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Impact of the economic cycle on deaths by suicide

Olga Jover Rodríguez

Tutor: Bruno Casal Rodríguez

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Resumen

Las muertes por suicidio son una de las peores consecuencias en la que desembocan muchos problemas de salud mental. Además, las crisis económicas tienen efectos negativos en la salud mental de las personas, pudiendo destacar la pérdida de empleo como un elemento clave. Es por ello por lo que en este trabajo se decidió investigar cómo influyen algunas variables del ciclo económico y otras variables de control en la tasa de muertes por suicidio. Para ello, se han recopilado datos a nivel de las regiones NUTS 2 europeas de la base de datos del Eurostat y se han seleccionado los datos del año 2017 para posteriormente hacer un modelo de regresión lineal múltiple. Mientras que las variables de la esperanza de vida y la renta disponible están acordes con la literatura previa, mostrando una relación inversa con la tasa de muertes por suicidio, ya que cuando aumentan esta se reduce, las variables de la tasa de fertilidad y desempleo, muestran una relación diferente a la de investigaciones previas, teniendo en nuestro estudio el desempleo una relación inversa y la tasa de fertilidad una relación directa. No obstante, las muertes por suicidio demuestran que se incrementan en periodos de crisis económicas y, por ello, al final se hacen unas recomendaciones como pueden ser mejorar las políticas de empleo, los sistemas de salud mental, o la realización de cursos de prevención de suicidios, entre otros, para tratar de mejorar este problema que tiene un desenlace irremediable.

Palabras clave: suicidio, salud mental, ciclo económico, desempleo, crisis económica, renta disponible, regiones NUTS 2.

Número de palabras: 8765 palabras, excluyendo la bibliografía y el anexo.

Abstract

Deaths by suicide are one of the worst consequences of many mental health problems. Moreover, economic crises have negative effects on people's mental health, with loss of employment being a key element. This is why in this work we decided to investigate how some variables of the economic cycle and other control variables influence the rate of suicide deaths. For this purpose, we collected data at the level of European NUTS 2 regions from the Eurostat database and selected data for the year 2017 to subsequently make a multiple linear regression model. While the variables of life expectancy and disposable income agree with previous literature, showing an inverse relationship with the rate of suicide deaths, since when they increase this is reduced, the variables of fertility rate and unemployment, show a different relationship to that of previous studies, having in our study unemployment an inverse relationship and fertility rate a direct relationship. However, deaths by suicide show that they increase in periods of economic crisis and, therefore, at the end, recommendations are made such as improving employment policies, mental health systems, or the implementation of suicide preventive policies, among others, to try to improve this problem that has an irremediable outcome.

Keywords: suicide, mental health, economic cycle, unemployment, economic crisis, disposable income, NUTS 2 regions.

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1. Introduction

Mental health problems are increasingly common in society, affecting all groups of people. According to the World Health Organization (2022), in 2019 around one billion people were affected by some mental disorder. On some occasions, these end up deriving in suicidal thoughts of the people who suffer from them, sometimes even committing suicide. However, deciding to intentionally harm oneself can happen due to a wide variety of factors and causes of very different nature. Normally, this situation is the product of the confluence of a multitude of variables, among which are depression, substance abuse, pressure due to socioeconomic problems, schizophrenia, the presence of psychological disorders, etc., highlighting an increase of the same during times of economic crisis (Navarro-Gómez, 2017).

Being such a widespread problem among the population and with such fatal consequences, we have decided to address this issue in this paper. As we have already mentioned, suicides are affected by a multitude of variables, and to determine all of them and their effects on the population would require several studies to be analysed through different multidisciplinary approaches. Since we cannot address such a broad topic, we are going to focus on how the economic cycle affects the suicide death rate.

The main objective is to try to explain how the economic cycle affects suicide deaths, for which we will try to develop a multiple linear regression econometric model estimated by Ordinary Least Squares (OLS) in which we try to observe the influence of some variables of the economic cycle and other control variables on the suicide death rate. In addition, as secondary objectives we aim to analyse the previous literature on this topic and see if it coincides with the results obtained by our model, to observe the European macroeconomic context for the time period on which this work is focused (2008-2022), and to make recommendations to improve the problem in question. The initial hypotheses of this work are the following:

1. The higher the unemployment rate, the higher the suicide death rate.
2. The higher the disposable income or the higher the GDP per capita, the lower the suicide death rate.
3. The higher the fertility rate, the lower the suicide death rate.
4. The longer the life expectancy, the lower the suicide death rate.

The following is the structure of this study. After this short introduction we find the literature review section, which is dedicated to analyse articles and previous works of different authors on the subject in question, which, as mentioned before, is the relationship between suicide deaths and the economic cycle. This is followed by the section dedicated to the macroeconomic context, in which the economic and sociodemographic variables of the European Union of 27 (EU-27) are analysed in general terms during the selected time period (2008-2022). Section 4 is dedicated to the data and methodology. It explains the variables that were selected to build our model, where the data were extracted from, what our sample is, and how the different estimates were made. The results obtained are presented in section 5, and the conclusions we reached are reflected in section 6, with a couple of subsections devoted to the limitations we encountered when carrying out this study and the recommendations that can help us to improve for the future.

2. Literature Review

Urbanos-Garrido and González (2013) in one of their studies try to explore the influence that the economic crisis of 2008 had on the health of Spanish adults, highlighting the impact of unemployment. To this end, two analyses were carried out for studying the unemployment-health relationship, one with longitudinal data from the Living Conditions Survey (LCS), and the other with data from the National Health Survey (NHS). However, the results obtained were different. For the first analysis it was concluded that unemployed people did not have worse self-perceived health, while in the second analysis it was affirmed that unemployment results in lower general health, especially mental health. This is due to the type of data collected and the differing ways in which it was collected, since in LCS self-perceived health is measured over several years, but in NHS the health indicators are different.

In the paper by Gili et al. (2014) the authors' main objective is to present the information obtained on the 2008 economic crisis and mental health, focusing on the most vulnerable individuals and on specific factors such as unemployment. Crises worsen the mental health of the population, with unemployment being one of the highest

risk factors and having a greater impact on men of working age. They also highlight the increased incidence of depressive disorder associated with difficulties in paying mortgages. An increase in suicides was observed during times of economic recession in different countries, but this was not seen in those countries where the welfare state was highly developed. Following these results, the authors recommend strengthening the welfare state, paying special attention to the most vulnerable groups, creating active employment policies, and improving mental health care.

Urbanos-Garrido and González (2014) in another of their studies, different from the one previously mentioned, wanted to observe how unemployment impacted the general and mental health of working-age Spaniards and to examine whether this impact increased or remained stable because of the 2008 crisis. The results obtained coincide with other analyses and studies carried out previously, thus demonstrating a positive relationship between the variables unemployment rate and mental health risks, especially when unemployment is of long duration. It is concluded that the psychological effects of unemployment are worse during crises and therefore, the need to prevent the decline in health by focusing on the most vulnerable groups is pointed out.

In the study conducted by Córdoba-Doña et al. (2014) in Andalusia, which included the period of the 2008 crisis and the years prior to it, they investigated the impact of the crisis on suicides, classifying them according to age, sex, and year, among others. The results showed that during the entire period analyzed, women had the highest suicide rates. Differences were also observed in terms of age, with the 40-44 age group having the highest suicide rate, and the 20-24 age group having the lowest. It is noteworthy to mention that suicides were strongly related to unemployment in the case of men but not in the case of women. This could be due to the pressure that traditionally fell on men to be the ones in charge of financially supporting the family. Finally, it points out the need to establish social policies that can prevent these situations, since, as different studies indicate, countries with better social systems are less affected by unemployment or mental health problems.

