Check for updates

Suicide and economic uncertainty: New findings in a global setting

S. Tolga Er [a], Ender Demir [b,c], Emre Sari [d,e,*]

[a] *Institute of Law and Economics, University of Hamburg, Johnsallee 35, Hamburg, 20148, Germany*
[b] *Department of Business Administration, School of Social Sciences, Reykjavik University, Menntavegur 1, 102, 101 Reykjavík, Iceland*
[c] *Istanbul Medeniyet University, Kadıköy, İstanbul, Turkey*
[d] *School of Business and Economics, UiT the Arctic University of Norway, 9010, Tromsø, Norway*
[e] *Division for Health and Social Sciences, NORCE Norwegian Research Centre, Tromsø, Norway*

ARTICLE INFO

ABSTRACT

This study extends the previous literature on the association between country-level economic uncertainty and suicide rate to 141 countries by introducing the World Uncertainty Index. We first examine the role of economic uncertainty on the suicide rates in a global setting for the period 2000–2019 and then analyze if the association varied across different income groups. Our primary findings suggest that a rise in economic uncertainty is related to an increased suicide rate. According to the estimates based on various income levels, higher economic uncertainty is associated with increased suicide risk in high-income countries. For middle- and low-income countries, we find no such impact. Overall, we conclude that contemporaneous and lagged economic uncertainty is a concern for the increased risk of suicide, especially in high-income countries. The results highlight the need for proactive suicide-prevention strategies in uncertain times.

1. Introduction

Suicide is a serious public health issue worldwide. Although suicide is under-reported and misclassified more frequently than most other causes of death, it is estimated that around 800,000 individuals take their own lives each year, with many more attempting suicide (Van Harmelen et al., 2019; WHO, 2021). For instance, the United States (US) witnessed over 47,500 deaths due to suicide in 2019, and the suicide rate escalated by 33% between 1999 and 2019 (Abdou et al., 2022). This highlights the crucial need to understand the underlying motivators and factors contributing to suicide to devise efficacious preventive interventions and enhance public awareness. In this study, we investigate whether there is a significant relationship between country-level economic uncertainty and the suicide rate in a global context and, if there is, whether this relationship varies across different income level groups. While the previous literature widely uses macroeconomic variables as possible determinants of suicide, the consideration of economic uncertainty in suicide estimations gains popularity after the introduction of the Economic Policy Uncertainty (EPU) Index by Baker et al. (2016). EPU index is constructed by counting newspaper articles' frequency, including economic, policy, and uncertainty terms. So far, it is mainly used as a determinant of suicides in a single country (Abdou et al., 2022;

Antonakakis & Gupta, 2017; Vandoros et al., 2019; Vandoros & Kawachi, 2021).

In a global context, economic uncertainty has only recently attracted empirical attention in the suicide literature, with just two recent studies investigating the association between economic uncertainty and suicide rates globally (Claveria, 2022, de Bruin et al., 2020). De Bruin et al. (2020) extend the studies mentioned above to a cross-country level by analyzing the relationship between EPU and suicide rates across 17 countries and conclude that economic uncertainty leads to increased suicides. In a more recent study, Claveria (2022) analyzes the association between global EPU, proxied by the GDP weighted average of 21 country-level EPU indices, and suicide rates. The findings show that the global EPU with a one-year lag is associated with an increased risk of suicide for 183 countries. Overall, de Bruin et al. (2020) and Claveria (2022) provide evidence that economic uncertainty and its indicators might offer valuable insights related to the risk of suicide.

In this background, we use a recently developed economic uncertainty measure named the World Uncertainty Index (WUI) by Ahir et al. (2022), who follow the spirit of Baker et al. (2016). WUI is constructed by counting the frequencies of the word "uncertainty" and its variants in the Economist Intelligence Unit country reports and scaling the raw

---

counts by the total number of words in each report (Ahir et al., 2022). To our knowledge, we are the first to use WUI as a possible determinant of suicides in a global setting, including 141 countries from 2000 to 2019. Our paper differs from Claveria (2022) in two ways. First, we use WUI, which is more comparable across countries than EPU since WUI is constructed and standardized based on reports of a single source, while EPU relies on the coverage of different newspaper outlets. Second, we use economic uncertainty calculated for each country in our sample, while Claveria (2022) considers global economic uncertainty based on the GDP-weighted average of a limited 21 country-level EPU indices as a predictor of suicide across countries.

To empirically test the association, we use Poisson fixed effect estimations for our sample of 141 countries over the period 2000–2019. Additionally, we consider the role of economic uncertainty in countries with different income levels. The WHO (2021) reports that suicide is a global phenomenon in all regions. There are, however, few studies involving low- and middle-income countries (Claveria, 2022; Guzmán et al., 2019). Therefore, our research endeavors to broaden the scope of longitudinal suicide studies by encompassing a diverse array of countries and then categorizing them based on their respective income levels. This multifaceted approach seeks to provide a more comprehensive understanding of the phenomenon and facilitate advancements in suicide prevention research. In this regard, two such questions are dealt with in the present study. The first question is whether there is a correlation between the levels of economic uncertainty in the countriesand the suicide rate. We anticipate finding not only a statistically significant positive association but also more dependable outcomes as a result of a standardized approach to addressing uncertainty at the country level on a global scale. The second question is, if there is a significant relationship between economic uncertainty and suicide rates, does this association vary between low-, middle-, and high-income nations? Due to the varying economic dynamics of this group of countries, we anticipate that different answers will be found for different country income groups.

