Abstract In this paper we analyse suicides across the 17 Spanish regions over the period 2002–2013. In doing so, we estimate count panel data models considering gender differences taking into account before and during economic crisis periods. A range of aggregate socioeconomic regional-level factors have been considered. Our empirical results show that: (1) a socioeconomic urban–rural suicide differentials exist, (2) there exists a Mediterranean suicide pattern; and (3) unemployment levels have a marked importance during the crisis period. The results of this study may have usefulness for suicide prevention in Spain.

Keywords Suicide · Material deprivation · Count panel data · Economic conditions

1 Introduction

Empirical evidence on the relationship between macroeconomic conditions and health has not yet reached a consensus on how business cycles, and more precisely economic downturns, affect health behaviours and results. Regarding the latest, generally for developed countries, and particularly for Spain, it has been shown that economic crisis intensifies mental illness disorders. Thus, evaluating the mental-health consequences of the latest economic crisis, Gili et al. (2013) report there was a significant increase in the
number of patients seeking treatment at primary-care centres for mood, anxiety, somatoform and alcohol-related disorders.

Thus, regardless of theoretical orientation, it is assumed that people behave rationally even when their decisions are based on the present value of future life (Bandyopadhyay and Green 2013). However, it should be also identified the new standard economic-approach which considers suicide is consequence of an irrational behaviour due to mental illnesses (Hong and Lee 2015) or social disintegration (Jarosz 1985) or less social capital (Heliwell 2007).

Suicide is a significant cause of death in many OECD countries (Chen et al. 2010). There are different reasons which could explain why people choose to attempt or commit suicide. Besides, there exist multiple risk factors that can predispose a person to attempt to take their own life: mental-health disorders, the social context where the individual lives, low income, “bad” lifestyles, and/or unemployment status (OECD 2013). In this framework, Spain provides a good opportunity to examine deaths from suicide and self-harm because, since the start of the “Great Recession”, it has experienced one of the worst economic scenarios.

Thus, although suicide mortality rates for Spain are up to date well below the average, an important shift has appeared since the start of the latest economic crisis. In fact, according with OECD Health Statistics (2015), suicide rates (defined as the total number of suicides per 100,000 persons) rose from 6.7 to 7.5 % between 2007 and 2013, while for the OECD-34 countries they were 12.7 and 11.7 %, respectively. Therefore, in spite different studies have analysed suicides for Spain (Granizo et al. 1996; Tapia-Granados 2005; Bernal et al. 2013; Giner and Guija 2014), little evidence is still found for the latest economic crisis. Hence, to identify how many, who, and why people are prone to suicide has become crucial.

Small proof is yet found mainly because delays in data availability. Therefore, given that international limitation of empirical evidence regarding effects of the recent economic crisis, the results obtained for the Spanish case would be of interest for this country and for any other one. This information is crucial in order to understand and know where interventions and policies to mitigate the problems should be implemented.

Our objective is to study the determinants and patterns of suicides using Spanish regional aggregate data for 2002–2013. The analysis is performed, both jointly and separately, for two main marked different business cycles periods of this century for Spain: “Great Expansion” (2002–2007) and “Great Recession” (2008–2013). We use count panel data models and the analysis is stratified by sex. In order to do so, we transmit a distinction on previous contributions and we provide new highlights for suicide prevention in Spain.

The study is structured as follows. The following section contains the data and methodological aspects. The estimation results are presented in Sect. 3. Finally, Sect. 4 summarizes and concludes.

2 Data and Methods

In order to identify patterns, we analyse the different determinants through which deaths from suicide and self-harm may be affected during this latest century in Spain, two 6-year periods according to two different business cycles scenarios are studied1: 2002–2007 (“Great Expansion”) and 2008-2013 (“Great Recession”). The units of analysis are all the

1 Nonetheless, the results are compared to the full sample period 2002–2013.
Spanish regions, small enough to consider there is internal homogeneity so aggregate socioeconomic factors considered in the regressions could correctly reflect the nature of the social environment where people live (Chang et al. 2011; Santana et al. 2015).