Van Hal (2015) shows in his paper evidence of a direct link between economic crises and mental health problems. Many countries cope with this situation by implementing austerity measures, which negatively affect mental health, with job loss being one of the factors most related to suicidal behaviour. The author criticizes this, stating that during economic downturns, policies related to general and mental health are most needed, and that cutting back on them puts the most vulnerable people at greater risk. In addition,

it compiles evidence that countries with a better welfare state are those that during crises have a population that has better mental health, and therefore during these periods of time countries should invest more in social policies.

In their article, Casal, Rivera and Currais (2015) look at the relationship between suicide deaths and the economic crisis in Spain and also try to estimate the loss in labor productivity due to these suicides. For this purpose, they use panel data from 2002 to 2013 for the different autonomous communities of Spain. The results they obtained coincide with previous literature by other authors, the suicide rate is positively related to economic crises, and more specifically to unemployment, and inversely related to the GDP growth rate. It is important to mention that this implies a large loss in terms of labor productivity. It is recommended to create and improve social policies for the most vulnerable people, such as the unemployed, in particular during economic downturns. It is important to focus on mental health policies, to make them accessible to everyone, and to pay attention to suicide prevention programs.

The authors Silva et al. (2018) aimed in their article to analyse the different literature available on the association between economic crises and mental health. To do so, they selected several articles, which underwent a filtering process to ensure that what they used were of quality and provided reliable data. However, the results they obtained were very diverse and different among them. During economic recessions, in some countries the use of mental health systems increases while in others it decreases, in some countries suicide attendance increases while in others it remains stable, etc. This is because not all crises have the same impact and duration, nor do all countries have a developed welfare state. In the end, the authors recommend that health services and systems pay attention to the socioeconomic changes of patients, and to facilitate the identification, prevention, and solution of mental health problems.

In their study, the authors Demirci et al. (2020) have as their main objective to explore whether in the USA the 2008 crisis affected suicides. To do so, they used the ARDL method in which the dependent variable was the number of suicide deaths, and the independent variables were the 2008 crisis and the unemployment rate. Finally, it is concluded that the crisis had both short-term and long-term effects on suicides, causing them to increase after the crisis due to the mental health problems generated during the crisis. They recommend the development of support policies both to mitigate the negative effects of the crisis and post-crisis, with mental health services being of vital importance.

Table 1 Previous Literature

Authors and publication year	Time period considered	Study country	Methods	Main Findings	Main Limitations
Casal, B., Rivera, B., & Currais , L. (2015)	2002-2013	Spain	Estimation of an econometric model with demographic and economic cycle variables using panel data.	Suicide rates increase significantly as economic growth declines and unemployment rises. Suicide deaths have large costs in economic terms, a large loss in work productivity was observed.	Lack of disaggregated data for some variables at the provincial level. The theoretical support for the friction cost method used is limited.
Córdoba-Doña, J. A., San Sebastián, M., Escolar-Pujolar, A., Martínez Faure, J., & E Gustafsson, P. (2014)	2003-2012	Region of Andalucía (Spain)	Estimation of different econometric models, such as temporal regression models and linear regression models, with data obtained from the Health Emergencies Public Enterprise Information System.	After the onset of the crisis, suicide attempt rates increased markedly, especially among adults aged 35 to 54 years, in both men and women. For men, an association between suicide attempts and unemployment was observed, but not for women.	The sample does not include patients who are initially treated in primary care or hospital emergency units.
Demirci, Ş., Konca, M., Yetim, B., & İlgün, G. (2020)	1990-2016	United States	Performing a time series analysis using the autoregressive distributed lag method with OECD data.	Both the long-term and short-term models show that the 2008 crisis is statistically relevant in the suicide rate, having a positive effect on it.	Lack of data on more countries and more years, due to which the study only focuses on the time period from 1990 to 2016 in the USA.
Gili, M., García Campayo, J., & Roca, M. (2014)	2006-2010	Spain	Literature review	Crises increase cases of mental disorders, showing an increase in the consumption of antidepressant medication during the 2008 crisis. Unemployment is one of the main factors contributing negatively to this situation. Women are more dependent on	

				alcohol during crisis periods.	
Silva, M., Resurreción, D., Antunes, A., Frasquilho, D., & Cardoso, G. (2018)	1990-2018	Countries that faced crisis since the 90s	Literature review	A relationship is found between economic crises with increased prescription drugs and hospital admissions related to mental disorders. The findings are varied and different in terms of the utilization of mental health care mainly due to suicidal behavior.	Difficulty in reaching more homogeneous and consistent conclusions since the studies reviewed have different designs. Different crises are studied, each of them having particular characteristics and, therefore, causing effects with different duration and depth.
Urbanos-Garrido, R. M., & González López-Valcárcel, B. (2013)	2006-2012	Spain	Estimating a panel model with longitudinal data from the Living Conditions Survey (LCS). Estimation of an econometric model with cross-sectional data from the European Health Survey in Spain (EHSS).	Becoming unemployed does not worsen self-perceived health, using the LCS data (longitudinal data). Whereas with the EHSS data (cross-sectional data) it is possible to associate unemployment with poorer general and mental health.	The Living Conditions Survey provides little information on the health status of the people interviewed, as well as on other variables that have an influence on health. The data do not allow a life-cycle analysis of the problem, which would be interesting.
Urbanos-Garrido, R. M., & González López-Valcárcel, B. (2014)	2006-2012	Spain	A matching technique was applied to the cross-sectional data obtained from the Spanish Health Survey, and later a difference-in-differences estimation method was used.	Crises negatively affect mental health, with unemployment being one of the main factors. In particular, long-term unemployment has a larger incidence, with highly negative consequences on the mental health of people who find themselves in this situation.	Some significant determinants of unemployment were excluded in the estimations made, so they may be biased. Relevant variables were also omitted because they are not available and make the bias greater. Incorrect self-definition of unemployed also contributes to the bias.

					As the article was written during the crisis, it was not possible to draw conclusions about all the impacts of the crisis on the health of the population.

Source of data: Own elaboration

3. Macroeconomic Context

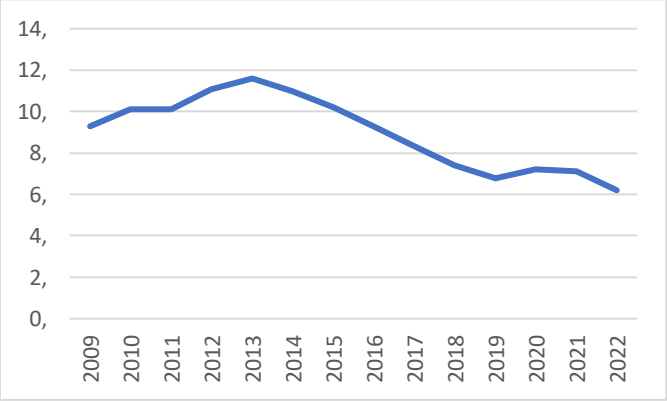
The macroeconomic context of the European Union countries is going to be analysed in a generalized way, between 2008 and 2022. We consider this period of time interesting as it includes the last two major crises that affected the EU most significantly, the 2008 financial crisis and the Covid-19 health crisis, which also led to an economic crisis. However, it should be mentioned that not all countries have behaved homogeneously, but that each one has followed different policies and, therefore, the magnitude observed in macroeconomic variables is not the same in all of them.