2. Data and methodology

2.1. Data

We use a panel dataset that comprises country-year data for 141 countries spanning six continents from 2000 to 2019 based on the availability of the data. The dependent variable is the suicide rate, measured as the number of suicides per 100,000 population (Lutter et al., 2020; Milner et al., 2020). We utilize the publicly available data from World Health Organization (WHO, 2022) as in Milner et al. (2020), İlgün et al. (2020), and Claveria (2022), with 2000 as the initial and 2019 as the latest available year at the time of this writing.

Our variable of interest is economic uncertainty, proxied by the World Uncertainty Index (*for more detail*, see Ahir et al. (2022)).[1] Compared to other uncertainty and risk measures in the literature, such as EPU, WUI is obtained from one source and is subject to a standardized structure, making it a more compatible choice for cross-country analysis. The WUI is a quarterly constructed based on the frequency of the word "uncertainty" and its variants in the quarterly Economist Intelligence Unit country reports.,[2,3] The raw counts are normalized by the total amount of words in each report so that the WUI can be compared across countries. Ahir et al. (2022) find no consistent differences between country income level groups, despite the average number of pages being higher in developed countries than in developing and low-income ones. As the frequency of the data is quarterly, we average the values from four quarters to transform them into annual. We anticipate that an increased level of economic uncertainty is associated with an increased risk of suicide.

Table 1 reports the descriptive statistics of variables used in the analysis, and Table 2 presents the pairwise Pearson correlation matrix for the variables. Low correlations reported in the table indicate no issue of multi-collinearity. We include age-standardized prevalence of depressive orders and anxiety disorders as control variables, considering that mental health disorders affect the mood or feelings of individuals (WHO, 2017; İlgün et al., 2020). Also, we control for income, proxied by the GDP per capita (current US dollar ($)), since diminished wealth and income are associated with suicidal behavior (de Bruin et al., 2020; Milner et al., 2020). Another control variable is the unemployment rate to control job market conditions that are an indicator of financial hardship, which is related to the increases in the risk of suicide (de Bruin et al., 2020; Lutter et al., 2020). The final control variable is the population size on a logarithmic scale since population increases may accelerate the changes and increase the number of unexpected events in a society, which in turn disrupts collective consciousness, resulting in anomie-induced suicides, or in other words, suicides caused due to the individuals' deviance from norms due to the disruptions in integration to the society (Durkheim, 2014; Lutter et al., 2020; Milner et al., 2020).

Finally, we present the scatter plot to illustrate each country's mean economic uncertainty and suicide rate levels in Fig. 1. The fitted line in the figure demonstrated that increased economic uncertainty was related to the increased level of suicide risk for 141 countries over the sample period.

Table 1
Descriptive statistics.

	Obs.	Mean	S.D.	Min.	Max.
Dependent Variable	2820	10.513	8.817	1.45	92.64
Suicide					
Suicide mortality rate (per 100,000 population)					
Variable of Interest	2820	0.060	0.051	0	0.418
WUI					
The percent of word "uncertainty" (or its variant) in the Economist Intelligence Unit country reports					
Control Variables	2780	4.047	0.919	2.157	7.6882
Depression					
Prevalence of depressive disorders, age standardized					
Anxiety	2820	4.310	1.335	1.975	9.016
Prevalence of anxiety disorders, age standardized					
Income	2804	8.233	1.596	4.718	11.951
GDP per capita (Current US $)(log)					
Unemployment	2820	7.645	5.914	0.11	37.25
Unemployment, modeled ILO estimate					
Population	2820	16.480	1.351	13.292	21.065
Total population (log)					

Notes: The table presents the number of observations, along with mean, standard deviation, minimum, and maximum values, sources for the dependent variable, variable of interest, and control variables.

---

[1] The quarterly World Uncertainty Index is available at https://worlduncertaintyindex.com/data/.

[2] The Economist Intelligence Unit's country reports are created by a network of field-based and headquarters-based professionals. There are five stages involved in creating a country report for the Economist Intelligence Unit: authoring, editing, a second check, sub-editing, and finally, production (Ahir et al., 2022). In the report writing phase, specialists in the field compile data and deliver a draft to specialists in the headquarters. Thus, their method mitigates issues regarding the WUI's precision, ideological bias, and consistency within and between country reports.

[3] For more details on the Economist Intelligence Unit, please visit https://www.eiu.com/.

