The increasing role of spatial economic inequalities to explain suicide in France from 1979 to 2016

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Abstract

France is one of the European countries with the highest suicide rate. The question of its evolution has been of growing interest since Case and Deaton (2015) show that deaths of despair increase in the USA. In this study, we analyse the suicide rate in France, its recent evolution, and the role of economic development in this evolution. One methodological issue concerns deaths classified as "unknown cause of death". This share is growing from a decade and cannot be ignored nowadays. We compute unbiased suicide rates, using Ledermann method – a largely ignored method in the literature – that take advantage of local variation of deaths of unknown cause. We provide them by gender and age groups, at the national level and for the 95 French departments from 1979 onwards. We show that the mortality by suicide decreases since 1985 at the national level for both sexes, in all age groups. However, the relative spatial inequality of mortality by suicide increases since 2000, and overtake the level reached in 1979. Moreover, we show that economic development plays an increasing role in explaining these spatial inequalities, giving rise to fears of Matthew effect.

KEYWORDS: *suicide, unknown cause of death, inequalities, economic development.*

Epidemiology of suicides is a question of interest from several decades, and especially since the 1970's, because many european countries observed an increase in mortality by suicide for all age groups. Vallin and Meslé (1988) focus on the French case and show that this increase, from 1976 to 1980, was higher in France than in Italy or England. Mouquet and Bellamy (2006) show that this trend is reversed from 1985 for both genders in France, as in many countries. In this context, the interest was fading. With Case and Deaton (2015) publication, showing that mortality by suicide increases in the USA for some specific groups of population, the epidemiology of suicide has been a source of renewed interest.

A second interesting question about suicides is its explanation through socio-economic factors. This has been source of many publications in economics since Durkheim (1897). As shown in a systematic review (Rehkopf and Buka, 2006), there is a large literature on the association between suicide and socio-economic characteristics (86 studies between 1897 and 2004).

This article aims at (1) explaining the evolution of suicide in France between 1979 and 2016, at the national and department levels (administrative division of France, in 95 geographical areas), and (2) at measuring the evolution of inequalities between departments.

One methodological challenge to address this question is to adjust suicide rate to take into account unknown causes of death. Unknown causes of death changed over time (5% of death of unknown causes in France in 1979 against 10% in 2016), over age groups and gender, and over geographical areas. Thus, the analysis over time has to take into account the unknown causes of death to be relevant. In this paper, we use the Ledermann method to compute unbiased death rates.

This article has two major contributions. First, it is the first paper to compute the suicide rate by gender and age group, for the previous three decades, taking into account unknown causes of death. Second, we use the local unbiased suicide rates to analyse geographical inequalities. Combined with an analysis of gradient economic development, we are also able to analyses the relationship between the evolution of suicide inequalities and the evolution of economic development inequalities.

1 Data

We use two datasets to estimate mortality by suicide. First, Cépi-DC provides the number of deaths by cause, gender, age range and department from 1979 to 2016. Causes of death are classified in 65 categories, for 12 age ranges and 95 departments of mainland France. We group causes of death in three categories: "Suicides" (E950-E959 in ICD 9; X60-X84 in ICD 10), "Ill-defined and unknown" (780-799 less 798 in ICD 9; R00-R99 less R95 in ICD 10), "Others".

Second, we use population by age, department and gender computed by Bonnet (2020). These estimations of population were produced using age-specific populations at census years as well as births and age-specific deaths collected on an annual basis. Methods are similar to those used in the Human Mortality Database protocol (Wilmoth et al. (2020)).

We also take advantage of economic developement measures such as population densities, fiscal income per capita (data from Bonnet et al. (2020)); income distributions of fiscal income (data from (Bonnet and Sotura, 2021)); unemployment rate (data from Insee).

