



# Global economic uncertainty and suicide: Worldwide evidence

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## ARTICLE INFO

### JEL classification:

C33  
C51  
I15  
J17  
O57  
Z18

### Keywords:

Economic uncertainty  
Suicide  
Prevention  
Unemployment  
Economic growth  
Panel model

## ABSTRACT

Economic uncertainty is a driver of the business cycle. Its leading properties make it a key advanced indicator to assess the impact of socioeconomic factors on suicide for prevention purposes. This paper evaluates the effect of economic uncertainty on suicide rates worldwide. Uncertainty is gauged by a global economic policy uncertainty index. Suicide rates from 183 countries between 2000 and 2019 are matched to annual economic uncertainty, controlling for unemployment and economic growth in a fixed-effects panel model. Overall, the analysis suggests that increases in lagged economic uncertainty, as well as in unemployment and economic growth, may lead to an increased risk of suicide. When replicating the experiment for different regions of the world, the greatest impact of an increase in economic uncertainty can be found in Africa and the Middle East. Given the anticipatory nature of economic uncertainty regarding the evolution of economies, and its relationship with suicide rates, the results highlight the usefulness of uncertainty indicators as tools for the early detection of periods of increased suicide risk and the design of suicide prevention strategies.

## 1. Introduction

Despite a progressive decline in recent years, suicide continues to be one of the most important causes of mortality, especially in countries with higher per capita income. According to the World Health Organization (WHO), low- and middle-income countries bear most of the global suicide burden. Suicide is the fourth leading cause of death amongst 15–29-year-olds, and in recent years there has been a rise amongst older adults (Hempstead and Phillips, 2015). While more than 700,000 people die by suicide every year, for each suicide there are more than 20 suicide attempts (WHO, 2021). Since suicide has proven to be preventable, it is crucial to make progress in research aimed at preventing it.

Researchers from different fields have examined the factors that may be influencing suicidality. The existing literature has shown that mental illness (Mann et al., 2005; Qin et al., 2003); personality disorders (Gray and Otto, 2001; Rihmer et al., 2004); and alcohol and drugs dependence (Comtois et al., 2004; Oquendo et al., 2007) are key risk factors. Morselli (1882) was the first to suggest that suicide rates could be dependent on socioeconomic factors. Since then, the effect that different economic aggregates can have on suicide has been widely studied (Fountoulakis et al., 2014a,b; Kentikelenis et al., 2011). The most commonly analysed variables are economic growth (Chang and Chen, 2017; Korhonen et al., 2017) and unemployment rates (Botha and Nguyen, 2022; Noh, 2009;

Nordt et al., 2015; Phillips and Nugent, 2014).

Since the Great Recession of 2008, there has been a renewed interest in measuring and studying economic uncertainty. The consensus in the literature is that uncertainty drives business cycles (Bloom, 2009, 2014; Meinen and Roehle, 2017). The role of economic uncertainty in growth and the high frequency with which it can be computed—as opposed to other macroeconomic variables such as gross domestic product (GDP), which are published quarterly and are subject to subsequent corrections—make it a key variable in analysing the effect of socioeconomic factors on suicide.

To the best of our knowledge, only four studies have investigated the relationship between economic uncertainty and suicide rates (Antonakakis and Gupta, 2017; De Bruin et al., 2020; Vantoros et al., 2019; Vantoros and Kawachi, 2021). Antonakakis and Gupta (2017) examined the relationship between policy-related economic uncertainty and suicide mortality in the United States (US) during the period 1950–2013, controlling for other socioeconomic determinants. The authors found that increased uncertainty was associated with increased suicide mortality in the youngest and oldest segments of the male population. De Bruin et al. (2020) estimated a fixed-effects panel model that matched economic uncertainty and other economic variables to suicide rates in 17 countries, and noted a significant association between them. Vantoros et al. (2019) used daily data for England and Wales, and found that

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<https://doi.org/10.1016/j.socscimed.2022.115041>

Received 14 December 2021; Received in revised form 11 May 2022; Accepted 13 May 2022

Available online 18 May 2022

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economic uncertainty had an effect on the increased risk of suicide in the short term. [Vandoros and Kawachi \(2021\)](#) analysed the relationship by matching monthly suicide data from the US at states' level from 2000 to 2017 with economic uncertainty and other economic indicators. The authors found a positive association and highlighted the importance of providing access to suicide prevention interventions during periods of high economic uncertainty.

One of the reasons why this link has not been analysed in more depth may be related to the nature of economic uncertainty. As it is an unobservable phenomenon, there is no consensus on how to measure its level. An indication of the difficulty in specifying what exactly is understood by uncertainty shocks and disentangling them from other types, is the number of different strategies that are used to proxy uncertainty. These can be grouped into five categories: disagreement among professional forecasters; responses from business and consumer surveys; econometrically-constructed measures; those based on financial data; and text-based proxies.

The first two are based on dispersion metrics that vary depending on the type of survey information ([Claveria, 2021](#); [Mokinski et al., 2015](#); [Rossi and Sekhposyan, 2015](#)). The third way to proxy uncertainty, as proposed by [Jurado et al. \(2015\)](#), is to measure econometric unpredictability, which is understood as the conditional volatility of the unforecastable components of a broad set of economic variables. The ex-post nature of this approach has recently generated a strand in the empirical research that makes use of more direct measures of uncertainty based on prospective information. The fourth strategy has focused on the exploitation of financial data (bond yields, exchange rates, and so on). However, since developments in the stock market only partially reflect developments in the economy ([Girardi and Reuter, 2017](#)), some authors have opted to collect different types of data.