Table 2
Matrix of pairwise correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Suicide	1						
(2) WUI	0.047	1					
	(0.013)						
(3) Depression	0.041	−0.002	1				
	(0.031)	(0.896)					
(4) Anxiety	−0.088	0.092	0.145	1			
	(0.000)	(0.000)	(0.000)				
(5) Income	0.173	0.061	−0.215	0.503	1		
	(0.000)	(0.001)	(0.000)	(0.000)			
(6) Unemployment	0.223	0.045	0.023	0.060	0.071	1	
	(0.000)	(0.017)	(0.230)	(0.001)	(0.000)		
(7) Population	−0.112	0.112	−0.069	0.041	−0.024	−0.225	1
	(0.000)	(0.000)	(0.000)	(0.031)	(0.208)	(0.000)	

Notes: The table reports the pairwise correlations between variables. The p-values are in parentheses. The dependent variable is the suicide rate per 100,000 persons, while WUI (World Uncertainty Index) is the main variable of interest. The depression rate, anxiety disorder rate, the natural logarithm of GDP per capita, the unemployment rate, and the natural logarithm of the population are control variables. We detect no high correlation between any of the variables.

2.2. Methodology

In the domain of the suicide literature, researchers commonly apply either linear models (*for instance*, see de Bruin et al. (2020), Lutter et al. (2020) and Milner et al. (2020)) or utilize count models such as Poisson and negative binomial models because the data does not follow normal distribution (*for instance*, see Kyriopoulos et al. (2022), Nomura et al. (2021) and Shearer et al. (2018)). As commonly documented in previous studies, our dependent variable, the suicide rate, does not show a normal distribution and is skewed to the right. Thus, we consider implementing count models for the methodology. Even though our measure of suicide is a "rate", more precisely the suicide rate per 100,000 population, it is initially recorded as an integer and appropriate to be the dependent variable in count models. Therefore, we adopt count data models, namely the fixed-effects Poisson models, in our study. Our choice of the fixed-effects Poisson model over negative binomial models has the following reasons. First, we estimate fixed effects models due to the global representation of our sample and in order to control unobserved country heterogeneity, preventing time-variant variables coefficient bias. Contrary to the fixed-effects Poisson model, which controls for all-time invariant covariates, the fixed-effects negative binomial model for panel data is not a "true" fixed-effects method since it fails to control for all stable covariates (Allison & Waterman, 2002) and does not remove the individual fixed effects in count panel data unless specific conditions are met (Guimarães, 2008). Second, the Poisson model makes weaker distributional assumptions than the negative binomial model and produces robust and consistent parameter estimates whether the dependent variable is under-dispersed or over-dispersed, which is the case for our sample (Wooldridge, 1999, 2020).

Fig. 1. Scatter plot - suicide rate and economic uncertainty. The x-axis represents the mean of the economic uncertainty proxied by the World Uncertainty Index, while the y-axis represents the average suicide rate per 100,000 persons for each country between 2000 and 2019. The line is the fitted line, demonstrating the association in the same direction between suicide rates and economic uncertainty levels.
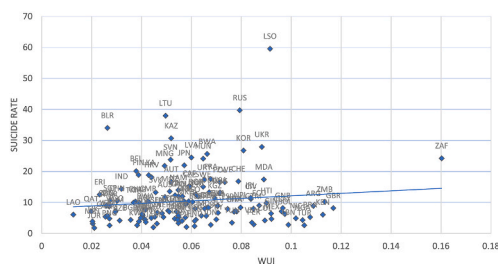
As a result, we utilize fixed effects Poisson models with robust standard errors, including year fixed effects, to predict the association between WUI and suicide rates. Initially, we estimate the association between economic uncertainty and suicide rates for the full sample. Then, we group the countries according to their income levels based on the World Bank classification for the latest calendar year (World Bank, 2022). We utilize the model for three country groups; low-income, middle-income, and high-income countries in line with Moore (2022). Furthermore, for each analysis, we replace contemporaneous WUI with its one-year lagged form to analyze the lagged effect on the suicide rate.

3. Findings

Table 3 presents the estimations for the relationship between economic uncertainty and suicide. We first estimate a model with only economic uncertainty (WUI) as an explanatory variable (Panel A, column 1) and subsequently introduce the control variables (Panel A, column 2). Across all columns, the coefficients of the economic uncertainty from the Poisson regressions are positive and statistically significant. More specifically, in Panel A, columns 1 and 2, the coefficients of WUI are 0.389 and 0.282, respectively, and the standard deviation for WUI is 0.051. Hence, a one standard deviation increase in WUI yields a 0.014 (0.282×0.051) in the suicide rates while holding the other variables in the model constant (column 2). The mean value for the suicide rates is 10.513, and so a one standard deviation increase in WUI creates a 0.14% ($0.282 \times 0.051 \div 10.513$) increase in the probability of the suicide rate per 100,000 persons in a country, similar to the findings of the previous studies (Antonakakis & Gupta, 2017; de Bruin et al., 2020; Vandoros et al., 2019; Vandoros & Kawachi, 2021). When we replace WUI with its lagged form, the results remained parallel, indicating that lagged WUI is related to an increased suicide rate.

In Table 3, Panel B, we also present results for the countries that range between 0.05 and 0.95 percentile in terms of average suicide rates to confirm that the results hold when we exclude countries with exceptionally high and low suicide rates. Comparing the WUI and lagged WUI results to those in Panel A, the only noticeable difference is that the Poisson coefficients are slightly smaller, and the significance levels are higher in Panel B.