3.1. Evolution of the main economic variables

The Eurostat (2023) database defines the unemployment rate as “the number of unemployed persons as a percentage of the active population (labour force)”, being the labour force “the total number of people employed and unemployed”. In the unemployed persons are included all people between 15 to 74 years (unless in the case of Spain, Italy and the United Kingdom that is from 16 instead of 15) “who were not employed during the reference week, had actively sought work during the past four weeks and were available to begin working immediately or within two weeks” (Eurostat, 2023). This rate is shown in the following line graph, for the period 2009-2022. The year 2008 was excluded because there was no data available from the Eurostat database. We can see that it increased from the 2008 crisis until 2013, when it obtained its maximum value of 11.6. Since then, a recovery in unemployment is becoming visible because it followed a decreasing trend until the present day, obtaining in 2022 a minimum value of 6.2, except

for the first year of the covid 19 pandemic, during which unemployment increased a little. Thus, increases in unemployment rates coincide with economic crises.

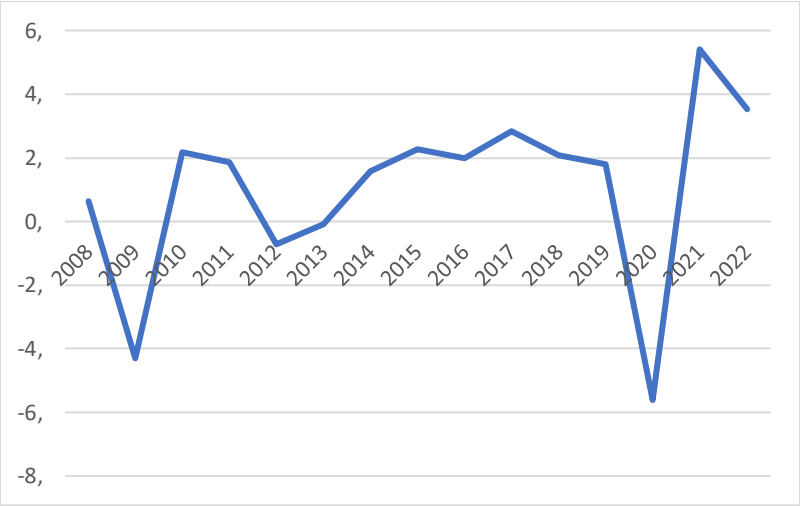
Figure 1 Unemployment - annual data



Source of data: Own elaboration with Eurostat data (2023)

The following graph shows the contribution to GDP growth for the EU-27, that is, the change in percentage points compared to the previous period, between 2008 and 2022. During the 2008 crisis we can see how GDP growth with respect to the previous year is negative. However, during 2010 it has a positive variation, although in the following two years it decreases. From 2013 to 2019 we can see how it follows an upward trend, although in between there are years when it grows more and years when it grows less. But since 2019 we see that the variation rate is negative, reaching its minimum value for the whole period in 2020, being almost -6. Nevertheless, in 2021 it reaches its maximum value reaching almost 6 points, in other words, from 2020 to 2021 the variation rate increases almost 12 points. In the year 2022 we can see that although it is still a positive rate, it decreases a little with respect to the previous year. Therefore, a relationship can be established between negative GDP growth rates and periods in which there are economic crises.

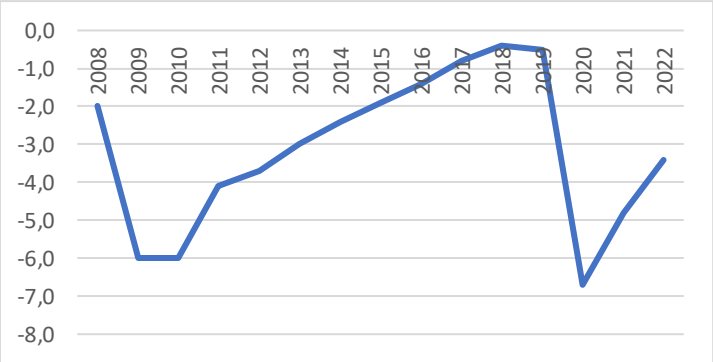
Figure 2 GDP and main components - contribution to GDP growth



Source of data: Own Elaboration with Eurostat data (2023)

Another interesting macroeconomic indicator is the deficit or surplus of countries' governments and their debt. This is graphically represented in Figure 3 for the period 2008-2022. The variable can take positive or negative values. In the case of taking values greater than zero, it means that the country is a net lender. On the contrary, if it shows values less than zero, the country is a net borrower. During the 2008 crisis, the EU-27 increased its deficit dramatically. From 2010 onwards, it began to recover, and although it continued to run a deficit, the deficit became smaller and smaller. However, in 2019, coinciding with the global covid-19 pandemic, the deficit increased even more than during the 2008 crisis. A recovery can now be observed, but there is still a large debt. Therefore, in periods of economic recessions, the government deficit or debt is significantly higher than during economic prosperity periods.

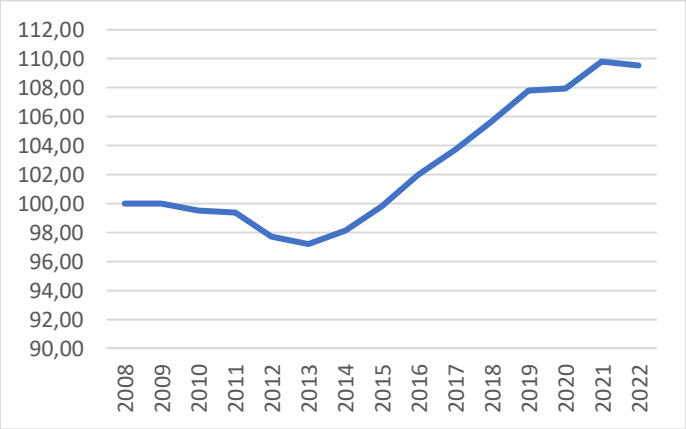
Figure 3 Government deficit/surplus, debt and associated data



Source of data: Own elaboration with Eurostat data (2023)

The following figure shows the real gross disposable income of households per capita between 2008 and 2022. During this period, we can observe a general trend that is increasing. However, after the 2008 crisis it began to fall, especially between 2011 and 2013. Then we observe a recovery, but with the covid-19 crisis it falls slightly again, specifically from the year 2021 onwards. As we can see, disposable income does not fall just when the crises start, but has a lag effect, and a fall can be seen in the following years. This could be due to government aid programs to enable the population to maintain its standard of living to a certain extent.