The most popular approach is based on calculating the frequency with which concepts related to uncertainty appear in the media. [Baker et al. \(2016\)](#) constructed the economic policy uncertainty (EPU) index by computing a text-mining measure using ten American newspapers from the US. The degree of subjectivity entailed in the selection of newspapers and its limited scope, led [Davis \(2016\)](#) to calculate a global economic policy uncertainty (GEPU) index by taking a GDP weighted average of EPUs from several countries proportional to the monthly share of national articles. The countries on the GEPU index account around 80% of global output at market exchange rates.

In the present study, the GEPU index is used to evaluate the relationship between global economic uncertainty and suicides worldwide. Given the geographical scope of the study and the leading properties of uncertainty with respect to the business cycle ([Basu and Bundick, 2017](#); [Bloom, 2009, 2014](#)), the selection of this index seems particularly appropriate. Most of the literature linking economic variables to suicide has found that macro aggregates have a significant effect on suicide rates ([Coope et al., 2014](#); [Iglesias-García et al., 2017](#); [Phillips and Nugent, 2014](#)), but there are divergences as to how. While there is some consensus regarding the effect of job loss on suicide, the impact of income level and the phase of the economic cycle in some cases show conflicting results. While [Dos Santos et al. \(2016\)](#) and [Luo et al. \(2011\)](#) found a significant and inverse relationship between these variables and suicide rates in Portugal and the US, respectively, the results of studies carried out in other countries have been mixed ([Chang et al., 2009](#); [Chen et al., 2010](#); [Wang et al., 2020](#)).

Suicide, like uncertainty, is the result of a complex interaction of a range of factors. The ultimate goal of the present study is to advance the research aimed at suicide prevention by evaluating the extent to which economic uncertainty can be used as an advanced indicator of increased suicide risk. The contribution of the study is threefold. First, as [Fountoulakis et al. \(2014a,b\)](#) noted, most research on suicide is based on samples from developed countries. The present study covers 183 countries, using the suicide mortality rates published by the WHO. Second, rather than focusing on a cross-sectional analysis, the study takes into account the temporal dimension of the annual suicide rates for the

period 2000–2019. With this aim in mind, we use a fixed-effects panel model to examine the relationship between economic uncertainty and suicide risk, controlling for unemployment and economic growth, and replicating the analysis for different regions. Third, the study is the first to assess the effect of global economic uncertainty on suicide rates worldwide.

The study is structured as follows. Section 2 describes the data that were used and the methodology. Section 3 presents the results. The latter are discussed in Section 4, while Section 5 draws some conclusions and offers suggestions for future avenues of research.

## 2. Data and methods

### 2.1. Economic uncertainty

Recent years have seen great advances in the approximation of economic uncertainty. Nevertheless, the question of what exactly is meant by the term, and how it can be measured, are still the subject of debate ([Dibiasi and Iselin, 2021](#); [Glas, 2020](#)). [Kozeniauskas et al. \(2018\)](#) differentiated three types of uncertainty: micro uncertainty (a cross-sectional variance in firm-level outcomes); macro uncertainty (aggregate shocks); and higher-order uncertainty (disagreement). [Castelnuovo \(2019\)](#) has provided an overview of recent developments in this area.

An alternative taxonomy is that of [Binge and Boshoff \(2020\)](#), who grouped the different approaches to proxy economic uncertainty into five categories: disagreement among professional forecasters; responses from business and consumer surveys; econometrically-constructed measures; those based on financial data; and text-based proxies. Survey-based measures of economic uncertainty are usually obtained through different dispersion metrics computed from forecast surveys. Recent studies that have taken advantage of this type of information include [Altig et al. \(2020\)](#) and [Jo and Sekkel \(2019\)](#) for the US and [Rich and Tracy \(2021\)](#) and [Rossi and Sekhposyan \(2017\)](#) for the Eurozone.

Forecast surveys have also been used to derive and assess different proxies of economic uncertainty based on the disagreements amongst professional forecasters ([Dovern, 2015](#); [Krüger and Nolte, 2016](#)). Several authors have proposed alternative measures to proxy economic uncertainty based on qualitative expectations from business and consumer surveys in which respondents are asked about the expected direction of change of a wide range of economic variables ([Bachmann et al., 2013](#); [Claveria et al., 2019](#); [Girardi and Reuter, 2017](#); [Glocker and Hölzl, 2021](#)).

[Caggiano and Castelnuovo \(2021\)](#) combined volatility data on the stock market, exchange rate returns, and bond yields to construct a measure of global financial uncertainty. However, because finance offers only a limited scope, some authors collect new data for approximating economic uncertainty. The most popular approach is based on calculating the frequency with which concepts related to uncertainty appear in the media. [Baker et al.'s \(2016\)](#) EPU index is the most widely used text-based uncertainty proxy. It combines a text-mining measure with disagreements amongst forecasters, as well as the number of tax code provisions that are set to expire in the future. Since then, various authors used this methodology to develop indicators of economic uncertainty for their respective countries, for example, [Armeliuss et al. \(2017\)](#) for Sweden; [Ghirelli et al. \(2019\)](#) for Spain; and [Sorić and Lolić \(2017\)](#) for Croatia.

As was mentioned in the Introduction, the EPU is computed for the US and its construction is conditioned by the criteria used for the selection of newspapers. [Davis \(2016\)](#) proposed calculating the GEPU by taking a GDP weighted average of EPUs for 21 individual countries: Australia, Brazil, Canada, Chile, China, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States.