Moreover, we find that depression is related to increased suicide rates (Panel A, column 4) similar to the findings of the previous studies (Sari et al., 2023; Wang et al., 2015). In Panel B, the only significant difference is in the results for the unemployment rate. Before excluding the countries with exceptionally high and low suicide rates, we find no significant association between unemployment and suicide rates, like Sari et al. (2023) and Vandoros et al. (2019). However, after excluding those countries, the unemployment rate became significant, similar to

Table 3
The association between suicides and economic uncertainty.

Dependent Variable: Suicide rate per 100,000 persons in a country				
Panel A	Economic Uncertainty		Lagged Economic Uncertainty	
	(1)	(2)	(3)	(2)
WUI	0.389**	0.282**		
	(0.191)	(0.138)		
WUI$_{(t-1)}$			0.419*	0.305*
			(0.218)	(0.173)
Depression		0.434***		0.417**
		(0.165)		(0.163)
Anxiety		−0.016		−0.014
		(0.076)		(0.078)
Income		−0.081*		−0.076
		(0.049)		(0.048)
Unemployment		−0.001		−0.001
		(0.011)		(0.011)
Population		−0.092		−0.083
		(0.130)		(0.134)
Year FE	YES	YES	YES	YES
# Countries	141	139	141	139
# Observations	2820	2764	2679	2626
Panel B	Economic Uncertainty		Lagged Economic Uncertainty	
	(1)	(2)	(3)	(2)
WUI	0.324***	0.243***		
	(0.097)	(0.084)		
WUI$_{(t-1)}$			0.300***	0.218**
			(0.099)	(0.087)
Depression		0.231***		0.214***
		(0.077)		(0.076)
Anxiety		−0.053		−0.050
		(0.064)		(0.066)
Income		−0.016		−0.014
		(0.029)		(0.030)
Unemployment		0.010***		0.010***
		(0.003)		(0.003)
Population		−0.083		−0.080
		(0.086)		(0.083)
Year FE	YES	YES	YES	YES
# Countries	125	124	125	124
# Observations	2500	2464	2375	2341

Notes: The coefficients are from the conditional fixed-effects Poisson model with year-fixed effects, and robust standard errors are in parentheses. Panel A reports the results for the entire sample, while the findings in Panel B are for the sample of countries with an average suicide rate between the 0.05 and 0.95 percentile. Excluded countries over the 0.95 percentile are Belarus, Botswana, Kazakhstan, South Korea, Lesotho, Lithuania, Russia, and Ukraine, whereas excluded countries below the 0.05 percentile are Honduras, Indonesia, Jamaica, Jordan, Kuwait, Philippines, Papua New Guinea, and Turkey. The dependent variable is the suicide rate per country, while the main variables of interest are economic uncertainty (WUI-World Uncertainty Index) and economic uncertainty per country with a one-year lag. The baseline estimations are in columns 1 and 3, and columns 2 and 4 report the results for estimations with control variables. Controls include the depression rate, anxiety disorder rate, the (log) GDP per capita, the unemployment rate, and the (log) population. ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively.

the findings of Antonakakis and Gupta (2017) and İlgün et al. (2020). In addition, the logarithm of the income had a negative and statistically significant association with suicide only in Panel A, column 2, consistent with de Bruin et al.'s (2020), implying that lower GDP per capita is linked to higher suicide rates. Also, the population size had no statistically significant association with suicide, confirming the findings of İlgün et al. (2020) and Vandoros et al. (2019).

In Table 4, we analyze the relationship between economic uncertainty and the suicide rate in different income groups. We present the findings based on two separate scenarios: the economic uncertainty (columns 1, 2, and 3) and the lagged economic uncertainty (columns 4, 5, and 6). The results for both current and lagged economic uncertainties for WUI are similar within low- (columns 1 and 4), middle- (columns 2 and 5), and high-income (columns 3 and 6) countries. According to our

results, the association between economic uncertainty and the suicide rate prevails only in high-income countries. In the case of middle- and low-income countries, the relationship turns out to be insignificant. Our findings suggest that one of the main determinants of suicide rate is economic uncertainty for high-income countries. In high-income countries, the relationship between depression and the suicide rate is insignificant, unlike in the middle- and low-income countries, while the unemployment rate is significantly associated with suicides in these countries.

4. Discussions

In general, our findings show that higher economic uncertainty proxied by World Uncertainty Index (WUI) is associated with increased suicide rates in 141 countries. This finding is consistent with our anticipations for the first question in this study, which is whether there is a relationship between the countries' levels of economic uncertainty and the suicide rates. Here, the most important aspect of these results is that they are derived from a standardized measure for economic uncertainty, although they are comparable to previous studies (Antonakakis and Gupta, 2017; de Bruin et al., 2020; Vandoros et al., 2019; Vandoros & Kawachi, 2021).

Our findings are parallel to de Bruin et al. (2020), which show that suicide rates tend to increase with higher economic policy uncertainty in a sample of mostly developed countries. Conversely, a recent analysis for the same period by Claveria (2022) using a global economic policy uncertainty (GEPU) index, which is a GDP-weighted average of EPUs (*for more details,* see Davis (2016)), shows a negative relationship between economic uncertainty and worldwide suicide rates. These disparate findings, between ours and Claveria's (2022), demonstrate the role of the index employed when examining the relationship between suicide rates and uncertainty at the aggregate-level.