Regarding the empirical strategy, as the dependent variable takes non-negative integer values (number of deaths from suicide and self-harm) the suitable framework is based on count data modelling. Poisson and negative binomial models have been estimated. Then, we try to contrast the relationship between number of suicides and different explanatory socioeconomic variables for the Spanish case. Suicides dataset is taken from the Spanish National Institute of Statistics (INE), specifically annual series (ICD-10) from health statistics according to cause of death where suicides are deaths coded as 098, are used. This dataset on causes of death is collected in three statistical questionnaire models: Medical Death Certificate/Statistical Death Register (CMD/BED), Judicial Statistical Death Register (BEDJ) and Statistical Bulletin of Infants who died within 24 h (BEP). The first one collects data on deaths due to natural causes, without requiring the intervention of a judge, whereas the second one is directed at obtaining information on deaths due to causes requiring judicial intervention, since there are signs of a possible accidental or violent cause. Both of them contain data on deaths among those who have lived more than 24 h whereas deaths occurring within 24 h of life are collected in the BEP. Available data is disaggregated by region, gender and age-group.

Assuming that, we consider a range of regional-level characteristics that can be distinguished by three subgroups of indicators: (1) self-regional area characteristics which are fixed throughout the sample period under consideration (for example, if the region is “foral” and so it has the greatest regulatory autonomy in indirect as well as direct taxation in Spain, or if the region is located on the coast (north or Mediterranean) as a proxy for climatic characteristics); (2) material deprivation factors (measured by an unemployment rate and by a ratio regarding the percentage of population that is at risk of poverty); urbanization/rural indicator (proxied by population density). In any case, the selected variables were based on the literature review as well as restrictions with data availability. Table 1 shows an overview of our key variables and sources of information. Further details on the variables used in the estimates are described in Table 2, where the summary statistics of the series by periods are provided.

Next, empirical methods are based on static panel count models. As fixed and random effects models for short panels introduce an individual-specific effect (Cameron and Trivedi 2013; Jones et al. 2013), our general specification can be described as follows:

\[ E(y_{it}|x_{it}, z_{it}) = z_{it} \exp(x_{it}'\beta), \quad i = 1, \ldots, 17; \quad t = 1, \ldots, 12 \]  

where \( y_{it} \) indicates number of deaths from suicide and self-harm, and \( x_{it} \) contains the aforementioned indicators (foral, north, mediterranean, unemployment, at-risk-of-poverty and density) for each region \( i \) during the years under consideration \( t \). Moreover, it should be highlighted that the intercept is merged into \( z_{it} \), and that the estimated coefficients can be interpreted as semi-elasticities.

In order to have a better knowledge of the situation and as a first approximation to our econometric estimations, we are going to explore how our dependent variables have been changing, both across regions and time.

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2 Constructed by Eurostat, it considers persons with an equivalised disposable income below the risk-of-poverty threshold: at 60% of the national median equivalised disposable income (after social transfers).

Important points: (i) persons are only counted once even if they are present in several sub-indicators; (ii) material deprivation covers indicators relating to different economic strain and durables.
Hence, the suicide deaths are described by age group in Table 3, where it can be noticed that it is mainly concentrated in people who are between 15 and 59 years old, mainly working-age population. However, the final estimations are only disaggregated by sex (total, males and females). In fact, it is noted that there appear larger differences. Specifically, Table 4 shows the distribution of suicides by sex whereas Table 5 focuses on the differences by regions. Also, it must be highlighted that the number of suicides is higher for men and that there appear not to be too many differences between the business cycles time periods considered. Regarding regions, the largest numbers are found in regions located in Mediterranean (Andalusia, Catalonia and Valencian Community) and north areas (Galicia) for the Spanish case.