To construct the GEPU, the authors re-normalised each national EPU index to a mean of 100 from the first year to 2015 and, imputed missing

values for certain countries using a regression-based method. This, yielded a balanced panel of monthly EPU index values for the 21 countries from January 1997 onwards. Finally, they computed the GEPU index value for each month as the GDP-weighted average of the 21 national EPU index values, using GDP data from the International Monetary Fund’s World Economic Outlook Database. In the present study, we used the version of the GEPU based on GDP adjusted by purchasing power parity (PPP). An additional advantage of the GEPU index is that it allows for a comparative analysis between the different countries. Given the main aim of the present study, the anticipatory nature of the GEPU makes it a suitable indicator. All GEPU data is available for free at <http://www.policyuncertainty.com/index.html>. Fig. 1 shows the annual evolution of the GEPU during the sample period and its frequency distribution.

### 2.2. Suicide mortality

The present study used the suicide mortality rate, understood as the number of suicide deaths in a year per 100,000 population (not age-adjusted), published by the WHO. These data are available at the Global Health Observatory Data Repository (<http://apps.who.int/ghodata/>). Table 1 contains the average and the standard deviation of

annual suicide rates over the period 2000–2019 for the 183 countries included in the study.

Table 1 shows that the countries of some regions bear most of the global suicide burden, with generally higher average rates than the rest. To examine the causes of the conspicuously high suicide rates in Eastern European economies, Kölves et al. (2013) used a wide range of variables—from unemployment rates and GDP to divorce rate and alcohol consumption—to assess the impact on changes in suicide rates in 13 former Soviet Union bloc countries between 1990 and 2008. They found that changes in suicide were related to the socioeconomic disruption experienced during the period of transition.

Fig. 2 provides a graphical analysis of the distribution of average suicide rates within the regions in each continent. The box plots show upper-average levels in Europe. Lesotho, Eswatini, Botswana and South Africa have particularly high average rates, despite having a lower average rate than Europe and Oceania. When the results are broken down by region, notable differences can be observed within each continent. Southern Africa, Northern America, Western Asia, Eastern Europe and Micronesia had the highest average suicide rates in the first two decades of the current century. As the WHO (2021) noted, the prevalence and characteristics of suicidal behaviour vary widely between different communities and over time.

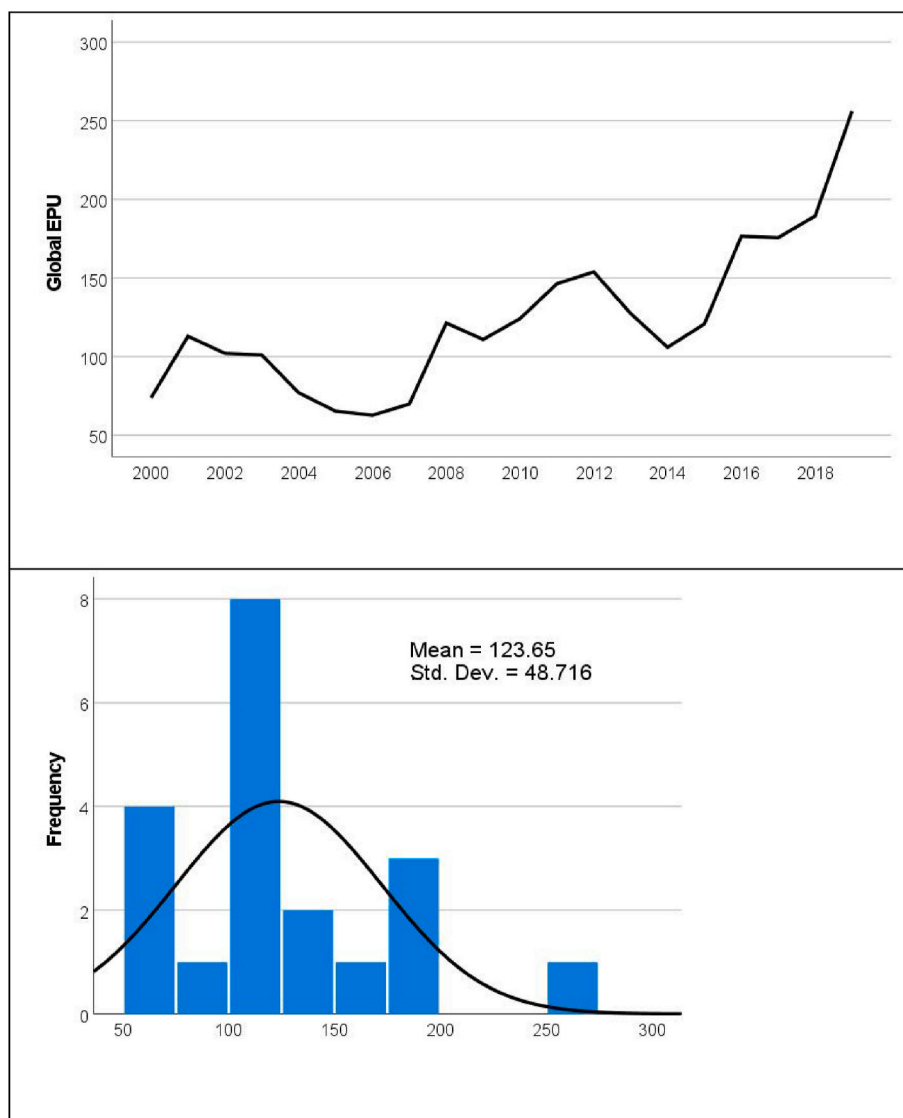


Fig. 1. Global EPU – Time-series plot and histogram.