The significance of utilizing WUI lies in its origin from a singular source, its cross-national comparability, and its inclusion of a greater number of countries. Ahir et al. (2022) present details that war, terrorist attacks, and public health problems are only some topics that WUI covers in addition to economic and political challenges. WUI peaks occurred around the same time as the terrorist attacks of September 11, 2001, the breakout of SARS, the second Gulf War, the European financial crisis, El Nio, the European border crisis, the UK Brexit vote, and the 2016 US election. In terms of specific countries, Norway experienced the peak of uncertainty due to Brexit and the closure of the Suez Canal in the year 1967. Around the same time, there was a significant increase in the degree of unpredictability in India's agricultural supply. According to Ahir et al. (2022), innovations in WUI forecast large decreases in production in all nations, but especially in developing countries characterized by poorer institutional quality.

Moreover, we present whether the relationship between economic uncertainty and suicide rates differs between low-, middle-, and high-income countries. According to our results, the association between economic uncertainty and the suicide rate prevails only in high-income countries. In the case of middle- and low-income countries, the relationship turns out to be insignificant. In this context, the vulnerability paradox can be discussed, particularly concerning high-income countries. It is not to say that suicide and a country's vulnerability, such as a low-income country, are mutually exclusive but rather highlight the vulnerability paradox (Dückers et al., 2019; Jorm & Mulder, 2022). In less vulnerable countries, culture may be a variable that increases the risk of an uncertain association with suicide. Hofstede's cultural dimensions classification, for instance, prioritizes individualism, power equality, and social indulgence in less vulnerable, wealthier countries (Hofstede, 2011). Hofstede (2011) hypothesizes that individualism, equal power distribution, and less restraint in pursuing basic human desires increase sensitivity to social failure.

Here, like Abdou et al. (2022), we can also speculate that negativity bias may be one of the mechanisms for high-income countries. The

Table 4
Suicides and economic uncertainty in different income groups.

Dependent Variable: Suicide rate per 100,000 persons in a country						
Variables	Economic Uncertainty			Lagged Economic Uncertainty		
	Low-Income Countries (1)	Middle-Income Countries (2)	High-Income Countries (3)	Low-Income Countries (4)	Middle-Income Countries (5)	High-Income Countries (6)
WUI	−0.094	0.262	0.223*			
	(0.088)	(0.190)	(0.134)			
WUI$_{(t-1)}$				−0.088	0.296	0.209*
				(0.101)	(0.202)	(0.121)
Depression	0.831***	0.766**	0.098	0.789***	0.723**	0.086
	(0.138)	(0.312)	(0.098)	(0.125)	(0.307)	(0.098)
Anxiety	0.044	0.024	−0.015	−0.040	0.006	−0.002
	(0.349)	(0.187)	(0.081)	(0.366)	(0.204)	(0.084)
Income	−0.058*	−0.066	−0.035	−0.064*	−0.061	−0.007
	(0.034)	(0.062)	(0.079)	(0.035)	(0.061)	(0.091)
Unemployment	−0.003	−0.005	0.008**	−0.005	−0.005	0.007**
	(0.012)	(0.015)	(0.004)	(0.012)	(0.016)	(0.004)
Population	0.117	−0.463	0.136	0.039	−0.434	0.141
	(0.319)	(0.386)	(0.106)	(0.308)	(0.404)	(0.110)
Year FE	YES	YES	YES	YES	YES	YES
# Countries	25	75	39	25	75	39
# Observations	489	1495	780	465	1420	741

Notes: The coefficients are from the conditional Poisson regression with fixed effects for the entire sample, and robust standard errors are in parentheses. We implement year fixed-effects. The dependent variable is the suicide rate, while the main variable of interest is economic uncertainty (WUI) for columns 1 to 3 and economic uncertainty with a one-year lag for columns 4 to 6. Controls include the depression rate, anxiety disorder rate, the (log) GDP per capita, the unemployment rate, and (log) population. We divide the sample into three groups according to the World Bank's income classification for the calendar year 2019, which is the last year of the sample. The sample groups are low-income countries (columns 1 & 4), middle-income countries (columns 2 & 5), and high-income countries (3 & 6). ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively.

concept of negativity bias refers to the assumption that adverse circumstances are generally more substantial, potent, capturing in combinations, and resourceful than their positive counterparts (Abdou et al., 2022). The principle of loss aversion in prospect theory is relevant to this negativity bias, which holds that people are more motivated by the threat of loss than by the promise of gain (Liu et al., 2022). People in high-income countries have more to lose due to economic uncertainty than those in the middle- and low-income countries; thus, it stands to reason that this is where we see the strongest association between economic uncertainty and suicide.