2 Methods

To take into account deaths classified as "Ill-defined or unknown", we use first a proportional method. However, this method under-estimates the real mortality by suicide. To compute unbiased mortality by suicide, we use the Ledermann method. This method relies on statistics of deaths by cause available at the local level. The regression of the share of deaths with cause classified as "Ill-defined or unknown" on the share of suicides gets an estimation of what would be the real share of suicides if there were no death with cause classified as "Ill-defined or unknown". Using this estimate and an iterative process, we deduce the rate of underestimation by department and use it to define the unbiased suicide rates at local level. We use this process for each age group, year and gender.

Moreover, we compute a measure which assesses the evolution of spatial inequality of suicide in France, adapted from Currie and Schwandt (2016a), Currie and Schwandt (2016b), Currie et al. (2020) and Bonnet et al. (2021). We create 20 groups of departments (ventiles), weighted by population. These groups are ranked according to their mortality by suicide. Group 1 thus refers to the top 5th percentile of the distribution, while group 20 is the bottom 5th percentile. This grouping is made for all years of the period considered. We fit those estimates with a linear trend and use the slope of the curve as a measure of absolute inequality. We do the same using relative death rates in order to obtain a relative measure of inequality.

To assess the role of economic inequalities in geographical differences in suicide, we compute this indicator by ranking departments according to their level of economic development. We obtain a measure of gradient in both absolute and relative terms.

3 Results

First, we show that the mortality by suicide is largely underestimated in France, especially for the working-life age classes, as shown in Figure 1. Moreover, this underestimation is increasing. The standardised death rate by suicide was underestimated by 18% in 1979 and 24% in 2016.

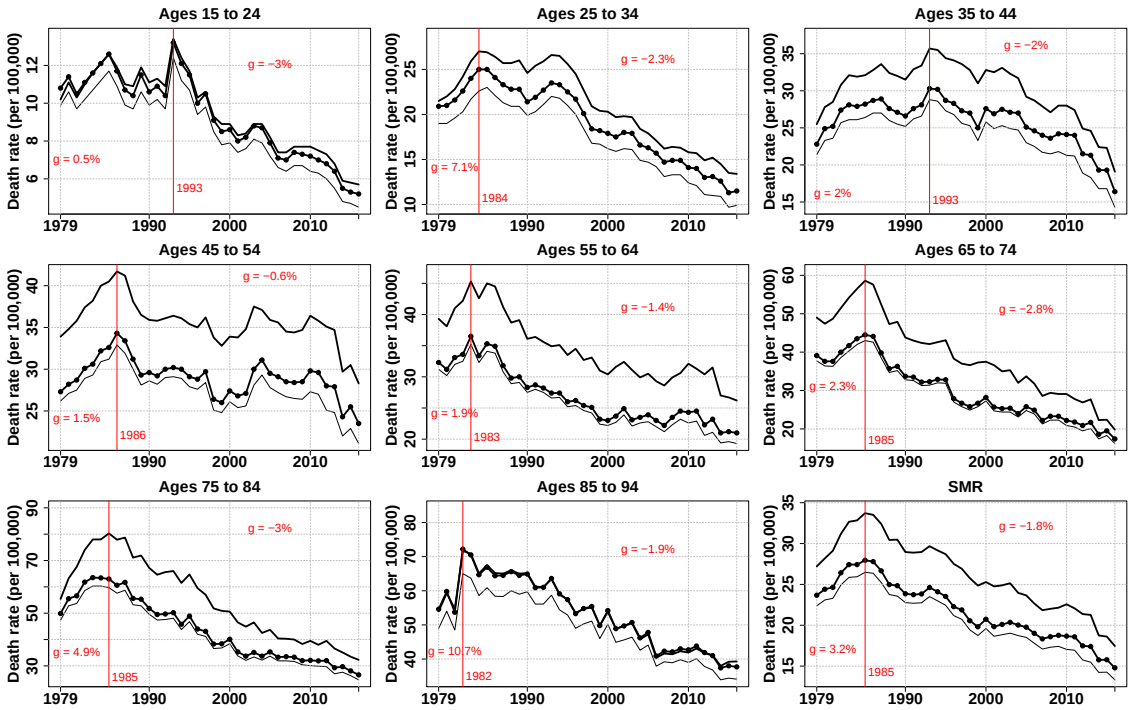
Second, we describe mortality by suicide in France since the late 1970's at the local level. We group departments in classes (clusters) as homogeneous as possible with regard to trends of death rates between 1979 and 2016. Figure 2 reveals these 5 clusters. The map on the left shows the composition of each of them: mortality by suicide is highest in the North-West and North of France, and it is all the lower as one moves South and East. This is consistent with the well-known North-South gradient of total mortality.

