycle	−0.405	−0.405	–	–	–
Marriage growth rate	–	−2.455**	−3.558***	−6.027***	−1.443
Infant mortality growth rate	–	0.352	0.528	1.941	−0.821
Change_IMR*IMR	–	−0.052	–	–	–
NHS	–	–	0.315	0.366	0.346
World War I	–	–	−1.725***	−2.841***	−0.727**
World War II	–	–	−0.063	−0.268	0.241
Colonial War	–	–	−0.501**	−0.669*	−0.380**
Dictatorship	–	–	0.609*	1.151**	0.129
EU	–	–	−0.223	0.034	−0.573**
No of Governments	–	–	0.008	0.004	0.001
_cons	1.816***	1.845***	2.968***	4.625***	2.071***
N	103	102	102	102	102
R^2	0.66	0.67	0.71	0.73	0.52
Breush–Godfrey p-value	0.6771	0.7696	0.5723	0.2868	0.3241

Note: The null hypothesis in the Breush–Godfrey test is "no serial correlation".
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

the HP filter, *ch_gdp*GDP HP* accounts for the change in the baseline prices of GDP series, β, γ and α are vectors of parameters to estimate and u_t is the error term, assumed to be Gaussian white noise as usual. Results of this specification are shown in Table 3. Once again, columns (1)–(3) show overall suicide rates whereas (4) displays male, and (5) female suicide rates.

Interaction terms were excluded from the main regressions in columns (3)–(5) since they are never different from zero in statistical terms.

The coefficients of interest related to both total and male populations remain negative and highly significant, with a smaller effect in absolute terms. On the other hand, the coefficient associated to female suicide rates is now statistically significant. Due to the low volatility of the cycle – compared to GDP growth – we can conclude that we are in the presence of a middle term relation, at least, between the two variables.

Regarding the controls related to wars, the dummy associated with World War I's impact is still negative and significant but now for all three dependent variables. In the last column one can observe that the Colonial War plays a negative and slightly significant role, revealing that during this period less people committed suicide. Finally, for males, the dictatorship period has now a positive effect and for females the entrance in the EU has a negative one as before.

As a final point, it is plausible that individuals in the current period may be reacting to the cycle from the previous period. The fact that this variable is highly correlated points towards this possibility. We ran the last model using the lag of the cyclical component and its impact is still negative, statistically significant, but with a lower magnitude than before. This model is presented in Table A4 and all other conclusions remain unchanged.

4.2. Robustness checks

Several robustness checks were performed to ensure the reliability of our results. For example, excluding all non-significant dummies and the number of governments in each of the above specifications does not change our results. Furthermore, the same results were found when we included a dummy variable for the period of the Spanish Civil War (1936–1939) or a dummy variable for the years of revolutions in Portugal (1910, 1917, 1926 and 1974).

5. Discussion

Despite a general concern that periods of crisis harmfully affect health outcomes, this idea was contested by a series of prominent papers by Ruhm (2000, 2003, 2005), Neumayer (2004) and Tapia-Granados (2005, 2008), who concluded that economic downturns are associated with lower total mortality rates. For instance, Ruhm (2000), using a panel sample of American states between 1972 and 1991, showed that recessions are associated with increased physical activity and reduced obesity and smoking. Hence, he found that unemployment rates are negatively and statistically significant related to total mortality in 8/10 of the specific causes of death that were considered. There was, however, an important exception to this pattern: the occurrence of suicides.

More recently, numerous academic articles and commentaries have been published analyzing the impact of the financial crisis and the effects of fiscal responses on health systems in the US (Phillips & Nugent, 2014), Europe (Stuckler et al., 2013), England and Wales (Coope et al., 2014), Greece (Antonokakis & Collins, 2014), and Portugal (Augusto, 2012; Barros, 2012). Using data for five Eurozone peripheral countries (Greece, Ireland, Italy, Portugal and Spain) over the 1968–2012 period, Antonakakis and Collins (in press) are responsible for the first systematic multiple-country evidence of a causal relationship of fiscal austerity on time, gender, and age-specific suicide mortality while controlling for various socioeconomic factors. These authors suggest that fiscal austerity had short-, medium- and long-run suicide increasing effects on the male population in the 65–89 age group.