When we delve deeper into the middle- and low-income countries, we see that suicide rates have no significant relationship with economic uncertainty. Individuals are more likely to perceive social inequalities in divided societies where the affluent and poor live near one another. Nevertheless, a person living in extreme poverty, such as in a low-income country, may not inevitably feel insufficient, unfortunate, or deprived (Zhang, 2019). From the perspective of the strain theory of suicide (*for more details*, see Zhang (2019)), we speculate that it may have something to do with the higher presence of conflicting and competing forces in the lives of individuals in the middle- and low-income countries as compared to high-income countries. Changes in the level of economic uncertainty could not be discussed in absolute magnitude but rather as gains or losses relative to a reference point; how a person perceives and evaluates stimuli is directly related to the prior experience (Abdou et al., 2022). This is especially true for middle- and low-income countries when differences in social inequality are large. Also, differences in the availability and accessibility of professional mental health services across countries may affect the likelihood of early diagnosis and suicide prevention interventions. In this case, Dückers et al. (2019, 2017) argue that community engagement and personal support networks can help compensate for the lack of institutional and professional health capacity and systems in more vulnerable countries; correspondingly, our results show that there is no significant association for middle- and low-income countries.

Various strategies are available to prevent suicide (Vandoros et al., 2019). To develop the most effective interventions, it is necessary to understand the factors that trigger suicide. This article emphasizes the adverse influences of economic uncertainty on suicide and provides insight into the motivations of suicide. Even though economic uncertainty is not likely the only reason for suicide, it may be a trigger for those considering it for some time. According to Chen et al. (2012), suicide is the ultimate, irreversible action and uncertain future. When deciding whether or not to attempt suicide, there is an 'option value' of staying alive and hoping for a better situation (Chen et al., 2012). However, adverse changes in societal circumstances cause anomie or a sense of normlessness, leading to suicide on an individual level (Jalles & Andresen, 2015).

As a result, our findings have some policy implications for regulatory bodies. Since it is not possible to make a policy for each of the things that could cause uncertainty, our advice to policymakers is to plan ahead for how to take proactive steps during times of crisis that will cause uncertainty. Recent experience with the COVID-19 pandemic has demonstrated the significance of proactive public health measures (Sher, 2020). To put it simply, the groundwork for support lines that people thinking about suicide can quickly access in times of heightened uncertainty should be prepared in advance (Van Der Burgt et al., 2022). Consequently, public health authorities in high-income countries should develop and implement uncertainty-specific prevention strategies in addition to their current plan and policies on this issue. Like Vandoros et al. (2019) and Sher (2020), we also foresee that public communications campaigns explicitly designed for periods of high economic uncertainty made through public health service with the appropriate timing, advertisements in the traditional media, and social media posts will be more effective in suicide prevention campaigns.

4.1 Strengths and limitations

To our knowledge, this is the very first study to estimate suicide rates utilizing the recently developed WUI. The findings of this study provide a suggestion for improving suicide prevention measures on a regional as well as an international scale. We acknowledge that the index developed to measure uncertainty has not yet been fully validated externally. On the other hand, Ahir et al. (2022) evaluate WUI's reliability, accuracy, and completeness. First, Ahir et al. examine the narrative behind the greatest worldwide surges. In addition, they demonstrate that increases in the index tend to occur around election times and that it is correlated

to higher levels of economic policy uncertainty (EPU), higher levels of stock market volatility, higher forecaster disagreement, and lower GDP growth. As a final point, they claim that the market's acceptance of the WUI index is confirmed by commercial data providers, including Bloomberg, and Reuters. Nevertheless, this index does not include other methods that account for the frequencies of the word "uncertainty" (and its variants) in the Economic Intelligence Unit's country reports. Thus, consideration of the WUI as the sole source is based on the assumption that the Economic Intelligence Unit provides politically or economically neutral country reports and provides high-quality reports.

Given the framework of the cross-country analysis in this study, the findings come with limitations. As highlighted, suicide is misclassified more frequently than most other causes of death, leading to under-reporting, which may cause biases that influence the comparability of data in a cross-country setting. So, like Dückers et al. (2019) and Milner et al. (2020), we acknowledge that suicide numbers may be affected by time and country. Statistics on suicide are more likely to be under-reported in low and middle-income countries than in high-income ones (Milner et al., 2011, 2012). In addition, studies of populations as a whole are more likely to produce methodological flaws such as the ecological fallacy. However, as Neumayer (2003) stated, an alleged ecological fallacy cannot be a reason to explicitly exclude existing findings at the cross-national level that explains the variation in large-unit aggregate level suicide data.

5. Conclusion

Our paper expands the scope of prior research on economic uncertainty and suicide rates by extending the analysis to 141 countries from 2000 to 2019, including low- and middle-income countries. In our results, we first document the positive association between economic uncertainty and suicide rates in all countries and later conduct the analysis based on the classification of countries according to income levels. Results on high-income countries show that economic uncertainty positively correlates with suicide, whereas no association is documented for middle- and low-income countries. Our findings are robust for economic uncertainty with a one-year lag in each estimate, and we find similar associations with suicide for several control variables, such as depression, anxiety, income, unemployment, and population, consistent with previous research.

Given the findings that we show on the relationship between economic uncertainty and suicide, the association between sources of uncertainty and suicide remains a topic for future research. Similar but more specific measures of uncertainty at an aggregate level in a global sample will contribute to the literature on suicide and uncertainty arising from political conditions, climate change, and overpopulation. Similarly, we suggest widely common disorders such as depression, anxiety, and substance use and their relation to economic uncertainty as another area for future research.