Additionally, since these first initials descriptive analyses, it can be pointed out that the number of suicides is determined by different factors further away from size of the region (i.e. the case of the Canary Islands and its not climate variability). Besides, our results are reinforced by Figs. 1 and 2. So, Fig. 1 plots the time evolution of total suicides by region whereas Fig. 2 shows the distribution disaggregating by gender. Nonetheless, the following section contains the empirical results when considering the above mentioned indicators for these patterns.

### 3 Results

The estimation results for the poisson/negative binomial panel model estimations are presented synthetically in Tables 6, 7 and 8. Thus, in Table 6 results for the total number of suicides are presented whereas Tables 7 and 8 contain the results when disaggregating by gender. Much more attention should be also paid to exploring how the methodology is

| Variable          | Definition                                                                 | Source                                      |
|-------------------|-----------------------------------------------------------------------------|---------------------------------------------|
| suicides_total    | Total number of deaths from suicide and self-harm, total population         | Spanish National Institute of Statistics (INE) |
| suicides_m        | Total number of deaths from suicide and self-harm, males                     | Spanish National Institute of Statistics (INE) |
| suicides_w        | Total number of deaths from suicide and self-harm, females                   | Spanish National Institute of Statistics (INE) |

| Variable   | Definition                                                                 | Source                                      |
|------------|-----------------------------------------------------------------------------|---------------------------------------------|
| foral      | 1 if the region is “foral” (and so has the greatest regulatory autonomy in indirect as well as direct taxes in Spain): Basque Country or Navarre Community | Authors’ elaboration                        |
| north      | 1 if the region is sited on the north of Spain: Asturias, Cantabria, Galicia and Basque Country | Authors’ elaboration                        |
| mediterranean | 1 if the region is sited on the mediterranean area of Spain: Andalusia, Balearic Islands, Canary Islands, Catalonia, Valencian Community and Murcia | Authors’ elaboration                        |
| unemployment | Unemployment rates                                                          | Eurostat                                   |
| at-risk-of-poverty | At-risk-of-poverty rate (percentage of total population)                    | Eurostat                                   |
| density    | Population density                                                          | Eurostat                                   |

Authors’ elaboration
Table 2  Summary statistics of selected variables used in estimations

| Variable         | Full sample (2002–2013) | Great expansion (2002–2007) | Great recession (2008–2013) |
|------------------|-------------------------|-------------------------------|-----------------------------|
|                  | Obs.  | Mean    | SD       | Min. | Max.   | Obs.  | Mean    | SD       | Min. | Max.   | Obs.  | Mean    | SD       | Min. | Max.   |
| suicides_total   | 204   | 198.01  | 178.63   | 16   | 823    | 102   | 196.32  | 173.15   | 16   | 741    | 102   | 199.71  | 184.79   | 17   | 823    |
| suicides_m       | 204   | 151.36  | 136.85   | 13   | 658    | 102   | 149.12  | 130.98   | 13   | 585    | 102   | 153.61  | 143.10   | 15   | 658    |
| suicides_w       | 204   | 46.65   | 42.74    | 0    | 188    | 102   | 47.21   | 43.07    | 0    | 174    | 102   | 46.10   | 42.61    | 1    | 188    |
| foral            | 204   | 0.12    | 0.32     | 0    | 1      | 102   | 0.12    | 0.32     | 0    | 1      | 102   | 0.12    | 0.32     | 0    | 1      |
| north            | 204   | 0.24    | 0.43     | 0    | 1      | 102   | 0.24    | 0.43     | 0    | 1      | 102   | 0.24    | 0.43     | 0    | 1      |
| mediterranean    | 204   | 0.35    | 0.48     | 0    | 1      | 102   | 0.35    | 0.48     | 0    | 1      | 102   | 0.35    | 0.48     | 0    | 1      |
| unemployment     | 204   | 14.08   | 7.26     | 4.7  | 36.2   | 102   | 9.26    | 3.21     | 4.7  | 18.6   | 102   | 18.90   | 6.97     | 6.6  | 36.2   |
| at-risk-of-poverty| 170   | 20.20   | 7.47     | 5.3  | 40.2   | 68    | 20.05   | 7.88     | 5.3  | 40.2   | 102   | 20.29   | 7.22     | 5.9  | 37.9   |
| density          | 204   | 158.94  | 174.48   | 22.4 | 806.4  | 102   | 152.40  | 166.75   | 22.4 | 772.6  | 102   | 165.49  | 182.48   | 26   | 806.4  |