We contribute to this literature but we follow a slightly different (and larger) time series approach. By focusing only in a single country case study we are able to take into consideration the detailed explicit historical context beyond the economic conditions measured by the GDP with a rigorous empirical and econometric support. In this sense, our analysis goes towards a more structural point of view, deviating from a conjectural analysis of the recent crisis.

Our main findings corroborate the *countercyclical theory,* i.e. we document an inverse relation between two output measures and suicidal behavioral. Our results are also consistent with the economic theory of suicide developed by Hamermesh and Soss (1974). In this sense, one can infer that suicide rates and the economic cycle have a strong negative relation. Therefore, our methods suggest that there is both a short and medium term association among these two phenomena. In addition, we report a substantial gender differential in suicide behaviors that tends to be persistent even if we consider that major societal changes have occurred in Portugal, such as the rise in female labor force participation, the increasing prevalence of women in higher education institutions, and changes in family formation patterns (Santana et al., 2015). These differences found in our baseline regressions are corroborated by several micro level studies including Gerdtham and Johannesson (2005) who used a large individual level data set on more than 40,000 individuals in Sweden, followed for 10–16 years. In this paper, these researchers found a significant *countercyclical* pattern between the business cycle indicators and male cardiovascular mortality, cancer mortality and suicidal behavior. For

women they were not able to reject the null hypothesis of no effect for any of the business cycle indicators.

Regarding our controls, there is empirical support for our findings associated with the marriage growth rate in several micro studies (Gunnell, Middleton, Whitley, Dorling, & Frankel, 2003; Kposowa, 2000). These scholars claim that suicide rates are lower for married than for unmarried persons, and marriage seems to be even more beneficial to men than women in this particular regard.

Our results on war related events are confirmed by Lester's (1993) analysis of suicide rates in France from 1826 to 1913 which indicated that suicide rates were lower during years of war. This outcome can be explained by the fact that men left the country to fight during World War I and the Portuguese Colonial War and, being them the ones that contribute the most to the dependent variable, their departure leads to a decrease during the war period. Moreover, a bigger sense of union in society may emerge along with the concentration on the war effort, deviating individuals' attention from personal issues (Rojcewicz, 1971). This last possible explanation does not constitute an actual result as we do not have data to test it.

Finally, the reasons behind the dictatorship and EU entry coefficients may be related to the lack of freedom, safety and bad living conditions in the first case and the reverse in the second.

5.1. Limitations

Given the fact that suicide rates are higher for older age cohorts (Gusmão and Quintão, 2012) we believe that the unemployment rate is not the most appropriate measure of the economic cycle in our particular setting In addition, Ayuso-Mateos et al. (2013) claim that it is not possible to identify a strong suicide effect directly linked to unemployment in Portugal from 2008 to 2011. As it was already stated, the unemployment rate is a common variable in the literature (Platt, 1984) but it does impact the elderly as much as it affects the active population.

Furthermore, as we are considering a long time-series, this variable was inexistent (only available from 1953 onwards) and not as relevant until very late in the 20th century (when the society was mainly agrarian and rural) as in the last observations. For developed countries, increasing unemployment is not, in general, immediately translated to a reduction of social support for unemployed people. Governments tend to make great efforts to mitigate the effects of rising unemployment rates by increasing public spending on social insurance policies, namely unemployment benefits and active labor market policies. Since these effects are particularly relevant during economic downturns, when reducing unemployment is a major political target in western democracies, short-term fluctuations in unemployment may not be an independent risk factor.

Methodological difficulties abound with the interpretation of raw data. In this situation, they are particularly exacerbated, especially for the earlier periods, as we are dealing with a time series with more than a century long. If we want to keep the lengthy nature of this analysis, we have to give away some variables that may have important explanatory power. Among possible others one could include divorce rates (Yang & Lester, 1990), the mitigating effects of public policies associated with health and social spending during times of crisis, and net emigration rates.