Ethics approval and consent to participate and publication

Not applicable.

CRediT author statement

Funding

Availability of data

The data utilized in the study was acquired through the World Health Organization database and the World Uncertainty Index. Data are available at https://www.who.int/data/gho and https://worlduncertaintyindex.com/data/.

Declaration of competing interest

All authors have no conflicts of interest to disclose.

References

Abdou, R., Cassells, D., Berrill, J., & Hanly, J. (2022). Revisiting the relationship between economic uncertainty and suicide: An alternative approach. *Social Science & Medicine, 306*, Article 115095. https://doi.org/10.1016/j.socscimed.2022.115095

Ahir, H., Bloom, N., & Furceri, D. (2022). *The World uncertainty index (No. 29763).* NBER Working Paper Series.

Allison, P. D., & Waterman, R. P. (2002). Fixed-effects negative binomial regression models. *Sociological Methodology, 32*, 247–265. https://doi.org/10.1111/1467-9531.00117

Antonakakis, N., & Gupta, R. (2017). Is economic policy uncertainty related to suicide rates? Evidence from the United States. *Social Indicators Research, 133*, 543–560. https://doi.org/10.1007/s11205-016-1384-4

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *Quarterly Journal of Economics, 131*, 1593–1636. https://doi.org/10.1093/qje/qjw024

de Bruin, A., Agyemang, A., & Chowdhury, M. I. H. (2020). New insights on suicide: Uncertainty and political conditions. *Applied Economics Letters, 27*, 1424–1429. https://doi.org/10.1080/13504851.2019.1686453

Chen, J., Choi, Y. J., Mori, K., Sawada, Y., & Sugano, S. (2012). Socio-economic studies on suicide: A survey. *Journal of Economic Surveys, 26*, 271–306. https://doi.org/10.1111/j.1467-6419.2010.00645.x

Claveria, O. (2022). Global economic uncertainty and suicide: Worldwide evidence. *Social Science & Medicine, 305*, Article 115041. https://doi.org/10.1016/j.socscimed.2022.115041

Davis, S. J. (2016). *An index of global economic policy uncertainty*. NBER Work. https://doi.org/10.3386/w22740. Pap. 22740.

Dückers, M. L. A., Reifels, L., De Beurs, D. P., & Brewin, C. R. (2019). The vulnerability paradox in global mental health and its applicability to suicide. *British Journal of Psychiatry, 215*, 588–593. https://doi.org/10.1192/bjp.2019.41

Dückers, M. L. A., Witteveen, A. B., Bisson, J. I., & Olff, M. (2017). The association between disaster vulnerability and post-disaster psychosocial service delivery across Europe. *Administration and Policy in Mental Health and Mental Health Services Research, 44*, 470–479. https://doi.org/10.1007/s10488-015-0671-8

Durkheim, E. (2014). *The division of labor in society*. New York: Simon & Schuster.

Guimarães, P. (2008). The fixed effects negative binomial model revisited. *Economics Letters, 99*, 63–66. https://doi.org/10.1016/j.econlet.2007.05.030

Guzmán, E. M., Cha, C. B., Ribeiro, J. D., & Franklin, J. C. (2019). Suicide risk around the world: A meta-analysis of longitudinal studies. *Social Psychiatry and Psychiatric Epidemiology, 54*, 1459–1470. https://doi.org/10.1007/s00127-019-01759-x

Hofstede, G. (2011). *Dimensionalizing cultures: The hofstede model in context.* Online Readings Psychol. Cult. 2.

İlgün, G., Yetim, B., Demirci, Ş., & Konca, M. (2020). Individual and socio-demographic determinants of suicide: An examination on WHO countries. *International Journal of Social Psychiatry, 66*, 124–128. https://doi.org/10.1177/0020764019888951

Jalles, J. T., & Andresen, M. A. (2015). The social and economic determinants of suicide in Canadian provinces. *Health Economics Review, 5*, 1–12. https://doi.org/10.1186/s13561-015-0041-y

Jorm, A. F., & Mulder, R. T. (2022). National characteristics associated with prevalence of depression and anxiety symptoms: A cross-sectional ecological study. *Global Mental Health, 9*, 65–71. https://doi.org/10.1017/gmh.2022.9

Kyriopoulos, I., Vandoros, S., & Kawachi, I. (2022). Police killings and suicide among Black Americans. *Social Science & Medicine, 305*, Article 114964. https://doi.org/10.1016/j.socscimed.2022.114964

Liu, Q., Zhong, R., Ji, X., Law, S., Xiao, F., Wei, Y., Fang, S., Kong, X., Zhang, X., Yao, S., & Wang, X. (2022). Decision-making biases in suicide attempters with major depressive disorder: A computational modeling study using the balloon analog risk task (BART). Depress. Anxiety 845–857 https://doi.org/10.1002/da.23291.