**Table 1**  
Suicide rates 2000–2019.

country	Mean	SD	Country	mean	SD
Afghanistan	4.5	0.4	Djibouti	8.3	0.9
Albania	5.9	1.6	Dominican Rep.	5.0	0.7
Algeria	3.3	0.7	Ecuador	9.0	1.2
Angola	7.3	1.0	Egypt	3.2	0.1
Antigua	0.7	0.7	El Salvador	6.7	0.9
Argentina	8.9	0.6	Equatorial Guinea	9.5	1.2
Armenia	4.8	1.6	Eritrea	12.6	1.0
Australia	11.7	0.9	Estonia	21.3	4.8
Austria	16.7	1.4	Eswatini	41.0	9.0
Azerbaijan	4.2	0.5	Ethiopia	7.1	1.5
Bahamas	3.2	0.5	Fiji	9.6	0.4
Bahrain	8.5	1.1	Finland	18.9	3.1
Bangladesh	4.4	0.8	France	17.6	2.0
Barbados	1.1	0.7	Gabon	10.1	1.2
Belarus	34.0	8.2	Gambia	5.4	0.4
Belgium	20.1	1.2	Georgia	8.3	1.5
Belize	6.2	0.7	Germany	13.3	0.7
Benin	8.4	0.3	Ghana	7.0	0.7
Bhutan	4.5	0.2	Greece	4.1	0.9
Bolivia	6.3	0.3	Grenada	1.8	1.4
Bosnia	10.4	0.6	Guatemala	8.0	2.2
Botswana	25.6	6.6	Guinea	6.4	0.7
Brazil	5.3	0.9	Guinea-Bissau	8.2	0.7
Brunei	2.1	0.6	Guyana	34.6	3.2
Bulgaria	12.7	2.7	Haiti	9.8	0.4
Burkina Faso	8.0	0.2	Honduras	2.4	0.6
Burundi	8.0	1.6	Hungary	24.1	4.5
Cabo Verde	13.6	1.0	Iceland	13.0	1.3
Cambodia	5.2	0.2	India	14.4	1.5
Cameroon	10.4	0.9	Indonesia	2.8	0.4
Canada	12.0	0.5	Iran	6.5	0.7
Central Africa	15.4	1.6	Iraq	3.9	0.2
Chad	7.4	0.5	Ireland	11.5	1.3
Chile	10.3	1.0	Israel	5.7	0.6
China	10.5	2.1	Italy	7.1	0.3
Colombia	4.2	0.4	Jamaica	2.0	0.3
Comoros	5.5	0.3	Japan	22.0	3.2
Congo	9.0	2.1	Jordan	1.8	0.4
Congo DR	7.1	0.4	Kazakhstan	30.7	7.8
Costa Rica	6.7	1.0	Kenya	6.1	0.5
Cote d'Ivoire	11.1	1.4	Kiribati	30.1	0.9
Croatia	18.1	1.5	Korea	26.8	5.5
Cuba	14.0	1.1	Korea DPR	9.5	0.4
Cyprus	3.8	1.5	Kuwait	2.6	0.2
Czechia	15.0	1.3	Kyrgyzstan	11.4	2.2
Denmark	12.9	1.6	Lao PDR	6.1	0.5
Latvia	24.5	4.5	Sao Tome	1.5	0.1
Lebanon	2.8	0.2	Saudi Arabia	5.0	1.3
Lesotho	59.6	23.7	Senegal	6.8	0.5
Liberia	4.8	0.2	Serbia	17.4	5.1
Libya	5.2	0.6	Seychelles	8.2	0.6
Lithuania	38.0	6.6	Sierra Leone	6.3	0.3
Luxembourg	12.8	2.1	Singapore	10.7	1.1
Madagascar	5.7	0.1	Slovak Republic	13.3	0.9
Malawi	7.4	1.4	Slovenia	23.8	4.4
Malaysia	4.7	0.4	Solomon Islands	14.9	0.7
Maldives	3.0	0.4	Somalia	8.4	0.4
Mali	4.5	0.2	South Africa	24.2	1.2
Malta	6.4	0.7	South Sudan	3.8	0.2
Mauritania	3.2	0.1	Spain	7.9	0.5
Mauritius	9.1	1.3	Sri Lanka	18.8	4.3
Mexico	4.7	0.7	St. Lucia	7.7	0.6
Micronesia FS	25.2	1.7	St. Vincent	4.3	2.6
Moldova	17.4	1.8	Sudan	4.0	0.1
Mongolia	21.8	1.9	Suriname	24.5	0.9
Montenegro	20.9	0.5	Switzerland	15.1	0.5
Morocco	8.7	1.0	Sweden	16.8	2.4
Mozambique	13.6	1.1	Syria	1.6	0.2
Myanmar	3.7	0.6	Tajikistan	3.9	0.3
Namibia	14.0	3.6	Tanzania	5.4	1.3
Nepal	8.4	0.4	Thailand	9.0	1.3
Netherlands	10.4	1.1	Timor-Leste	3.3	0.4
New Zealand	12.3	0.8	Togo	10.2	0.7
Nicaragua	4.9	0.4	Tonga	4.2	0.3

**Table 1 (continued)**

country	Mean	SD	Country	mean	SD
Niger	5.3	0.1	Trinidad Tobago	11.7	2.3
Nigeria	4.3	0.5	Tunisia	3.5	0.2
North Macedonia	9.4	1.1	Turkey	2.6	0.5
Norway	12.4	0.8	Turkmenistan	10.0	3.7
Oman	5.8	0.7	Uganda	7.0	2.2
Pakistan	9.0	0.1	Ukraine	27.9	6.2
Panama	4.4	1.1	Un. Arab Emirates	7.6	1.0
Papua New Guinea	2.6	0.3	United Kingdom	8.2	0.3
Paraguay	4.5	1.0	United States	13.2	1.6
Peru	2.9	0.3	Uruguay	17.3	2.4
Philippines	2.1	0.3	Uzbekistan	8.9	0.6
Poland	16.5	2.1	Vanuatu	18.8	0.5
Portugal	12.0	1.6	Venezuela RB	3.5	1.2
Qatar	7.2	0.9	Vietnam	6.9	0.6
Romania	12.0	1.2	Yemen	5.8	0.2
Russia	39.7	9.3	Zambia	10.2	1.7
Rwanda	8.1	3.1	Zimbabwe	16.6	3.1
Samoa	12.8	0.6	World	10.8	1.2

Notes: Suicide rates denote the number of suicide deaths in a year per 100,000 population (not age-adjusted). SD refers to the standard deviation. Antigua stands for Antigua and Barbuda, Bosnia for Bosnia and Herzegovina, Brunei for Brunei Darussalam, Central Africa for the Central African Republic, and Congo for the Republic of the Congo.