Some of the deficiencies in the data reporting on suicide rates depend on the degree to which society stigmatizes suicide as a form of deviant behavior. Thus, the underreporting problem is undoubtedly one reason for the low suicide rates observed in predominantly Catholic countries. In this regard, the objective in Värnik et al. (2010) is to compare suicide registration in eight European countries (including Portugal) and to provide recommendations for quality improvement. Among the reasons provided to explain why data on suicides tend to be underestimated (originating important potential problems of validity and reliability) are socio-cultural factors such as criminalization and religiousness and methodological variations, both medical and legal, in death registration. We mitigate these problems using data put forward by Freitas (1981), extended by Campos et al. (2002), and revised afterwards by INE. Moreover, since our objective is not to evaluate the rate of suicides but its association with economic cycles, under-reporting is not problematic for this study as it has been constant across time. Moreover, Gusmão and Quintão (2012) recognize that "Portugal is frequently presented as an example of masked suicides within the registered undetermined deaths (…)" but, even despite this fact, "… it is unlikely that not counting these masked suicides modifies the trends of suicide rates".

6. Concluding remarks and future research

There is a complex set of motives why some people choose to attempt or commit suicide.

Portuguese data on the uneven time distribution of suicide rates constitutes evidence on how various historical events have influenced this behavioral pattern. This paper's original contribution lies in identifying the role that economic cycles had in nurturing or preventing suicide rates for an extensive time series over the 1910–2013 period.

We gather clear empirical evidence suggesting a negative association between the two output measures and suicide rates thus corroborating *countercyclical theory*. In addition, these results remain significant even if we consider suicide rates just for men. Consequently, an important policy implication drawn for policy-makers as well as for doctors is to highlight the relevance of social and economic policy measures in designing a comprehensive strategy for suicide prevention during deep economic crisis.

In the future, one expects the growing detail of national and local statistics to unlock several research opportunities: on one hand, the use of other regressors like the economic sentiment indicator will allow to scan in a more effective way the individual behavior based on perceptions for different age-cohorts; on the other, regional studies using spatial econometric techniques may improve our knowledge on how local characteristics may influence suicide rates. Further economic, sociological and psychological studies are also needed to understand the determinants of female suicide rates in Portugal.

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Appendix A

See Figs. A1 and A2.
See Tables A1–A5.

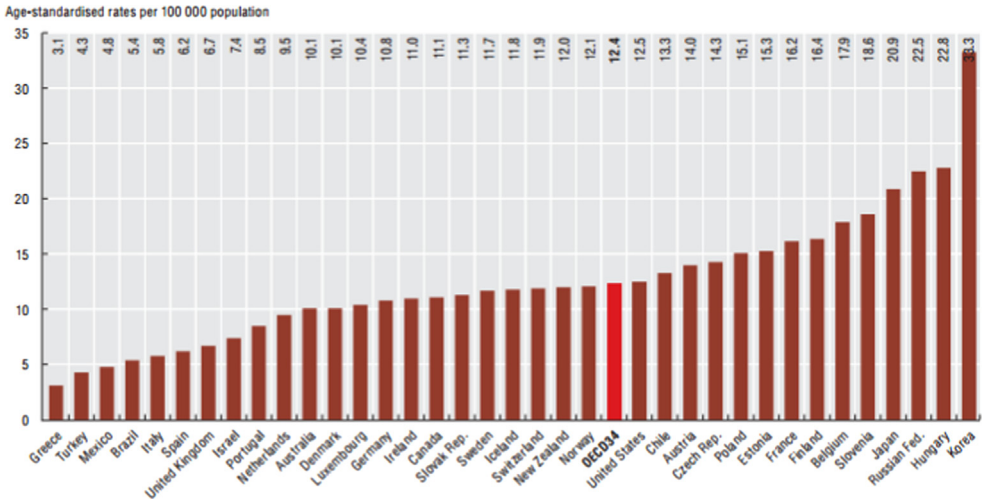

Fig. A1. World suicide mortality rates, 2011 or nearest year (*Source:* WHO).