Authors’ calculations
| Age Group | 2002 (%) | 2003 (%) | 2004 (%) | 2005 (%) | 2006 (%) | 2007 (%) | 2008 (%) | 2009 (%) | 2010 (%) | 2011 (%) | 2012 (%) | 2013 (%) |
|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <1 year   | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| 1–14 years| 0.2      | 0.1      | 0.3      | 0.2      | 0.2      | 0.4      | 0.1      | 0.2      | 0.1      | 0.1      | 0.1      | 0.2      |
| 15–29 years| 14.3    | 13.4     | 13.8     | 12.8     | 11.5     | 10.1     | 11.0     | 10.8     | 7.6      | 7.7      | 8.6      | 7.8      |
| 30–39 years| 16.2    | 17.9     | 16.1     | 16.9     | 17.2     | 16.5     | 16.3     | 15.1     | 15.8     | 15.6     | 15.5     | 13.4     |
| 40–44 years| 7.2     | 7.7      | 8.4      | 8.8      | 8.5      | 9.5      | 9.9      | 9.3      | 10.9     | 10.8     | 10.3     | 9.8      |
| 45–49 years| 7.2     | 7.2      | 8.3      | 7.1      | 8.6      | 8.7      | 8.6      | 9.9      | 9.8      | 9.4      | 9.6      | 10.6     |
| 50–54 years| 7.2     | 7.4      | 7.4      | 6.6      | 7.0      | 7.0      | 8.2      | 7.7      | 9.8      | 9.9      | 9.6      | 11.6     |
| 55–59 years| 7.0     | 6.6      | 6.0      | 6.6      | 6.8      | 7.1      | 7.7      | 7.4      | 7.4      | 7.5      | 8.1      | 8.4      |
| 60–64 years| 5.7     | 5.8      | 5.9      | 6.1      | 7.0      | 6.9      | 6.5      | 7.4      | 7.0      | 6.1      | 6.5      | 7.0      |
| 65–69 years| 8.0     | 6.6      | 6.4      | 6.4      | 5.6      | 5.6      | 6.5      | 6.1      | 6.3      | 6.2      | 5.5      | 6.6      |
| 40–74 years| 7.7     | 7.6      | 7.9      | 8.6      | 8.1      | 7.3      | 6.7      | 6.6      | 5.9      | 6.4      | 6.0      | 6.4      |
| 75–79 years| 8.2     | 7.9      | 7.9      | 7.9      | 7.4      | 7.7      | 7.4      | 8.2      | 7.3      | 8.1      | 7.6      | 6.6      |
| 80–84 years| 5.6     | 6.5      | 6.2      | 6.6      | 7.1      | 7.3      | 6.2      | 5.9      | 5.9      | 6.8      | 7.0      | 6.6      |
| 85–89 years| 3.9     | 3.7      | 3.6      | 3.4      | 3.5      | 4.5      | 3.5      | 4.0      | 4.3      | 3.9      | 3.9      | 3.5      |
| 90–94 years| 1.3     | 1.1      | 1.4      | 1.7      | 1.2      | 1.1      | 1.1      | 1.2      | 1.5      | 1.3      | 1.4      | 1.2      |
| >94 years  | 0.3     | 0.5      | 0.3      | 0.2      | 0.3      | 0.2      | 0.3      | 0.2      | 0.3      | 0.3      | 0.3      | 0.3      |

Authors’ calculations from Spanish National Institute of Statistics (INE)
employed and the Poisson distribution is the benchmark in count data applications. However, the use of one or the other estimator is determined by the Alpha $p$ value. In this study, negative binomial appear to fits better in all specifications (we always use random effects). Negative binomial model allows for over dispersion by assuming that the individual error term comes from a probability distribution (Jones et al. 2013). We use 170 observations for 2002–2013 (“Full sample”), 68 observations for 2002–2007 (“Great Expansion” period), and 102 observations for 2008–2013 (“Great Recession” period).