Notes: Suicide rates denote the number of suicide deaths in a year per 100,000 population (not age-adjusted). SD refers to the standard deviation. Sao Tome stands for Sao Tome and Principe, and Saint Vicente for Saint Vicente and the Grenadines.

**2.3. Methods**

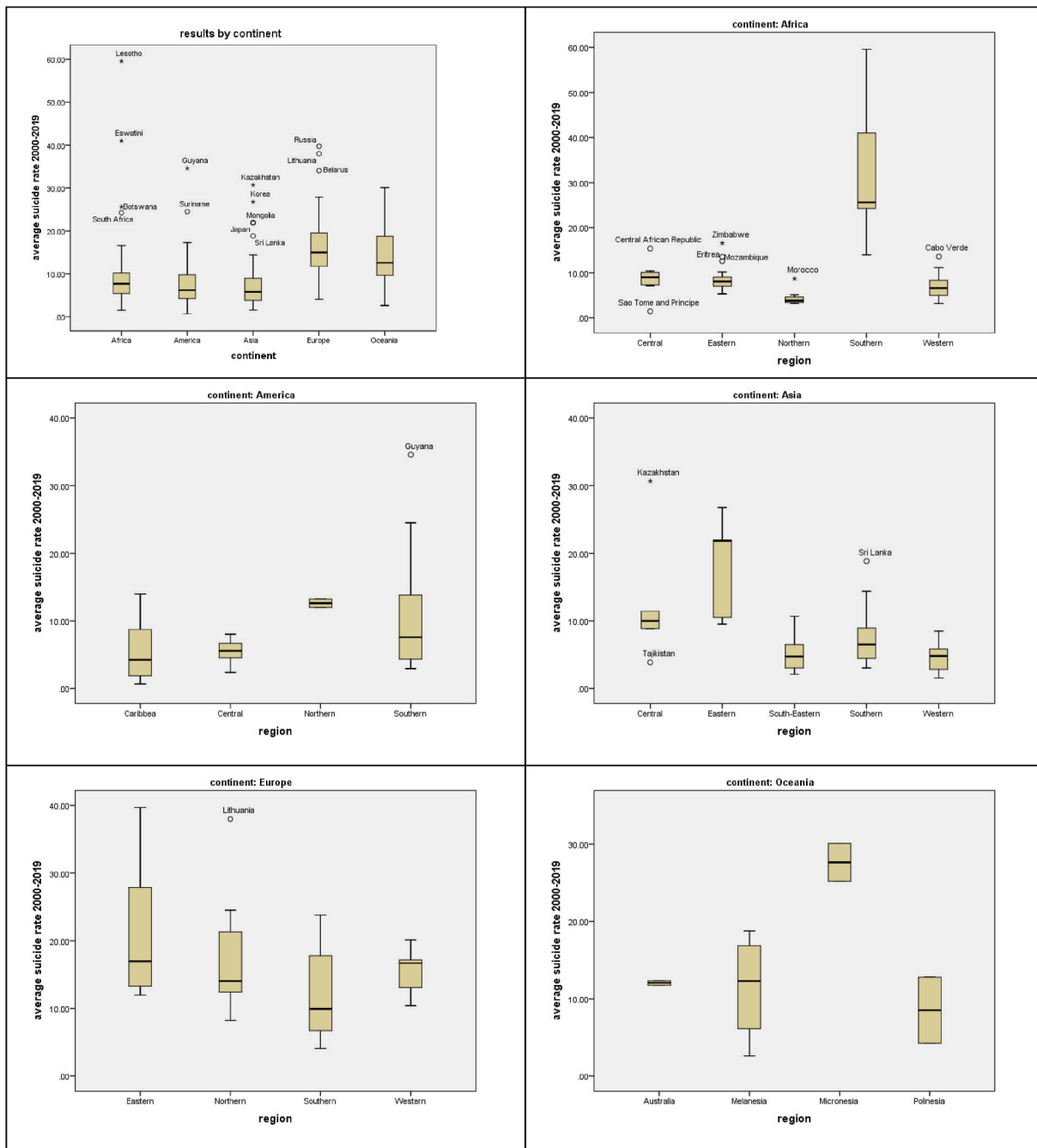
With regards to the empirical approach, the relationship between global economic uncertainty and suicide worldwide is examined using a fixed-effects panel model. Given that economic uncertainty is a driver of the business cycle, where shocks affect both economic growth and employment in subsequent periods (Bloom, 2009; Caggiano et al., 2017; Caldara et al., 2016), and that the main motivation of the present study is to analyse the role of uncertainty as a potential advanced indicator of increases in suicidal behaviour, the GEPU index is included in the model both contemporaneously and with a one-period lag. The model can be specified as follows:

$$y_{it} = \beta_0 + \beta_1 GEPU_t + \beta_2 GEPU_{t-1} + \gamma X_{it} + \alpha_i + \delta_t + \varepsilon_{it} \tag{1}$$

where  $y_{it}$  is the dependent variable (suicide rate) for country  $i$  in year  $t$ , for  $i = 1, \dots, N$  and  $t = 2000, \dots, 2019$ . The main explanatory variable is the GEPU index (uncertainty). Vector  $X_{it}$  includes two control variables: unemployment and economic growth (computed as the annual growth rate of GDP). Unobserved time-invariant country-specific characteristics are collected in  $\alpha_i$ , which is a set of  $N-1$  dummy variables multiplied by their respective regression coefficients to account for country fixed effects. We also added  $T-1$  dummy variables to account for time fixed effects, noted in Equation (1) as  $\delta_t$ . This allows controlling for time-varying differences in suicide rates common to all countries (e.g., the 2008 financial crisis). The models were estimated using heteroskedasticity- and autocorrelation-consistent (HAC) standard errors. Results are presented in Section 3.