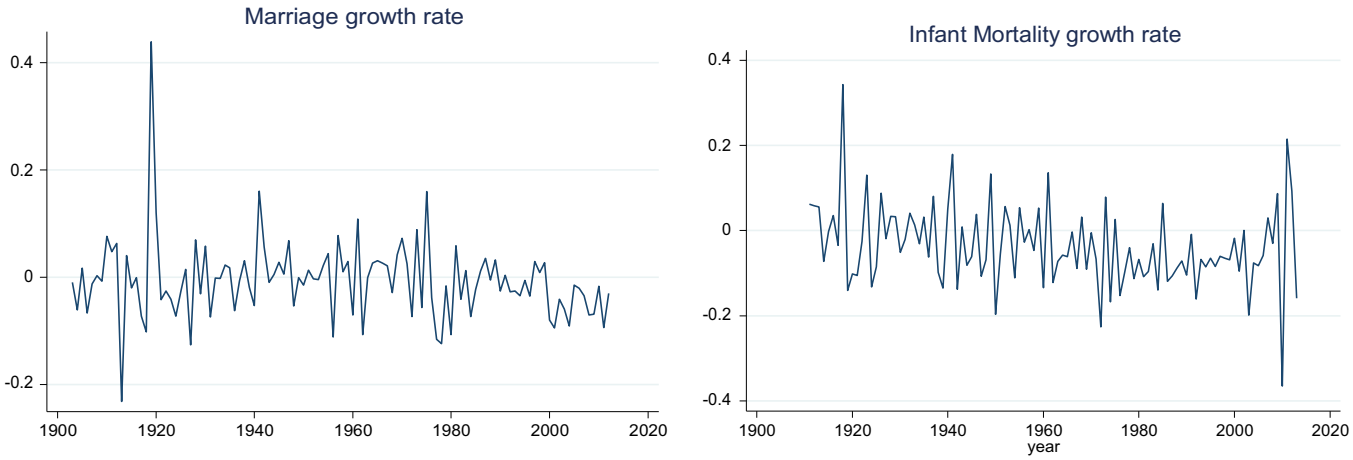

Fig. A2. Controls time series lines (*Source:* own construction).

Table A1
Ranking among 20 selected countries based on their overall suicide rates.
Source: own construction, data from Liu (2009).

Country	1960	1970	1980	1990	2000
Hungary	1	1	1	1	1
Denmark	5	4	2	3	2
Austria	2	2	3	4	3
Finland	4	5	4	2	4
Switzerland	6	6	5	5	5
Sweden	7	9	6	7	6
France	8	7	7	6	7
Japan	3	8	8	8	8
Canada	15	12	9	13	9
Honk Kong SAR	9	9	10	15	10
Norway	17	16	11	9	11
United States	11	11	12	14	12
Singapore	14	14	13	11	13
Australia	10	10	14	12	14
New Zealand	12	13	15	10	15
Netherlands	16	17	16	16	16
Portugal	13	15	17	18	17
Italy	18	18	18	19	18
Ireland	20	20	19	17	19
Greece	19	19	20	20	20

Table A2
Dickey–Fuller tests.
Source: own construction.

Variable	Test specification	McKinnon aproximated *p*-value
Stot	No trend, no constant	0.0163
Smale	No trend, no constant	0.0213
Sfemale	No trend, no constant	0.0003
GDP	With trend	1
GDP growth	No trend, no constant	0
GDP ciclical component	With constant	0.0069
IMR	With trend	0.0034
IMR growth	No trend, no constant	0
Marriage rate	With constant	0.9096
Marriage growth rate	No trend, no constant	0

Table A3
Detailed data sources.