Figure 4 The real gross disposable income of households per capita (index = 2008) EU27



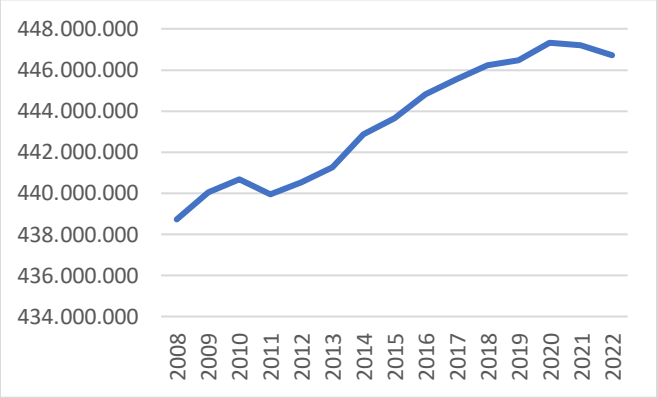
Source of data: Own elaboration with Eurostat data (2023)

3.2. Evolution of the main sociodemographic variables and death due to suicide rate

We are going to describe the sociodemographic variables and the death due to suicide rate, at the level of the European Union of 27 countries. First, we have the population, which as we can see is represented in the next graph for the EU-27 between 2008 and 2022. In general terms, it follows an increasing trend, although in the two years following the beginning of each crisis that occurred in the period analysed (the financial crisis of 2008 and the crisis that emerged as a result of the global pandemic of covid-19)

we can see a drop in the population. This is due to the deaths by suicide and the deaths caused by the covid-19 health pandemic, however, the recovery is fast.

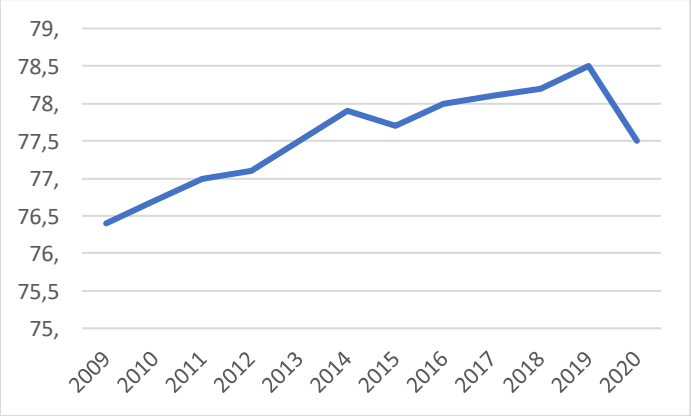
Figure 5 Population EU27 - annual data



Source of data: Own elaboration with Eurostat data (2023)

The life expectancy variable is reflected in the following graph for the period 2009-2020, because there is no data before and after those years. Its trend has been increasing significantly over time. Nevertheless, we observed that between 2014 and 2015 population declined slightly, and from 2019 to 2020 it decreased very considerably, possibly due to all the deaths caused by the health pandemic. It reached its peak before the onset of the pandemic in 2019, with a value of more than 78 years of age. But in general, it is a variable that tends to improve over the years thanks to all the health improvements that are being discovered.

Figure 6 Life Expectancy EU27 - annual data

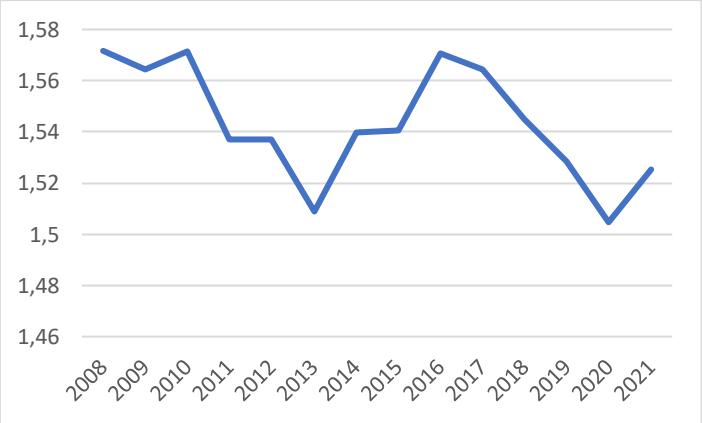


Source of data: Own elaboration with Eurostat data (2023)

The fertility rate is interpreted by the Eurostat (2023) as “the mean number of children that would be born alive to a woman during her lifetime if she were to pass

through her childbearing years conforming to the fertility rates by age of a given year and surviving". In the Figure 7 is represented the fertility rate for the EU-27 from 2008 to 2021. The overall trend is downward, since in 2008 the average was 1.6 and in 2021 it has dropped to 1.5. It has different variations throughout the period analysed, as we can see in the following graph. Starting in 2008, with the onset of the financial crisis, it has a decreasing trend, which in general terms continues until five years later. However, from 2013 to 2016 we see a change in the trend, which becomes increasing, but then falls again until 2020, when it increases slightly.

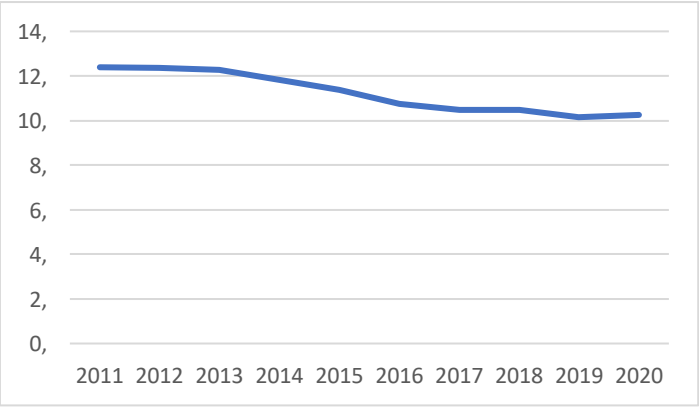
Figure 7 Fertility rate EU27 - annual data



Source of data: Own elaboration with Eurostat data (2023)

Regarding deaths by suicide, they are illustrated in the next line graph, for the EU-27 for the period 2011-2020. There is not data for the years of the 2008 crisis, but between the years 2011 and 2019 it follows a decreasing trend. In 2011 the deaths by suicide were 12,38 and in the year 2019 10,15. However, these increase slightly between 2019 and 2020 with the arrival of the global pandemic.

Figure 8 Death due to suicide EU27 - annual data



Source of data: Own elaboration with Eurostat data (2023)

4. Methodology and data

4.1. Data

To make the estimates, we used cross-section data we obtained from Eurostat for each of the variables, at the level of European NUTS 2 regions. We initially search for all data for the period between 2008 and 2022. Finally, we chose 2017 data for the study as it is the most recent year for which there is more available information for all variables.

Once we obtained all the cross-sectional data, before performing the model estimation tests, we looked for outliers that could alter the results. Hawkins (1980) defines an outlier as “an observation which deviates so much from other observations as to arouse suspicions that it was generated by a different mechanism”. To recognize them, a box-and-whisker plot was made for each of the variables with Excel, and all values that were identified as outliers were eliminated. This type of graph consists of a "box", which has the shape of a rectangle, where the longer sides show the interquartile range. The box is divided by a segment that indicates where the median is located. This figure is placed on a segment whose extremes are the minimum and maximum values, being these lines on both sides the "whiskers". Once all this is plotted, we can see which are the outliers (Minnaard et al., 2005). For example, in the case of GDP per capita, one figure that had to be eliminated was that of Luxembourg, which was 78,900, a far difference from the rest of the data. However, this figure can be considered merely accounting, since in this country, most of the wealth generated is only for accounting and taxation effects (Muñoz, 2022). In terms of disposable income, two outliers were the data of a region in France called Île de France, where the French capital, Paris, is located, and the Lombardy region in Italy, place where the city of Milan is situated, with disposable income above €200,000. The data on suicide deaths in Lithuania were deleted because the values were too high, exceeding a rate of 23 and even 30. According to authors such as Marusic et al. (2002) it could be due to a genetic predisposition. Once this process of selection and elimination of outliers was completed, the estimation process could be carried out.