It is noteworthy from these tables that coefficients are statistically significant and in most cases have the expected signs according to the priori economic criteria. Furthermore, it could be argued that the estimates are robust and consistent along periods regarding each of the dependent variables (total, males and females). Notwithstanding, it is noticed that there appear differences regarding the sample period under consideration.

If we focus on the three subgroups of indicators we can highlight the following results. On the one hand and as expected, material deprivation factors, when significant, have a clear positive effect on the number of suicides. On the other hand, the density indicator shows negative results. By way of interpretation, specific regional characteristics in all estimations appear to be only significant regarding Mediterranean regions. Therefore, whereas climatic factors could play a major role on individual lifestyles and behaviours, no significant effects are found for tax autonomy regional differences (foral). Besides, regarding differences between economic business cycles and gender, it can be noticed, material deprivation factors tend to raise its importance during recessions and that the magnitude for the variables is higher for women than for men.

### 4 Discussion

Empirical results obtained in this study would be in accordance with the studies that indicate suicides would be higher in rural areas and against the ones with claim suicides are located in areas of population concentration. So, the overall urban-rural suicide differential well known in other countries, like the United States (Singh and Siahpush 2002), is also presented for the Spanish case. Similarly, our findings are in line with those supporting the “bioclimatic theory” which suggests that temperature has a direct influence on the tendency to suicide and also explain suicidal seasonality (Lin et al. 2008; Tsai and Cho 2012; or Qi et al. 2015). Moreover, despite being shown in other studies that foral leads to greater health expenditure (Cantarero and Lago-Peñas 2010, 2012) here results do not support their importance in terms of health results. In any case, the findings presented here are in also in
|                  | Full sample (2002–2013) | Great expansion (2002–2007) | Great recession (2008–2013) |
|------------------|--------------------------|-----------------------------|-----------------------------|
|                  | Mean        | SD          | (95 % conf. interval)   | Mean        | SD          | (95 % conf. interval)   | Mean        | SD          | (95 % conf. interval)   |
| suicides_total   |             |             |                         |             |             |                         |             |             |                         |
| north            | 159.15      | 14.97       | [129.03, 189.26]       | 158.29      | 21.30       | [114.24, 202.35]       | 160.00      | 21.50       | [115.53, 204.47]       |
| mediterranean    | 316.76      | 27.57       | [261.80, 371.73]       | 305.19      | 38.22       | [227.60, 382.78]       | 328.33      | 40.18       | [246.76, 409.90]       |
| Rest of Spain    | 118.44      | 8.20        | [102.14, 134.74]       | 124.74      | 12.30       | [99.89, 149.59]        | 112.14      | 10.89       | [90.15, 134.14]        |
| suicides_m       |             |             |                         |             |             |                         |             |             |                         |
| north            | 117.21      | 11.05       | [94.99, 139.43]        | 115.75      | 15.55       | [83.58, 147.92]        | 118.67      | 16.02       | [85.53, 151.80]        |
| mediterranean    | 243.42      | 21.19       | [201.16, 285.67]       | 232.86      | 28.95       | [174.09, 291.63]       | 253.97      | 31.27       | [190.50, 317.45]       |
| Rest of Spain    | 91.98       | 6.21        | [79.63, 104.32]        | 96.40       | 9.25        | [77.73, 115.08]        | 87.55       | 8.33        | [70.72, 104.38]        |
| suicides_w       |             |             |                         |             |             |                         |             |             |                         |
| north            | 41.94       | 4.00        | [33.89, 49.99]         | 42.54       | 5.81        | [30.52, 54.56]         | 41.33       | 5.63        | [29.69, 52.97]         |
| mediterranean    | 73.35       | 6.49        | [60.40, 86.30]         | 72.33       | 9.44        | [53.17, 91.50]         | 74.36       | 9.05        | [55.98, 92.74]         |
| Rest of Spain    | 26.46       | 2.16        | [22.17, 30.76]         | 28.33       | 3.26        | [21.76, 34.91]         | 24.60       | 2.84        | [18.86, 30.34]         |