Third, we show the evolution of spatial inequality by suicide in both absolute and relative values (Figure 3). The absolute inequality decreased from 1979 to 2000 and remained stable from 2000 to 2016. However, inequality in relative terms increased sharply from 2000, reaching a level never observed since 1979. In a France where mortality by suicide halved between 1985 and 2016, relative inequality is strikingly on the rise.

Forth, we show that economic development plays an increasing role in explaining both the suicide inequalities in absolute and relative terms. Figure 4 reveals that the measure of gradient is on the rise too. Thus, mortality by suicide declines more sharply in the most developed departments, suggesting that a Matthew Effect is at work for this specific mortality in France.

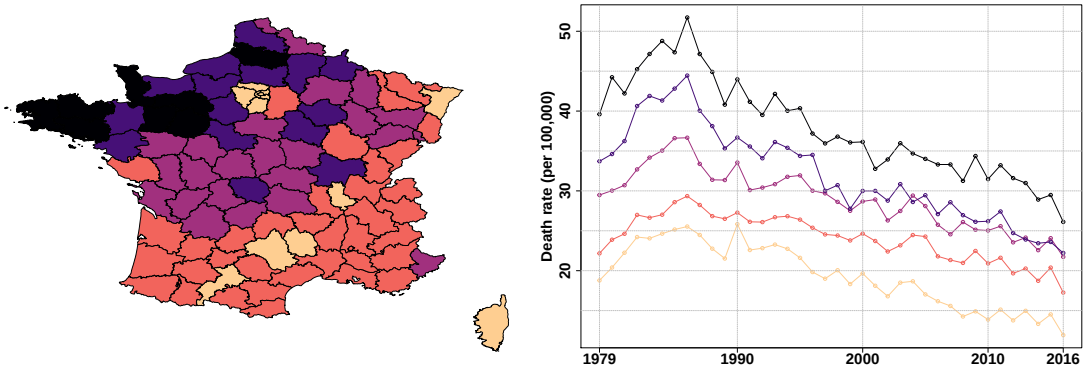
In the following months, we plan to replicate this analysis for Germany, using data available by *Raumordnungsregionen* (96 geographical units) from 1992 to 2018. Consequently we will discuss the differences of levels and trends of spatial inequality between the two countries. Moreover, we plan to broaden our analysis with other causes of death, in order to assess the specificity of mortality by suicide.

Figure 1: Trends of mortality by suicide in France



Note: Thin solid lines are raw death rates. Dotted lines are suicide rates corrected using proportional reallocation. Large solid lines are unbiased suicide rates computed using Ledermann's method. Red vertical line for the year with the highest mortality by suicide. Average annual growth rate for the periods before and after this date are in red.
Source: Cepi-DC data and Bonnet (2020).