Table 2 presents the variables that were initially considered for this study, together with their label and definition according to the database from which they were extracted

(Eurostat), their mean, standard deviation and maximum and minimum, before eliminating outliers.

Table 2 Definition of variables and descriptive statistics for the sample (n=338 regions) of the Eurostat databse – 2017

Variable	Label	Definition	Mean	Std. Dev.	Max	Min
Death by suicide	Deaths	The standardised death rate, which is "a weighted average of age-specific mortality rates" (Eurostat, 2023) due to intentionally self-inflicted injury.	10,25	4,64	30,46	0,89
Population	pop	"The number of persons having their usual residence in a given area (NUTS 2 region) on 1 January" (Eurostat, 2023)	1874834,76	1637992,15	14804116	29214
Life Expectancy	Life_Exp	"The mean number of years that a newborn child can expect to live if subjected throughout his life to the current mortality conditions (age specific probabilities of dying)." (Eurostat, 2023)	80,65	2,48	85,1	73,5
Fertility rate	Fert	"The mean number of children that would be born alive to a woman during her lifetime if she were to survive and	1,65	0,37	4,92	1,03

		pass through her childbearing years conforming to the fertility rates by age of a given year." (Eurostat, 2023)				
Disposable Income	disp_income	"The disposable income of private households is the balance of primary income (operating surplus/mixed income plus compensation of employees plus property income received minus property income paid) and the redistribution of income in cash." (Eurostat, 2023)	29305,01	30360,44	248471,19	548,15
Unemployment rate	unemp	"It represents unemployed persons as a percentage of the economically active population". "The indicator is based on the EU Labour Force Survey" (Eurostat, 2023)	8,01	5,73	29,6	1,7
Long-term unemployment rate	long_t_unemp	"It is the share of unemployed persons since 12 months or more in the total active population, expressed as a	3,88	4,19	25,2	0,3

		percentage." (Eurostat, 2023)				
GDP in PPS per inhabitant	GDP	"It reflects the total value of all goods and services produced less the value of goods and services used for intermediate consumption in their production. Expressing GDP in PPS (purchasing power standards) eliminates differences in price levels between countries. Calculations on a per inhabitant basis allow for the comparison of economies and regions significantly different in absolute size" (Eurostat, 2023)	26942,86	11524,87	78900	7300

Source of data: Own elaboration with Eurostat data (2023)

4.2. Estimation Method

The multiple linear regression model estimated by the Ordinary Least Squares (OLS) method was the most appropriated method for our estimation, based on previous literature and on the knowledge acquired in the economics´ degree program. Multiple linear regression models have a dependent variable (Y) that is explained by several independent variables (X) and a random term (u). In addition, they must meet the hypotheses of linearity, homoscedasticity, independence, and normality. (Abuín, 2007)

Our model has deaths by suicide as a dependent variable. The explanatory variables considered appropriated based on the literature review were 6: population, life expectancy, fertility rate, disposable income, unemployment rate and GDP in PPS per inhabitant. The matrix form of this model is depicted in the following way:

$Y = X*\beta + u$

Where "Y" is the vector that captures the endogenous variable, that is, deaths by suicide, for the different observations (T; the NUTS 2 regions), "X" is the matrix that captures the explanatory variables for each of the t, which are population, life expectancy, fertility rate, disposable income, unemployment rate and GDP in PPS per inhabitant, "β" is the vector that captures the coefficients of each of the explanatory variables, and "u" is the vector that captures the random terms.

The method that is used in our study, as mentioned above, is the Ordinary Least Squares method, that consists of minimizing the square of the residuals, defining these as the difference between the actual values and the estimated values (Molina, 2020).

We used the Gretl econometric program (2021c version) to perform our estimations.

5. Results

First, we made different estimations with the variables already presented in the methodology and data section. Initially, we included practically all the variables, but we realized that including variables such as GDP and disposable income at the same time could lead to multicollinearity problems, so we discarded the model. We tried to make two other models, including in one the initial variables and discarding the GDP, and the other one in the same way but discarding the disposable income. However, we realized that adding logarithms to the economic variables would improve our model[1], and therefore, we repeated the two previous ones but adding logarithms to GDP and disposable income. After making these first five models, which we can see in Table 3

[1] Logarithms allow us to eliminate the effect of the units of the variables on the coefficients, to limit the range of the variable to a smaller quantity than the original, and to go from measuring a variable that is in absolute terms to being able to understand it in relative terms.

that is at the end of this section, we saw that the best of them was model 5, which had the suicide death rate as the dependent variable and life expectancy, fertility rate, unemployment rate and the logarithm of disposable income as independent variables.

However, it later occurred to us that introducing other unemployment rate variables might improve the model. So, we tested with the lagged unemployment rate for the years 2014, 2015 and 2016 and with the long-term unemployment rate.

We realized that model 9 was better than model 5, which we initially believed was the most appropriate. This is because we changed the unemployment variable, which appeared in model 5, to the lagged unemployment variable of the year 2014, since when a person becomes unemployed mental health problems are created little by little as time goes by, and not just at the moment when a person becomes unemployed. In this model, although the R^2 is not high (0.212628), if we look at the contrast statistic for joint nullity of the explanatory variables (F) we see that the null hypothesis is rejected in favour of the joint relevance of the variables for practically any level of significance, because the p-value is less than 1%. Furthermore, if we look at the t-statistic and its associated p-value, which indicates the individual significance of each explanatory variable, we see that, although the logarithm of disposable income is not individually relevant, the constant, the fertility rate and the lagged 2014 unemployment rate are individually relevant for practically any significance level (below 1%) and life expectancy is shown to be individually relevant for the 5% significance level.

As for the coefficients estimated by the model, we interpret them as follows:

b_0= 24.0555 (constant). This is the estimated value of the suicide death rate when the explanatory variables are zero.

b_1=-0.198811 (Life expectancy). This indicates the estimated variation in the suicide death rate in the face of a unit variation in life expectancy, with all other explanatory variables held constant. In other words, it is estimated that, on average, if life expectancy increases (decreases) by one year, all other explanatory variables remaining constant, the suicide death rate decreases (increases) by 0.198811 points.

b_2=6.01372 (fertility rate). This indicates the estimated variation in the suicide death rate for a unit variation in the fertility rate, with all the other explanatory variables remaining constant. In other words, it is estimated that, on average, if the fertility rate increases (decreases) by one point, keeping the other explanatory variables constant, the suicide death rate increases (decreases) by 6.01372 points.

b_3=-0.412409 (logarithm of disposable income). Indicates that, holding all other explanatory variables constant, if disposable income per capita increases by 1%, the suicide death rate is estimated to decrease by 0.00412409 points.

b_4=-0.152082 (lagged unemployment rate for 2014). This indicates the estimated change in the suicide death rate given a unit change in the lagged unemployment rate for 2014, with the other explanatory variables remaining constant. In other words, it is estimated that, on average, if the lagged unemployment rate for 2014 increases (decreases) by one point, keeping the other explanatory variables constant, the suicide death rate decreases (increases) by 0.152082 points.

Both the life expectancy variable and the logarithm of disposable income are in line with previous literature. The higher the life expectancy and the higher the disposable income, the lower the suicide death rate.