Authors’ calculations
accordance with Valoiss et al. (2004) which exposed there is a clear relationship between perceived life dissatisfaction and self-reported poor mental health, suicide ideation (or suicidal thoughts) and suicide behaviour. Further extensions when new available data would be provided should focus on vulnerable groups, as done for homeless in Yoder et al. (2008).

**Fig. 1** Evolution of suicides_total by region. Notes North (Asturias, Cantabria, Galicia and Basque Country), Mediterranean (Andalusia, Balearic Islands, Canary Islands, Catalonia, Valencian Community and Murcia). Source Authors’ elaboration

**Fig. 2** Distribution of suicides (mean 2002–2013) by region. Notes Andalusia (region = 1), Aragon (region = 2), Asturias (region = 3), Balearic Islands (region = 4), Canary Islands (region = 5), Cantabria (region = 6), Castile and Leon (region = 7), Castile-La Mancha (region = 8), Catalonia (region = 9), Valencian Community (region = 10), Extremadura (region = 11), Galicia (region = 12), Madrid (region = 13), Murcia (region = 14), Navarre Community (region = 15), Basque Country (region = 16), and La Rioja (region = 17). Source Authors’ elaboration
Table 6  Poisson/negative binomial panel results: dependent variable *suicides_total*

| Variable     | Full sample (2002–2013) | Great expansion (2002–2007) | Great recession (2008–2013) |
|--------------|--------------------------|-----------------------------|----------------------------|
| *foral*      | 0.031 (0.05)             | −0.121 (−0.18)              | 0.093 (0.15)               |
| *north*      | 0.830 (1.58)             | 0.587 (1.06)                | 0.543 (1.04)               |
| *mediterranean* | 0.733* (1.78)       | 1.039** (2.26)              | 0.931** (2.19)             |
| *unemployment* | 0.005*** (4.01)        | 0.010 (1.21)                | 0.004* (1.83)              |
| *at-risk-of-poverty* | 0.009** (2.33)   | 0.000 (0.02)                | 0.004 (0.64)               |
| *density*    | −0.003*** (−5.31)       | −0.002** (−1.96)            | −0.003*** (−3.86)          |
| Alpha p value| 0.000                    | 0.000                       | 0.000                      |

Authors' calculations

*z*-statistics in parentheses. ***, **, and * denote significant at 1, 5, and 10 % respectively. Observations: 170 for 2002–2013, 68 for 2002–2007 and 102 for 2008–2013. The use of Poisson or the negative binomial estimator is determined by the Alpha parameter. If Alpha p value <0.05 it is estimated the negative binomial model.

Table 7  Poisson/negative binomial panel results: dependent variable *suicides_m*

| Variable     | Full sample (2002–2013) | Great expansion (2002–2007) | Great recession (2008–2013) |
|--------------|--------------------------|-----------------------------|----------------------------|
| *foral*      | 0.423 (0.60)             | −0.060 (−0.09)              | 0.242 (0.37)               |
| *north*      | 0.730 (1.32)             | 0.431 (0.77)                | 0.576 (1.11)               |
| *mediterranean* | 0.819* (1.92)       | 0.982** (2.10)              | 1.043*** (2.50)            |
| *unemployment* | 0.005*** (3.84)        | 0.010 (1.10)                | 0.003 (1.17)               |
| *at-risk-of-poverty* | 0.009** (1.99)   | −0.001 (−0.16)              | 0.003 (0.40)               |
| *density*    | −0.003*** (−4.82)       | −0.002** (−2.03)            | −0.003*** (−3.23)          |
| Alpha p value| 0.000                    | 0.000                       | 0.000                      |