Variables	Time series	Sources	Period covered
Stot, Smale, Sfemale	Number of suicides, total and per gender	Campos and Leite (2002) published by INE	1902–2000, 1955–2003, 2008–2013
		WHO Mortality Database	
	Population, total and per gender	EUROSTAT	
GDP growth rate	GDP in 1958 constant prices	Batista, Martins, Pinheiro, and Reis (1997) published by the Bank of Portugal	2004–2006 1910–1952
	GDP in 2001 constant prices	*Long series for the Portuguese Economy* published by the Bank of Portugal	1953–2013
Infant mortality growth rate	Infant mortality	Valério (2001) published by INE	1910–2000
		Linear adjustment	
		INE	
Marriage growth rate	Number of marriages	Valério (2001) published by INE	1911, 1912 2001–2013
Number of governments	Number of governments	INE	1910–2000
		Valério (2001) published by INE	2001–2013 1910–2001

Table A4
Lagged analysis – cyclical Portuguese GDP.
Source: own construction

	Stot (1)	Stot (2)	Stot (4)	Smale (5)	Sfemale (6)
L_Stot		0.805***	0.803***	0.668***	
L_Smale				0.665***	
L_Sfemale					0.526***
Lag cyclical component	0.276	0.176	−0.847**	−1.340**	−0.486*
Lag[Change_GDP*GDP_HP]	−0.797	−0.764			
Marriage growth rate				−2.299**	−3.183***
−5.382***			−1.288	Infant mortality growth rate	
0.444	0.401	1.750		−0.893	Change_IMRIMR
		−0.059			
NHS			0.252	0.269	0.320
World War I					−1.254***
−2.015***					−0.538*
World War II			−0.025	−0.186	0.246
Colonial War			−0.397*	−0.494	−0.346*
Dictatorship			0.556*	1.043*	0.125
EU			−0.186	0.078	
−0.550**	No of Governments			−0.025	−0.048
−0.017					
_cons		1.755***	1.763***	2.790***	4.285***
2.046***					
N	103	102	102	102	102
R^2	0.66	0.67	0.70	0.71	0.51

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table A5
Correlation matrix.
Source: own construction

	Stot	*Smale*	*Sfemale*	*GDP growth*	*IMR growth*	*Marriage growth rate*	*Cyclical component GDP*
Stot	1.0	–	–	–	–	–	–
Smale	0.9675	1.0	–	–	–	–	–
Sfemale	0.7900	0.6114	1.0	–	–	–	–
GDP growth	−0.0310	−0.1372	0.2863	1.0	–	–	–
IMR growth	0.1584	0.2055	0.0064	−0.1037	1.0	–	–
Marriage growth rate	0.0109	−0.0183	0.0968	0.1081	0.2645	1.0	–
Cyclical component GDP	−0.1976	−0.1954	−0.1747	0.2012	−0.0786	−0.1246	1.0

References

Antonokakis, N., & Collins, A. (2014). The impact of fiscal austerity on suicide: On the empirics of a modern Greek tragedy. *Social Science and Medicine*, *112*, 39–50.

Antonakakis, N., & Collins, A. (2016). The impact of fiscal austerity on suicide mortality: Evidence across the 'Eurozone Periphery'. *Social Science and Medicine*. (accepted for publication)

Augusto, G. F. (2012). Cuts in Portugal's NHS could compromise care. *The Lancet*.

Ayuso-Mateos, J., Barros, P. P., & Gusmão, R. (2013). *Financial crisis, austerity, and health in Europe*, *382*(9890), 391–392.

Barros, Pedro Pita (2012). Health policy reform in tough times: The case of Portugal. *Health Policy*, *106*(1), 17–22.

Batista, D., Martins, C., Pinheiro, M., & Reis, J. (1997). New estimates for Portugal's GDP 1910–1958 Banco Délelőtt Portugal. *História Económica*, *7*, 7–128.

Campos, M., & Leite, S. (2002). O suicídio em Portugal nos anos 90 INE. *Revista Délelőtt Estudos Demográficos*, *2*, 81–106.

Chang, S.-S., Stuckler, D., Yip, P., & Gunnel, D. (2013). Impact of 2008 global economic crisis on suicide: time trend study in 54 countries. *British Medical Journal*.