However, the fertility rate and the lagged unemployment variable for 2014 are not shown to be in line with the literature. The higher the unemployment rate, the lower the suicide death rate, when in previous studies the result is that the higher the unemployment rate, the higher the suicide death rate. The higher the fertility rate, with our model, the higher the suicide death rate, while most previous analyses show that a higher fertility rate corresponds to a lower suicide death rate.

All of the above models, and some others, are shown in Table 3. Due to the fact that different models were estimated and in order to facilitate the reading and understanding of these models, it was decided to put the main ones in this table. However, in the annexes we can see all of models from Gretl. The mentioned table shows the model, its explanatory variables, whether they are related to the dependent variable according to previous literature, their individual significance level, the joint nullity statistic of the variables (F), and the R^2, which is a statistic that indicates the goodness of fit.

Table 3 Estimated models and characteristics

Models	**Variables**	**According to literature**	**Significance level**	**F (joint nullity)** H_0: $\beta_0=\beta_1=\beta_k=0$	**R^2**
1	const			F= 12,51872 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the	R^2 = 0,251791 The regression explains 25.18% of the sample variations in suicide deaths.
	Life_Exp	No			
	Fert	No	1%		
	disp_income	Yes			

	unemp	No	1%	variables, for any significance level at which α > p-value (which is less than 1%).	
	GDP	Yes	1%		
2	const			F= 8,564551 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,131128 The regression explains 13.11% of the sample variations in suicide deaths.
	Life_Exp	No			
	Fert	No			
	unemp	No	1%		
	GDP	Yes	10%		
3	const		10%	F= 13,14090 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,215811 The regression explains 21.58% of the sample variations in suicide deaths.
	Life_Exp	Yes			
	Fert	No	1%		
	unemp	No	1%		
	disp_income	Yes			
4	const			F= 7,901615 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,122218 The regression explains 12.22% of the sample variations in suicide deaths.
	Life_Exp	No			
	Fert	No			
	unemp	No	1%		
	l_GDP	Yes			
5	const		5%	F= 12,65408 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,209491 The regression explains 20.95% of the sample variations in suicide deaths.
	Life_Exp	Yes			
	Fert	No	1%		
	unemp	No	1%		
	l_disp_income	Yes			
6	const		5%	F= 12,12328 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the	R^2 = 0,210389 The regression explains 21.04% of the sample variations in suicide deaths.
	Life_Exp	Yes			
	Fert	No	1%		
	l_disp_income	Yes			

	long_t_unemp	No	1%	variables, for any significance level at which α > p-value (which is less than 1%).	
7	const		5%	F= 14,68700 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,228816 The regression explains 22.88% of the sample variations in suicide deaths.
	Life_Exp	Yes	10%		
	Fert	No	1%		
	l_disp_income	Yes			
	unemp_16	No	1%		
8	const		1%	F= 12,35080 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,202138 The regression explains 20.21% of the sample variations in suicide deaths.
	Life_Exp	Yes	5%		
	Fert	No	1%		
	l_disp_income	Yes			
	unemp_15	No	5%		
9	const		1%	F= 13,09732 The statistic is high and is associated with a very low p-value, therefore, we reject the null hypothesis in favor of the joint significance of the variables, for any significance level at which α > p-value (which is less than 1%).	R^2 = 0,212628 The regression explains 21.26% of the sample variations in suicide deaths.
	Life_Exp	Yes	5%		
	Fert	No	1%		
	l_disp_income	Yes			
	unemp_14	No	1%		

Source of data: Own elaboration with Eurostat data (2023) and Gretl

6. Conclusions

Initially, a literature review was conducted to obtain information from previous studies, and subsequently to see if it coincided with our research. Previous studies included in this paper have found that times of economic crisis cause an increase in deaths by suicide, since during these times people's mental health worsens severely. In

particular, they highlight unemployment as a factor that substantially worsens the situation, and economic problems to face household expenses derived from a reduction in disposable income. In addition, during these periods of economic recession, people abuse substances such as alcohol and mental disorders increase, and, consequently, suicide attempts increase too. Therefore, it is observed that during periods of economic crisis, suicides increase. However, this does not coincide with the relationship shown by our model. We find an opposite relationship: the higher the level of unemployment, the lower the rate of suicide deaths. Therefore, during economic crises, which is when the number of unemployed people increases, even though the mental health of the population worsens, suicides do not increase. However, the relationship we found with respect to the disposable income variable is in line with previous literature, since when disposable income increases, the suicide death rate is lower. During economic crises, people's income in most cases tends to decrease, and, therefore, this negatively affects the suicide death rate by increasing it. Therefore, this in some ways creates confusion since during economic crises unemployment increases and disposable income decreases.

Regarding the macroeconomic context at the EU-27 level, the period chosen for the analysis was from 2008 to 2022, because it includes the two most significant and impactful crises of this century. Unemployment rises during economic recessions and falls as economies recover from the crises. However, GDP generally follows an upward trend, declining slightly during the year the crises begin and recovering within a short period of time. If we analyse the government deficit, even though there is never a surplus, the deficit increases enormously during times of crisis, although it then improves, but it never fully recovers. These variables show the expected results, according to the economic cycle, in times of crisis they worsen and in times of expansion they improve, but at different times and with different intensities.

Lastly, to explain the influence of the economic cycle on the suicide death rate, a multiple linear regression model estimated by ordinary least squares was developed. After performing different estimation tests with different economic cycle and control variables, which we have chosen based on the literature review that was done previously, the model that best explained our objective is the afore mentioned Model 9 (which can be seen in Table 3 and in the Annexes at the end of the document).

In this model we use the unemployment variable with 3 lags, that is, for the year 2014. It was decided to use the lagged variable instead of the current variable because

when a person loses employment mental health does not deteriorate at the moment, but over time, as the situation is assimilated. The variables referring to life expectancy, disposable income and unemployment showed a negative relationship with the suicide death rate, that is, when these increase the suicide death rate decreases. The opposite is the case for the fertility rate, which showed a positive relationship with the suicide death rate. However, some of these results are not consistent with findings previously discovered by other authors. If we recapitulate the starting hypotheses, we will see which ones are fulfilled and which are not.

The first initial hypothesis was that the higher the unemployment rate, the higher the suicide death rate. This hypothesis is not fulfilled by our model, since the higher the unemployment rate, the lower the rate of suicide deaths. Therefore, instead of finding a procyclical relationship we find a countercyclical relationship. Thus, during economic crises, which are the periods in which we can see higher unemployment rates because many people lose their jobs, is when there are lower suicide rates, and during periods of expansion, in which unemployment is reduced due to improvements in the economy, higher rates of suicide deaths are observed. This is in contradiction with the contributions of authors such as Urbanos-Garrido and González (2013) in the study they conducted with data from the Living Conditions Survey (LCS), or in the study in which they obtained the data from the Spanish Health Survey (2014), Casal, Rivera and Currais (2015), Córdoba-Doña et al. (2014) and Demirci et al. (2020). All these authors found in their studies that when the unemployment rate was higher, coinciding with times of economic recession and crisis, people's mental health was greatly impaired, and the rate of suicide deaths increased.