**3. Results**

In this section, we evaluate the relationship between global economic uncertainty and suicide worldwide, controlling for unemployment and economic growth, and accounting for country fixed effects and for time fixed effects. While empirical evidence exists that uncertainty shocks are an important exogenous source of economic fluctuation (Ahiadorme, 2022; Istiak and Serletis, 2018; Yildirim-Karaman, 2017), only a few recent studies have examined the link between economic uncertainty and suicide (Antonakakis and Gupta, 2017; De Bruin et al.,



**Fig. 2.** Box-plot of average suicide rates by continent and region – 2000–2019. Notes: Suicide rates denote the number of suicide deaths in a year per 100,000 population (not age-adjusted). SD refers to the standard deviation. Sao Tome stands for Sao Tome and Principe, and Saint Vicente for Saint Vicente and the Grenadines.

2020; VANDOROS et al., 2019; VANDOROS and KAWACHI, 2021).

Results of the model for the 183 countries analysed in this study are presented in Table 2. The results obtained at the global level, controlling for unemployment and economic growth, as well as for country and year (column 1), show that the economic uncertainty indicator, both contemporaneous and lagged, shows a significant association with suicide at the global level. The difference between the two variables lies in the sign and the magnitude: while the contemporary impact is slight and negative, the delayed effect takes the opposite sign and is of greater magnitude. The coefficient of a one-period lag of global economic uncertainty suggests that a one-unit increase in the index is associated with an increase in the average suicide rate by 0.034 in the subsequent period. At a contemporary level, the coefficient of the GEPU indicator

takes a lower value, of  $-0.008$ , suggesting that an increase of one unit in the index is associated with a decrease in the mean suicide rate of 0.008. It should be noted that both control variables show positive coefficients, although only the one associated with economic growth is significant. In this case, the coefficient takes the same value as the global uncertainty indicator lagged one period.

To further substantiate our results, we conducted several supplementary analyses. On the one hand, to examine regional differences, we replicated our analysis for five different regions of the world: East Asia and the Pacific; Europe and Central Asia; Latin America and the Caribbean; the Middle East and North Africa; and sub-Saharan Africa. We followed the World Bank classification (<https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-cla>



**Table 2**  
Regression results—Global and by region.

	World	East Asia and Pacific	Europe and Central Asia	Latin America and Caribbean	Middle East and North Africa	Sub-Saharan Africa
GEPU( <i>t</i> )	−0.008** (0.004)	−0.008 (0.008)	0.006 (0.004)	−0.001 (0.007)	−0.019*** (0.006)	−0.022** (0.009)
GEPU( <i>t</i> −1)	0.034** (0.016)	0.041 (0.043)	−0.037* (0.020)	0.004 (0.038)	0.086*** (0.034)	0.099*** (0.036)
Unemployment	0.089 (0.119)	0.374*** (0.126)	0.134* (0.053)	0.172** (0.078)	−0.004 (0.039)	−0.088 (0.504)
GDP growth	0.034** (0.015)	0.031 (0.022)	−0.001 (0.011)	0.039 (0.038)	−0.002 (0.009)	0.106** (0.051)
Constant	4.465** (1.986)	−0.087 (6.213)	14.063*** (2.731)	7.049 (5.422)	12.105** (4.794)	−1.702 (5.104)
R-squared	0.922	0.960	0.955	0.954	0.980	0.889
Cross-sectional units	183	26	48	31	20	48
Observations	3477	494	912	589	400	912

Notes: Robust (HAC) standard errors between brackets. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$ .

ssify-countries). Due to the low number of cross-sectional units, North America and South Asia were not included in the regional analysis. Table 2 presents the results for the five regions; country effects for *N*-1 states and time fixed effects for each year were included in all models but are not reported.

At the regional level, we find similarities in the results obtained across regions. On the one hand, the coefficient associated with contemporary global uncertainty takes in all cases lower values than for the index lagged one period. The coefficients associated with the GEPU index, both contemporary and with a one-period lag, are found to be significant in the Middle East and North Africa (column 5) and in sub-Saharan Africa (column 6). In sub-Saharan Africa, the coefficient for lagged economic uncertainty takes the highest value, suggesting that an increase of one unit in the index is associated with an increase in the mean suicide rate of 0.099 in the subsequent year. On the other hand, as was the case globally, in all regions except Europe and Central Asia, the lagged effect of the GEPU index is positive while the contemporary one is negative.

Overall, these results suggest that economic uncertainty shocks have a more immediate reflection in suicide rates in Europe and Central Asia, while in the rest of the regions the bulk of the impact of a global uncertainty shock does not occur until the next period. This result could be explained in part by the existence of developed social welfare systems in European countries. In this regard, easier access to government aid, as well as to prevention programs and quality public medical care, would mitigate the economic strain caused by the initial impact of economic uncertainty shocks. In this regard, using US state data, Minoiu and Andrés (2008) found evidence that increases in the proportion of public health expenditure led to a reduction in total suicide rates.

Regarding the unemployment rate and economic growth, in all the regions for which significant coefficients are obtained, they take on a positive sign. For sub-Saharan Africa, the coefficient associated with economic growth takes the highest value, 0.106. This result suggests that, in some cases, increases in GDP may be associated with additional pressures on working conditions, especially in environments with high rates of inequality and little government aid.