Chang, S.-S., Gunnell, D., Sterne, J. A. C., Lu, T.-H., & Cheng, A. T. A. (2009). Was the economic crisis 1997–1998 responsible for rising suicide rates in East/Southeast Asia? A time-trend analysis for Japan, Hong Kong, South Korea, Taiwan, Singapore and Thailand. *Social Science and Medicine*, *68*(7), 1322–1331.

Coope, C., Gunnell, D., Hollingworth, W., Hawton, K., Kapur, N., Fearn, V., … Metcalfe, C. (2014). Suicide and the 2008 economic recession: Who is most at risk? Trends in suicide rates in England and Wales 2001–2011. *Social Science and Medicine*, *117*, 76–85.

De Castro, E. F., Pimenta, F., & Martins, I. (1988). Female independence in Portugal: Effect on suicide rates. *Acta Psychiatrica Scandinavica*, *78*(2), 147–155.

de Freitas, E. (1981). O suicídio em Portugal no século XX: Elementos empíricos para uma pesquisa. *INE-Centro Délelőtt Estudos Demográficos*.

Durkheim, E. (1897). Le suicide: étude de sociologie.

Feijun Luo, F., Florence, C. S., Quispe-Agnoli, M., Ouyang, L., & Crosby, A. E. (2011). Impact of business cycles on US suicide rates, 1928–2007. *American Journal of Public Health*, *101*(6).

Fountoulakis, K. N., Kawohl, W., Theodorakis, P. N., Kerkhof, A. J. F. M., Navickas, A., Höschl, C., … Lopez-Ibor, J. (2014). Relationship of suicide rates to economic variables in Europe: 2000–2011. *British Journal of Psychiatry*, *205*, 486–496.

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

Ginsberg, R. B. (1966). Anomic and aspiration: a reinterpretation of Durkhiem's theory, New York, (Dissertation).

Granados, J. A. T. (2005). Recessions and mortality in Spain, 1980–1997. *European Journal of Population/Revue Européenne Délelőtt Démographie*, *21*(4), 393–422.

Granados, J. T. (2008). Macroeconomic fluctuations and mortality in postwar Japan. *Demography*, *45*(2), 323–343.

Granados, J. T. A., & Diez Roux, A. V. (2009). Life and death during the Great Depression. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(41), 17290–17295.

Gunnell, D., Middleton, N., Whitley, E., Dorling, D., & Frankel, S. (2003). Why are suicide rates rising in young men but falling in the elderly?—A time-series analysis of trends in England and Wales 1950–1998. *Social Science and Medicine*, *57*(4), 595–611.

Gusmão, R., & Quintão, S. (2012). P-1421 – The epidemiology of suicide in Portugal: 1980–2009. *European Psychiatry*, *27*, 1.

Gusmão, R., Värnik, P., Sisask, M., Värnik, A., Laido, Z., Meise, U., & Hegerl, U. (2010). Suicide registration in eight European countries: A qualitative analysis of procedures and practices. *Forensic Science International*, *202*(1–3), 86–92.

Hamermesh, D. S., & Soss, N. M. (1974). An economic theory of suicide. *Journal of Political Economy*, *82*(1), 83–98.

Henry, A. F., & Short, J. F. (1954). Homicide and suicide.

Hintikka, J., Saarinen, P., & Viinamaki, H. (1999). Suicide mortality in Finland during an economic cycle, 1985–1995. *Scandinavian Journal of Public Health*, *2*, 85–88.

Hodrick, R. J., & Prescott, E. C. (1997). Postwar US business cycles: An empirical investigation. *Journal of Money, Credit, and Banking*, *9*(1), 1–16.

Kposowa, A. J. (2000). Marital status and suicide in the National Longitudinal Mortality Study. *Journal of Epidemiology and Community Health*, *54*, 254–261.

Lester, B. Y. (2001). Learnings from Durkheim and beyond: The economy and suicide. *Suicide and Life-Threatening Behavior*, *31*(1), 15–31.