This differences in the results may be because we use data for a single year (cross-sectional data), instead of using longitudinal data, like the authors mentioned before, that could give us a broader view of many years. Also, it could be because unemployment is not necessarily the most optimal indicator to measure household financial constraints. This is due to the fact that, during periods of crisis, governments give both monetary and non-monetary aid to try to soften the consequences of recessions, there are unemployment benefits which are an important support for people who lose their jobs, some people who lose their jobs are not the only source of income within the household and the rest of the people with whom they live can help them financially, etc. Nevertheless, in a study that we mentioned in the literature review section, Urbanos-Garrido and González (2013) analyzed the relationship between unemployment and

health, carrying out two different estimations with data collected in different ways, and this originated disparities in the results of both estimates. In one case, using cross-sectional data, it was shown that unemployed people had poorer health while in the other, using longitudinal data, it could not be said that unemployed people had worse health. This may be the case of what happened with our study, perhaps we did not find the results we expected, because we did not value or treat the same type of data as in other analyses, nor did we use the same estimation methods.

The second hypothesis was that the higher the disposable income or GDP per inhabitant, the lower the suicide death rate. We see that this relationship is indeed fulfilled by the model we estimate. Therefore, the higher the disposable income, which coincides with times of economic expansion, the lower the rate of suicide deaths. And *vice versa*, the lower the disposable income, during times of crisis, the higher the suicide death rate. This is consistent with the research of other authors such as Casal, Rivera and Currais (2015) or Urbanos-Garrido and González (2013), and is coherent since, during these times, the mental health of the population is deteriorated by the negative consequences of a crisis, and in times of expansion people normally improve their standard of living and have fewer problems, at least at the economic level, and therefore, this rate is reduced. Disposable income is a better measure of household financial capacity than the unemployment rate, since the effect of the latter can be altered for the reasons mentioned above, while disposable income is what it is, without any possible alteration. So, as regards the economic cycle, the results obtained by this variable are more reliable than those obtained by the unemployment rate.

The third hypothesis was that the higher the fertility rate, the lower the suicide death rate. This hypothesis is not fulfilled, since in our model the opposite occurs, the higher the fertility rate, the higher the suicide death rate.

The fourth hypothesis was that the higher the life expectancy, the lower the suicide death rate. This relationship does hold in the model we estimated.

6.1. Limitations

A very important limitation is the possible omission of relevant variables in the model. Not including relevant variables in the model, due to a lack of awareness of its importance, can lead to bias and inconsistency in the OLS estimates of the parameters (Balacco, 2011). Another limitation was the lack of more recent data for all European NUTS 2 regions for each of the variables we included in our model.

Moreover, we are working with aggregated data, but it would be desirable to have analysed individual data to be more precise and obtain more specific results. Furthermore, it would be interesting to have used panel data to make the estimations and obtain more precise results, but the economics degree does not include this content in the econometrics courses.

6.2. Recommendations

Economic crises have negative consequences that affect the entire population. Among them we can highlight the loss of employment and the reduction of disposable income, with all that this entails. Mental health is seriously affected by this, leading to disorders such as depression, anxiety, psychological problems, etc. Sometimes this causes an increase in smoking and greater consumption of alcohol and other substances, which instead of improving the situation in which people find themselves, worsen it, and in the worst cases can lead to suicide.

That is why this problem must be approached from different perspectives and with a variety of measures to try to avoid such dramatic consequences.

The government can try to improve health care and social services related to mental health, avoiding long waiting times to address the problem from the beginning and alleviating the economic cost of private health care for these problems, since the simple fact of going to a private psychologist there are people who cannot afford it. In this way, people whose mental health is unstable can have the opportunity to see a specialist without temporal or economic obstacles.

Improving mental health education for all population groups, especially the most vulnerable, can be a prevention strategy. Teaching children from an early age in schools how to deal with conflictive situations, the resources they can use and who they should contact, makes it easier for them to ask for help when they need it and to manage the situations they face with the available resources.

The participation and collaboration of the media (Barrero, 2005) can ensure reaching a wider audience and in a way that is understandable to the people to whom the information is directed.

Research (Barrero, 2005) is a fundamental factor in any field. Therefore, encouraging mental health experts to explore this field in greater depth and detail can contribute to finding more specific and effective solutions.

Since unemployment is a risk factor for suicidal behaviour, governments should improve both active employment policies, to make it easier for people to find a job, and passive policies, so that those who have lost their jobs do not have financial problems to support themselves on a day-to-day basis until they find a new job.

At the individual level, suicide prevention programs can be carried out to try to help people who find themselves in a problematic situation, since, without prior training, it is very difficult to act in the right way.

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8. Annexes

Model 1

```
Modelo 1: MCO, usando las observaciones 1-338 (n = 192)
Se han quitado las observaciones ausentes o incompletas: 146
Variable dependiente: deaths

              coeficiente   Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------------
  const        -2.93814      10.2094         -0.2878     0.7738
  Life_Exp      0.141264      0.136521        1.035      0.3021
  Fert          6.02240       1.30004         4.632      6.78e-06 ***
  disp_income  -1.11097e-05   1.46167e-05    -0.7601     0.4482
  unemp        -0.333500      0.0854593      -3.902      0.0001   ***
  GDP          -0.000119932   4.00406e-05    -2.995      0.0031   ***

Media de la vble. dep.  12.05990   D.T. de la vble. dep.   3.761545
Suma de cuad. residuos  2022.036   D.T. de la regresión    3.297144
R-cuadrado              0.251791   R-cuadrado corregido    0.231678
F(5, 186)               12.51872   Valor p (de F)          1.75e-10
Log-verosimilitud      -498.4552   Criterio de Akaike      1008.910
Criterio de Schwarz     1028.455   Crit. de Hannan-Quinn   1016.826

Sin considerar la constante, el valor p más alto fue el de la variable 5 (disp_income)
```

Model 2

```
Modelo 2: MCO, usando las observaciones 1-338 (n = 232)
Se han quitado las observaciones ausentes o incompletas: 106
Variable dependiente: deaths

             coeficiente    Desv. típica   Estadístico t   valor p
  ------------------------------------------------------------------
  const       -0.444949      11.7171          -0.03797      0.9697
  Life_Exp     0.197872       0.153768         1.287        0.1995
  Fert         0.503817       1.32705          0.3797       0.7046
  unemp       -0.482612       0.0904467       -5.336        2.30e-07 ***
  GDP         -6.86823e-05    4.13734e-05     -1.660        0.0983   *

Media de la vble. dep.  11.07543   D.T. de la vble. dep.   4.338504
Suma de cuad. residuos  3777.878   D.T. de la regresión    4.079538
R-cuadrado              0.131128   R-cuadrado corregido    0.115817
F(4, 227)               8.564551   Valor p (de F)          1.87e-06
Log-verosimilitud      -652.8547   Criterio de Akaike      1315.709
Criterio de Schwarz     1332.943   Crit. de Hannan-Quinn   1322.659

Sin considerar la constante, el valor p más alto fue el de la variable 4 (Fert)
```

Model 3

```
Modelo 3: MCO, usando las observaciones 1-338 (n = 196)
Se han quitado las observaciones ausentes o incompletas: 142
Variable dependiente: deaths

              coeficiente   Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------
  const        14.9638       8.37323          1.787      0.0755   *
  Life_Exp     -0.135569     0.101524        -1.335      0.1834
  Fert          6.23591      1.29231          4.825      2.85e-06 ***
  unemp        -0.188804     0.0693300       -2.723      0.0071   ***
  disp_income  -1.95439e-05  1.44263e-05     -1.355      0.1771

Media de la vble. dep.  12.05480   D.T. de la vble. dep.   3.723826
Suma de cuad. residuos  2120.480   D.T. de la regresión    3.331965
R-cuadrado              0.215811   R-cuadrado corregido    0.199388
F(4, 191)               13.14090   Valor p (de F)          1.79e-09
Log-verosimilitud      -511.4777   Criterio de Akaike      1032.955
Criterio de Schwarz     1049.346   Crit. de Hannan-Quinn   1039.591

Sin considerar la constante, el valor p más alto fue el de la variable 3 (Life_Exp)
```