Authors' calculations

*z*-statistics in parentheses. ***, **, and * denote significant at 1, 5, and 10 % respectively. Observations: 170 for 2002–2013, 68 for 2002–2007 and 102 for 2008–2013. The use of Poisson or the negative binomial estimator is determined by the Alpha parameter. If Alpha p value <0.05 it is estimated the negative binomial model.
Table 8  Poisson/negative binomial panel results: dependent variable suicides_w

| Variable       | Full sample (2002–2013) | Great expansion (2002–2007) | Great recession (2008–2013) |
|----------------|--------------------------|-----------------------------|-----------------------------|
| foral          | -0.076                   | -0.165                      | 0.004                       |
|                | (-0.11)                  | (-0.26)                     | (0.01)                      |
| north          | 0.971*                   | 0.612                       | 0.734                       |
|                | (1.69)                   | (1.18)                      | (1.30)                      |
| mediterranean  | 1.362***                 | 1.126***                    | 1.276***                    |
|                | (2.90)                   | (2.49)                      | (2.72)                      |
| unemployment   | 0.004*                   | 0.018                       | 0.009**                     |
|                | (1.75)                   | (1.19)                      | (2.24)                      |
| at-risk-of-poverty | 0.009                  | -0.003                      | 0.008                       |
|                | 1.30                     | (-0.19)                     | (0.71)                      |
| density        | -0.002***                | 0.000                       | -0.002***                   |
|                | (-3.37)                  | (0.25)                      | (-2.57)                     |
| Alpha p value  | 0.000                    | 0.000                       | 0.000                       |

Authors’ calculations  
z-statistics in parentheses. ***, **, and * denote significant at 1, 5, and 10 % respectively. Observations: 170 for 2002–2013, 68 for 2002–2007 and 102 for 2008–2013. The use of Poisson or the negative binomial estimator is determined by the Alpha parameter. If Alpha p value <0.05 it is estimated the negative binomial model.

5 Conclusion

Our empirical results may have some usefulness for suicide prevention and control in Spain. Specifically, urban-rural disparities in suicides may reflect differential changes over time in key social integration indicators, as shown by the results for deprived indicators/areas. Public health strategies to prevention and allocation of resources should clearly take into account this diversity in order to make an efficient use of resources. Education programmes or improvements in housing conditions could be implemented.

In any case, to the extent that suicides are somehow consequences of macro-level circumstances, it would be also desirable to design specific policy measures countering major events that generate them, for instance massive layoffs, high unemployment rates or low income. Given the positive relationship between health and economic growth (Blázquez-Fernández et al. 2015), regions cannot afford losing (young and working-age) population, particularly when it is avoidable. Furthermore, suicides do not only terminate the lives of individuals in their most productive years, they also produce health, emotional and financial troubles to family and friends left behind (Piérard and Grootendorst 2014). All this issues should be considered in health policy thereby leading to improve health outcomes.

To summarise, the main aim of this paper is to identify suicide patterns and analyse the different determinants through which deaths from suicide and self-harm may be affected during this latest century twenty-first in Spain. This topic is particularly relevant for this country given the relationship between mental health problems and economic crisis. The analysis has been done for the 17 Spanish regions during the period 2002–2013, while considering business cycles (Great Expansion period 2002–2007 and Great Recession period 2008–2013).
 Preliminary analysis shows that suicide mortality varied slightly by period of time or age, and that the highest differences are found by gender. Also, empirical results have highlighted that the socioeconomic urban-rural suicide differentials exist and its slope continues over time; Mediterranean regions are more prone to suicides; and variables regarding material deprivation, like unemployment and people at risk of poverty, are more important during the crisis. In any case, these macroeconomic conditions can use at the same time many pathways to affect commit suicide. Exploring these different lines is not possible with current Spanish regional available data but it could be interesting to do it in next research.

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