Lutter, M., Roex, K. L. A., & Tisch, D. (2020). Anomie or imitation? The werther effect of celebrity suicides on suicide rates in 34 OECD countries, 1960–2014. *Social Science & Medicine, 246*, Article 112755. https://doi.org/10.1016/j.socscimed.2019.112755

Milner, A., McClure, R., & de Leo, D. (2012). Globalization and suicide: An ecological study across five regions of the world. *Archives of Suicide Research, 16*, 238–249. https://doi.org/10.1080/13811118.2012.695272

Milner, A., McClure, R., Sun, J., & De Leo, D. (2011). Globalisation and suicide: An empirical investigation in 35 countries over the period 1980-2006. *Health & Place, 17*, 996–1003. https://doi.org/10.1016/j.healthplace.2011.03.002

Milner, A., Scovelle, A. J., Hewitt, B., Maheen, H., Ruppanner, L., & King, T. L. (2020). Shifts in gender equality and suicide: A panel study of changes over time in 87 countries. *Journal of Affective Disorders, 276*, 495–500. https://doi.org/10.1016/j.jad.2020.07.105

Moore, M. D. (2022). What about development? Social capital and suicide. *Sociological Focus, 55*, 392–404. https://doi.org/10.1080/00380237.2022.2133032

Neumayer, E. (2003). Socioeconomic factors and suicide rates at large-unit aggregate levels: A comment. *Urban Studies, 40*, 2591–2612. https://doi.org/10.1007/s00127-010-0316-x

Nomura, S., Kawashima, T., Yoneoka, D., Tanoue, Y., Eguchi, A., Gilmour, S., Kawamura, Y., Harada, N., & Hashizume, M. (2021). Trends in suicide in Japan by gender during the COVID-19 pandemic, up to September 2020. *Psychiatry Research, 295*, Article 113622. https://doi.org/10.1016/j.psychres.2020.113622

Sari, E., Er, S. T., & Demir, E. (2023). Suicide as globalisation's black swan: Global evidence. *Public Health, 217*, 74–80. https://doi.org/10.1016/j.puhe.2023.01.026

Shearer, A., Russon, J., Herres, J., Wong, A., Jacobs, C., Diamond, G. M., & Diamond, G. S. (2018). Religion, sexual orientation, and suicide attempts among a sample of suicidal adolescents. *Suicide and Life-Threatening Behavior, 48*, 431–437. https://doi.org/10.1111/sltb.12372

Sher, L. (2020). The impact of the COVID-19 pandemic on suicide rates. *QJM: An International Journal of Medicine, 113*, 707–712. https://doi.org/10.1093/QJMED/HCAA202

Van Der Burgt, M. C. A., Mérelle, S., Beekman, A. T. F., & Gilissen, R. (2022). The impact of COVID-19 on the suicide prevention helpline in The Netherlands. *Crisis 0* https://doi.org/10.1027/0227-5910/a000863.

Van Harmelen, A. L., Schmaal, L., & Blumberg, H. P. (2019). Journal of affective disorders special issue on suicide-related research: Hopeful progress but much research urgently needed. *Journal of Affective Disorders, 251*, 39–41. https://doi.org/10.1016/j.jad.2019.03.054

Vandoros, S., Avendano, M., & Kawachi, I. (2019). The association between economic uncertainty and suicide in the short-run. *Social Science & Medicine, 220*, 403–410. https://doi.org/10.1016/j.socscimed.2018.11.035

Vandoros, S., & Kawachi, I. (2021). Economic uncertainty and suicide in the United States. *European Journal of Epidemiology, 36*, 641–647. https://doi.org/10.1007/s10654-021-00770-4

Wang, Y. Y., Jiang, N. Z., Cheung, E. F. C., Sun, H. W., & Chan, R. C. K. (2015). Role of depression severity and impulsivity in the relationship between hopelessness and suicidal ideation in patients with major depressive disorder. *Journal of Affective Disorders, 183*, 83–89. https://doi.org/10.1016/j.jad.2015.05.001

WHO. (2017). *Depression and other common mental disorders: Global health estimates*. Geneva: World Health Organization. WHO/MSD/MER/2017.2.

WHO. (2021). Fact Sheet: Suicide [WWW Document]. World Heal. Organ. URL https://www.who.int/news-room/fact-sheets/detail/suicide, 3.1.22.

WHO. (2022). Suicide mortality rate (per 100,000 population) [WWW Document]. World Heal. Organ. URL https://www.who.int/data/gho/data/indicators/indicator-details/GHO/suicide-mortality-rate-(per-100-000-population.

Wooldridge, J. M. (1999). Distribution-free estimation of some nonlinear panel data models. *Journal of Econometrics, 90*, 77–97. https://doi.org/10.1016/S0304-4076(98)00033-5

Wooldridge, J. M. (2020). 17.3 the Poisson regression model. In *Introductory econometrics: A modern approach* (pp. 127–128). Cengage Learning. https://doi.org/10.1201/9781315215402-43.

World Bank. (2022). World development indicators database [WWW Document]. URL https://datacatalog.worldbank.org/dataset/world-development-indicators.

Zhang, J. (2019). The strain theory of suicide. *Journal of Pacific Rim Psychology, 13*. https://doi.org/10.1017/prp.2019.19