Model 4

```
Modelo 4: MCO, usando las observaciones 1-338 (n = 232)
Se han quitado las observaciones ausentes o incompletas: 106
Variable dependiente: deaths

             coeficiente   Desv. típica   Estadístico t   valor p
  ------------------------------------------------------------
  const       12.7770       9.71599          1.315       0.1898
  Life_Exp     0.101676     0.168164         0.6046      0.5460
  Fert         0.592748     1.33592          0.4437      0.6577
  unemp       -0.433544     0.0915375       -4.736       3.84e-06 ***
  l_GDP       -0.772191     1.18616         -0.6510      0.5157

Media de la vble. dep.  11.07543   D.T. de la vble. dep.   4.338504
Suma de cuad. residuos  3816.616   D.T. de la regresión    4.100401
R-cuadrado              0.122218   R-cuadrado corregido    0.106751
F(4, 227)               7.901615   Valor p (de F)          5.58e-06
Log-verosimilitud      -654.0381   Criterio de Akaike      1318.076
Criterio de Schwarz     1335.310   Crit. de Hannan-Quinn   1325.026

Sin considerar la constante, el valor p más alto fue el de la variable 4 (Fert)
```

Model 5

```
Modelo 5: MCO, usando las observaciones 1-338 (n = 196)
Se han quitado las observaciones ausentes o incompletas: 142
Variable dependiente: deaths

                coeficiente  Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------------
  const           17.9534      8.44141          2.127      0.0347   **
  Life_Exp        -0.156094    0.101245        -1.542      0.1248
  Fert             6.22747     1.30036          4.789      3.35e-06 ***
  unemp           -0.184426    0.0700352       -2.633      0.0091   ***
  l_disp_income   -0.186233    0.343699        -0.5418     0.5886

Media de la vble. dep.  12.05480   D.T. de la vble. dep.   3.723826
Suma de cuad. residuos  2137.570   D.T. de la regresión    3.345365
R-cuadrado              0.209491   R-cuadrado corregido    0.192935
F(4, 191)               12.65408   Valor p (de F)          3.74e-09
Log-verosimilitud      -512.2644   Criterio de Akaike      1034.529
Criterio de Schwarz     1050.919   Crit. de Hannan-Quinn   1041.164

Sin considerar la constante, el valor p más alto fue el de la variable 9 (l_disp_income)
```

Model 6

```
Modelo 1: MCO, usando las observaciones 1-337 (n = 187)
Se han quitado las observaciones ausentes o incompletas: 150
Variable dependiente: deaths

                coeficiente  Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------------
  const           19.0854      8.30634          2.298      0.0227   **
  Life_Exp        -0.135643    0.100708        -1.347      0.1797
  Fert             5.73581     1.31421          4.364      2.13e-05 ***
  l_disp_income   -0.397256    0.345485        -1.150      0.2517
  long_t_unemp    -0.395905    0.126722        -3.124      0.0021   ***

Media de la vble. dep.  12.05963   D.T. de la vble. dep.   3.749865
Suma de cuad. residuos  2065.179   D.T. de la regresión    3.368551
R-cuadrado              0.210389   R-cuadrado corregido    0.193034
F(4, 182)               12.12328   Valor p (de F)          9.31e-09
Log-verosimilitud      -489.9157   Criterio de Akaike      989.8315
Criterio de Schwarz     1005.987   Crit. de Hannan-Quinn   996.3777

Sin considerar la constante, el valor p más alto fue el de la variable 12 (l_disp_income)
```

Model 7

```
Modelo 2: MCO, usando las observaciones 1-337 (n = 203)
Se han quitado las observaciones ausentes o incompletas: 134
Variable dependiente: deaths

                coeficiente  Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------------
  const           20.1926      8.17524          2.470      0.0144   **
  Life_Exp        -0.178961    0.0983260       -1.820      0.0703   *
  Fert             6.21149     1.29263          4.805      3.05e-06 ***
  l_disp_income   -0.208764    0.317001        -0.6586     0.5109
  unemp_16        -0.199526    0.0634993       -3.142      0.0019   ***

Media de la vble. dep.  11.88232   D.T. de la vble. dep.   3.819973
Suma de cuad. residuos  2273.160   D.T. de la regresión    3.388305
R-cuadrado              0.228816   R-cuadrado corregido    0.213236
F(4, 198)               14.68700   Valor p (de F)          1.59e-10
Log-verosimilitud      -533.2401   Criterio de Akaike      1076.480
Criterio de Schwarz     1093.046   Crit. de Hannan-Quinn   1083.182

Sin considerar la constante, el valor p más alto fue el de la variable 12 (l_disp_income)
```

Model 8

```
Modelo 3: MCO, usando las observaciones 1-337 (n = 200)
Se han quitado las observaciones ausentes o incompletas: 137
Variable dependiente: deaths

                coeficiente  Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------------
  const           22.1467      8.28855          2.672      0.0082   ***
  Life_Exp        -0.202543    0.0975991       -2.075      0.0393   **
  Fert             6.21357     1.32043          4.706      4.79e-06 ***
  l_disp_income   -0.237895    0.325290        -0.7313     0.4655
  unemp_15        -0.149730    0.0648271       -2.310      0.0220   **

Media de la vble. dep.  11.96790   D.T. de la vble. dep.   3.778658
Suma de cuad. residuos  2267.024   D.T. de la regresión    3.409657
R-cuadrado              0.202138   R-cuadrado corregido    0.185772
F(4, 195)               12.35080   Valor p (de F)          5.68e-09
Log-verosimilitud      -526.5783   Criterio de Akaike      1063.157
Criterio de Schwarz     1079.648   Crit. de Hannan-Quinn   1069.830

Sin considerar la constante, el valor p más alto fue el de la variable 12 (l_disp_income)
```

Model 9

```
Modelo 4: MCO, usando las observaciones 1-337 (n = 199)
Se han quitado las observaciones ausentes o incompletas: 138
Variable dependiente: deaths

                coeficiente  Desv. típica  Estadístico t  valor p
  ------------------------------------------------------------------
  const           24.0555      8.23513          2.921      0.0039   ***
  Life_Exp        -0.198811    0.0956586       -2.078      0.0390   **
  Fert             6.01372     1.31649          4.568      8.74e-06 ***
  l_disp_income   -0.412409    0.326171        -1.264      0.2076
  unemp_14        -0.152082    0.0577364       -2.634      0.0091   ***

Media de la vble. dep.  12.00960   D.T. de la vble. dep.   3.741774
Suma de cuad. residuos  2182.731   D.T. de la regresión    3.354279
R-cuadrado              0.212628   R-cuadrado corregido    0.196394
F(4, 194)               13.09732   Valor p (de F)          1.84e-09
Log-verosimilitud      -520.6740   Criterio de Akaike      1051.348
Criterio de Schwarz     1067.814   Crit. de Hannan-Quinn   1058.012

Sin considerar la constante, el valor p más alto fue el de la variable 12 (l_disp_income)
```