Finally, we subject our estimates to an additional robustness check, replicating the analysis for different groupings of countries according to their income level. With this aim, we used the same classification as that of the World Bank (<https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries>). For the current 2022 fiscal year, low-income economies are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of \$1045 or less in 2020; lower middle-income economies are those with a GNI per capita between \$1046 and \$4095; upper middle-income economies are those with a GNI per capita between \$4096 and \$12,695; high-income economies are those with a GNI per capita of \$12,696 or more. Due to the low number of low-income cross-sectional units, countries were regrouped into three categories: (i) low-income, which includes low- and lower middle-income

countries, (ii) middle-income, which includes lower middle- and upper middle-income countries, and (iii) high-income, including high- and upper middle-income countries. We used robust (HAC) standard errors and controlled for country and time fixed effects. Results of the robustness check are reported in Table 3.

When estimating the models for the different groups of countries according to their income level, we obtain similar results to those obtained by region. First, there is a difference in the coefficient sign of the uncertainty indicator: it is negative when it enters the model contemporaneously and positive when it is introduced with a one-period lag. Second, there is a difference in magnitude, the effect of the uncertainty shock lagged one period being always greater. The largest impacts are obtained for low-income countries. Again, these results support the idea that the bulk of the impact of a global uncertainty shock is not necessarily reflected immediately in the suicide rate. This indicates that there is a significant but complex relationship between both variables and that this can evolve over time.

Unemployment was found to be significantly and positively associated with suicide rates in high-income countries, where the social stigma of losing a job can be higher than in lower-income countries. The estimated coefficient suggests that a one-point increase in the unemployment rate is associated with an increase in the mean suicide rate of 0.138. Botha and Nguyen (2022) and Phillips and Nugent (2014) also found a positive relationship between unemployment and suicide in Australia and the US, respectively. The relationship between unemployment and economic uncertainty and suicide can often be channelled by intermediate variables that have an impact on mental health. This may include drug or alcohol abuse (Kölves et al., 2013); divorce (De Bruin et al., 2020); or sleep disruption caused by anxiety generated by job loss. In this sense, Blanchflower and Bryson (2021) found evidence that the unemployed are more likely to suffer from disturbed sleep.

A positive correlation between economic growth and suicide was observed in all cases. The link was particularly strong in middle-income countries (0.041). In this regard, Antonakakis and Collins (2018) found that in high-income countries, further income increases seemed to be

**Table 3**  
Regression results by income level.

	Low-income economies	Middle-income economies	High-income economies
GEPU( <i>t</i> )	−0.013* (0.007)	−0.009 (0.022)	−0.005* (0.003)
GEPU( <i>t</i> −1)	0.051* (0.030)	0.037 (0.120)	0.025 (0.017)
Unemployment	−0.017 (0.347)	−0.012 (0.033)	0.138*** (0.034)
GDP growth	0.075* (0.038)	0.041** (0.016)	0.012* (0.007)
Constant	3.849 (3.329)	4.579 (17.419)	4.321 (2.508)
LSDV R-squared	0.903	0.955	0.961
Cross-sectional units	81	105	102
Observations	1539	1995	1938

Notes: Robust (HAC) standard errors between brackets. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$ .

associated with net negative mental health spillover effects. The fact that at the aggregate level, a direct and significant relationship between economic growth and suicide rates was also noted, suggests that rapid economic growth may also be accompanied by rapid social instabilities that may in turn increase suicide risk. There is mixed evidence in the literature regarding the association between economic growth and suicide mortality. See [Chen et al. \(2012\)](#) for a review of empirical studies on the socio-economic aspects of suicide.

We want to note that several factors may have conditioned the results—for example, biases derived from the measurement of suicide and uncertainty. First, since suicide is stigmatised or illegal in many countries, the availability and quality of information on them are often limited, especially for those countries with small populations ([WHO, 2021](#)). Second, the low number of cross-sectional units from some regions means that the results have to be treated with caution. Third, the high heterogeneity between countries within each region cannot be overlooked. Finally, the absence of other determining factors that can influence suicide risk because information on them is lacking means that additional potential biases may have arisen.

#### 4. Discussion

Taking all of the above into account, this section discusses some of the findings in more depth. Overall, the results suggest that increases in unemployment, economic growth, and lagged economic uncertainty are associated with increased suicide risk. This delayed effect of uncertainty shocks found in most regions suggests that most of the impact of a global uncertainty shock is not always reflected immediately in the suicide rate, as it can be channelled by intermediate variables. In this regard, [Sinyor et al. \(2021\)](#) recently noted that emerging data from high- and upper-middle-income countries indicate that suicide rates generally did not increase during the initial months of the COVID-19 epidemic, despite rising rates in mental health symptoms and suicidal ideation. This, could be indicative of a change in the trend in the aftermath of the pandemic. [Gunnell et al. \(2020\)](#) and [Kawohl and Nordt \(2021\)](#) have pointed out that mental health effects of the pandemic may increase over time due to prolonged economic stress and underemployment. Relatedly, [Fountoulakis et al. \(2014a,b\)](#) found evidence of the delayed effect of unemployment on suicide rates in Hungary.

As suggested in the previous section, the existence of financial safety nets and prevention programs provided by governments to mitigate the effects that economic shocks can have on suicide risk could be explaining to some extent the fact that in the case of Europe and Central Asia the contemporary effect of an economic uncertainty shock is positive and the lagged one takes the opposite sign, suggesting that the impact has been offset. In this regard, [Chan et al. \(2018\)](#) found that the association between suicide and unemployment becomes less intense as there is an improvement in authorities' welfare policies aimed at helping people facing financial problems. Finally, we want to note that sometimes, increases in economic uncertainty may also be associated with new opportunities for improvement and therefore with a lower risk of suicide.