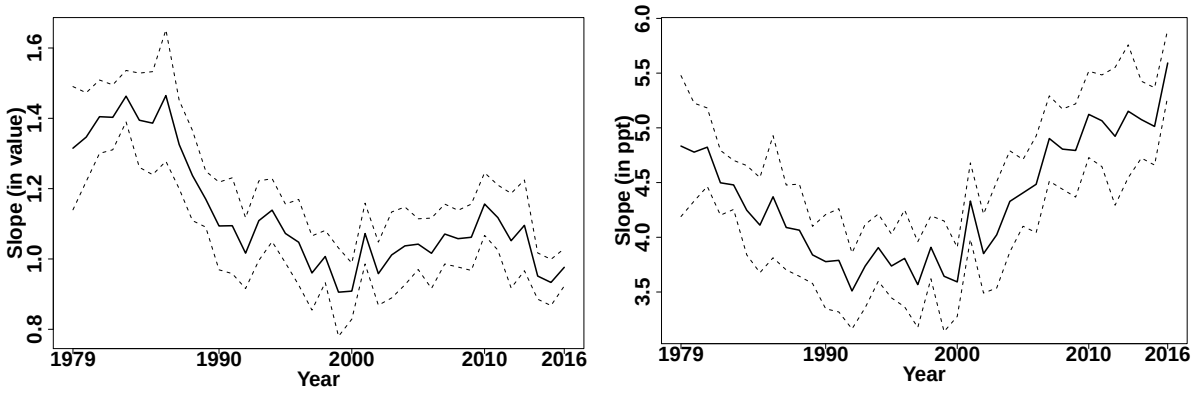
Figure 2: Trends of mortality by suicide in French department



Note: The black and yellow classes contain departments with the highest and lowest age-standardized death rate by suicide respectively.Sample includes 95 départements.
Source: Own computations based on Cepi-DC data and Bonnet (2020).

Figure 3: Spatial inequality of mortality by suicide

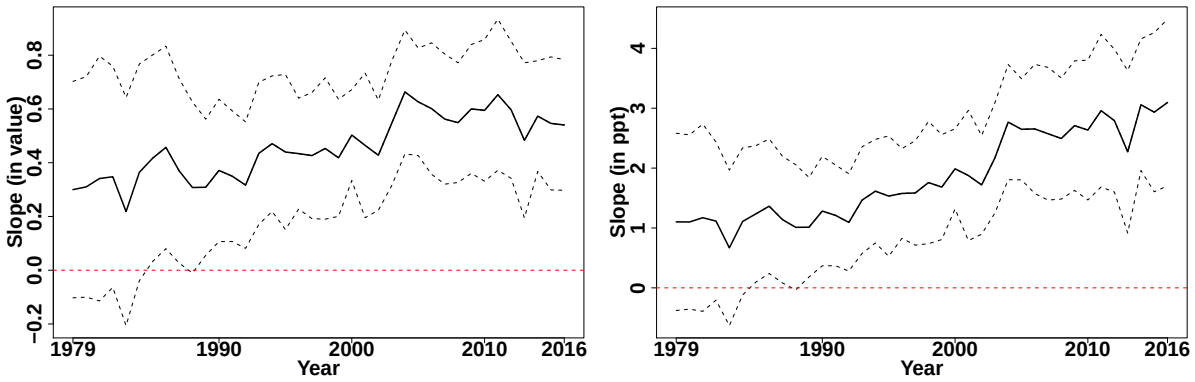
(a) Trend of absolute inequality (b) Trend of relative inequality



Note: Solid lines represent the evolution of spatial inequality of age-standardized mortality by suicide for both sexes combined. 95% confidence intervals are shown with dotted lines. For absolute measure, a 1 value means that the difference of death rate by suicide between two successive groups is equal to 1 per 100,000. For relative measure, a 5 value means that the difference of death rate by suicide between two successive groups is equal to 5 percentage points (expressed in terms of national death rate).
Source: Own computations based on Cepi-DC data and Bonnet (2020).

Figure 4: Gradient of mortality by suicide

(a) Absolute measure (b) Relative measure



Note: Solid lines represent the evolution of the gradient of age age-standardized mortality by suicide according to economic development for both sexes combined. Economic development corresponds to the level of income per capita. 95% confidence intervals are shown with dotted lines. For absolute measure, a 0.2 value means that the difference of death rate by suicide between two successive groups is equal to 0.2 per 100,000. For relative measure, a 2 value means that the difference of death rate by suicide between two successive groups is equal to 2 percentage point (expressed in terms of national death rate).
Source: Own computations based on Cepi-DC data and Bonnet (2020).

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