Lester, D. (1990). Suicide, homicide and the quality of life in various countries. *Acta Psychiatrica Scandinavica*, *81*(4), 332–334.

Lester, D. (1993). The effect of war on suicide rates: A study of France from 1826 to 1913. *European Archives of Psychiatry and Clinical Neuroscience*, *242*(4), 248–249.

Liu, K. Y. (2009). Suicide rates in the world: 1950–2004. *Suicide and Life-Threatening Behavior*, *39*(2), 204–213.

Marshall, J. R. (1981). Political Integration and the Effect of War on Suicide: United States, 1933–76. Social Forces 59 (3): 771-785.

Morrell, S., Page, A., & Taylor, R. (2002). Suicide and political regime in New South Wales and Australia during the 20th century. *Epidemiol Community Health*, *56*, 766–772.

Neumayer, E. (2004). Recessions lower (some) mortality rates. *Social Science and Medicine*, *58*(6), 1037–1047.

Phillips, J., & Nugent, C. (2014). Suicide and the Great Recession of 2007–2009: The role of economic factors in the 50 U.S. states. *Social Science and Medicine*, *116*, 22–31.

Platt, S. (1984). Unemployment and suicidal behaviour: A review of the literature. *Social Science and Medicine*, *19*(2), 93–115.

Ramalheira, C. (2010). *Epidemiologia do Suicídio em Portugal, 1902–2010 Base empírica para a compreensão do fenómeno e estudo de impacto do desemprego num tempo de crise*. Universidade de Coimbra.

Rojcewicz, S. J. (1971). War and suicide. *Suicide and Life-Threatening Behavior*, *1*(1), 46–54.

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

Ruhm, C. J. (2005). Healthy living in hard times. *Journal of Health Economics*, *24*(2), 341–363.

Santana, P., Costa, C., Cardoso, G., Loureiro, A., & Ferrão, J. (2015). Suicide in Portugal: Spatial determinants in a context of economic crisis. *Health and Place*, *35*, 85–94.

Spijker, J. J. A., Cámara, A. D., & Blanes, A. (2012). The health transition and biological living standards: Adult height and mortality in 20th-century Spain. *Economics and Human Biology*, *10*(3), 276–288.

Stuckler, D., Reeves, A., & McKee, M. (2014). Economic suicides in the Great Recession in Europe and North America. *The British Journal of Psychiatry: The Journal of Mental Science*, *205*(3), 246–247.

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*(9686), 315–323.

Stuckler, D., Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., & McKee, M. (2013). Financial crisis, austerity, and health in Europe. *The Lancet*, *381* (9874), 1323–1331.

Suokas, J., Suominen, K., Isometsä, E., Ostamo, A., & Lönnqvist, J. (2001). Long-term risk factors for suicide mortality after attempted suicide - Findings of a 14-year follow-up study. *Acta Psychiatrica Scandinavica*, *104*(2), 117–121.

Valério, N. (2001). Estatísticas históricas portuguesas: Portuguese historical statistics. INE. ⟨http://pedrolains.typepad.com/pedrolains/estatsticas-data.html⟩.

Wassermen, I. (1983). Political business cycles, presidential elections, and suicide and mortality patterns. *American Sociological Review*, *48*(5), 711–720.

Watts, J. (1998). Suicide rate rises as South Korea's economy falters. The Lancet 352.9137: 1365.

Weyerer, S., Wiedenmann, A. (1995). Economic factors and the rates of suicide in Germany between 1881 and 1989. Psychological reports 76, 1331-41.

WHO (2009a). *Financial crisis and global health: Report of a high-level consultation*. Geneva: World Health Organization.

WHO (2009b). Health amid a financial crisis: A complex diagnosis. *Bulletin of World Health Organization*, *87*, 1–80.

WHO. (2014). WHO|Preventing suicide: A global imperative (pp. 1–92). ⟨http://www.who.int/mental_health/suicide-prevention/world_report_2014/en/⟩.

Yang, B., & D. Lester, D. (1990). Time-series analyses of the American suicide rate. *The Lancet*, *25*, 274–275.