The positive relationship between economic growth and suicide in sub-Saharan countries may be due to some extent to growing inequalities in the distribution of income consubstantial to economic growth. Relatedly, [Pak and Choung \(2020\)](#) showed that relative deprivation had an impact on suicide risk in South Korea. Additionally, contrary to other regions, unemployment was not found to be significant in Africa. This can partly be explained by the fact that in countries with lower incomes, the informal economy tends to have greater weight, which facilitates the process of finding new work (regardless of whether individuals are registered or not). Also, family support networks and social ties that tend to play a lesser role in higher-income countries can mitigate the effect of economic downturns and persistent unemployment.

Overall, our results support the idea that indicators of economic

uncertainty can provide an early signal for the advanced detection of higher suicidal risk. These results are therefore in keeping with [Antonakakis and Gupta's \(2017\)](#) and [Vandoros and Kawachi's \(2021\)](#) US findings and [de Bruin et al.'s \(2020\)](#) analysis of 17 members of the Organisation for Economic Co-operation and Development (OECD). Likewise, [Vandoros et al. \(2019\)](#) found that daily economic uncertainty led to increases in the risk of suicide in the short run. [Antonakakis and Collins \(2014, 2015\)](#) concluded that the uncertainty arising from fiscal adjustment measures had a significant impact on suicidality (especially amongst retired men). [Abdou et al. \(2020\)](#) demonstrated that economic insecurity, as measured by a volatility index, adversely impacted suicide rates amongst males aged 15–24 and females aged 55–64.

In their analysis of the relationship between economic indicators and suicide rates in England and Wales before and after the 2008 recession, [Coope et al. \(2014\)](#) suggested that indicators of economic strain aside from unemployment may contribute to increased suicide rates. Linked to this, [Kölves et al. \(2013\)](#) showed that changes in suicide rates were related to a wide spectrum of socioeconomic disruption. [Vandoros et al. \(2019\)](#) noted that suicide is the result of interactions among a wide range of factors and that economic uncertainty may act as a trigger in some cases. Given the solid evidence that risk factors (both on a community and an individual level) are so diverse and that suicide can be prevented, it is imperative to design country-specific plans to improve the effectiveness of prevention strategies. Therefore—in addition to providing evidence of the preventive role that indicators of economic uncertainty may have in generating early signals of greater risk—we wish to point out that such plans must be based on high-quality data.

#### 5. Conclusion

The present study has analysed the effect of economic factors, and more specifically global economic uncertainty, on suicide rates in 183 countries. Since economic uncertainty has been proven to be a driver of the business cycle, it is a suitable indicator to assess the impact of socioeconomic factors on suicide rates. Uncertainty has been measured using a global index constructed by combining news-based text-mining measures of uncertainty from a set of countries.

We observed that countries in certain regions (e.g., Eastern Europe) had much higher average rates of suicide during the period under study (i.e., the first two decades of this century). This was not the case in Africa – with the exception of Southern Africa (i.e., Lesotho, Botswana, and South Africa). North America, Western Asia, and Micronesia were the other regions with the highest average suicide rates.

Second, we assessed the relationship between global economic uncertainty and suicide risk by estimating a fixed-effects panel model, controlling for unemployment and economic growth. Overall, we found that increased lagged uncertainty was associated with increased suicide rates. This suggests that the incidence of global economic uncertainty shocks is not immediately reflected in an increase in suicide rates and highlights the complex relationship between the two. Increases in unemployment and economic growth were also found to be associated with an increased risk of suicide, although there were differences between regions. Unemployment had its greatest impact in East Asia and the Pacific, while economic uncertainty and accelerated economic growth were most significant in Africa and the Middle East. Given the anticipatory nature of economic uncertainty and its relationship with suicide rates, the results confirm the usefulness of uncertainty indicators for the early detection of increases in suicide risk and the design of suicide prevention programmes.

The present study had several limitations. As has been noted, the findings may have been influenced by several biases derived from the measurement of suicide and uncertainty. In connection with this, the aggregate nature of the data did not allow us to analyse potential discrepancies between different socioeconomic groups. In addition, given the complex interplay between the very diverse factors that affect suicidal behaviour (some of which have not, for various reasons, been

considered), additional potential biases may have arisen. Finally, future researchers might consider applying panel local projections to control for time-invariant factors and employing alternative techniques to model potential non-linear relationships between variables.

## Funding

This research was supported by the project PID2020-118800 GB-I00 from the Spanish Ministry of Science and Innovation (MCIN)/Agencia Estatal de Investigación (AEI). DOI: <http://doi.org/10.13039/501100011033>.

## Availability of data and material

The datasets used and/or analysed during the current study are:

- Suicide mortality rates by country from the World Health Organization – Global Health Observatory Data Repository (<http://apps.who.int/ghodata/>)
- The Global Economic Policy Uncertainty Index constructed by Davis (2016). Freely available at: <http://www.policyuncertainty.com/index.html>
- Unemployment rates by country from the International Labour Organization, ILOSTAT database (<https://ilostat.ilo.org/topics/unemployment-and-labour-underutilization/>)
- Gross Domestic Product (GDP) annual growth rates by country from the World Bank national accounts data, and OECD National Accounts data files (<https://databank.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/1ff4a498/Popular-Indicators>)

## CRediT authorship contribution statement

**Oscar Claveria:** Conceptualization, Formal analysis, Data curation, Writing – original draft, Writing – review & editing.

## Declaration of competing interest

The author states that there is no conflict of interest.

## Acknowledgements

We want to thank Professor Vicente Royuela, the Editor and three anonymous referees for their useful comments and suggestions.

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