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Do Stock Market Fluctuations Affect Suicide Rates?

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Abstract

In this study, we extend the standard economic model of suicide by considering a new influential factor driving the voluntary death rate. Using an international sample, we estimate the model and document a robust and significant inverse relation between stock market returns and the percentage increase in suicide rates. Trends in male and female suicide are affected by market fluctuations, both contemporaneously and at a lag. This predictive quality of stock returns offers the potential to implement pro-active suicide prevention strategies for those who could be affected by the vagaries of the market and general economic downturns.

JEL Classification: G11, I12, I18

I. Introduction

Except for *Homo sapiens*, no conclusive evidence for suicidal behavior has been observed elsewhere in the animal kingdom (Preti 2011). The trauma of suicide imposes a high cost on society, and therefore its prevention is arguably an important policy goal. To implement effective preventative strategies, we need first to identify and understand the determinants of suicide. Although there are already empirically documented rationalizations for the behavior, our model is the first to consider price movements in the stock market. Previous studies and theories have found an inverse relation between income and the suicide rate. It is reasonable to assume that a significant part of an individual's income in economically developed societies comes from investment in stock markets. Therefore, one might expect that portfolio value variations could play a critical role in choosing to end one's own life.

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The Bankers' Panic of 1907 sent shockwaves through the market, causing U.S. stock prices to halve in value from their previous year's high. Mortality statistics for 1908 reflect this, showing that the percentage of deaths attributed to suicide among bankers, brokers, and company officials was more than twice as high as that of the general population (Department of Commerce and Labor 1909). Suicides on Wall Street have become mythologized through the popular press and cinema (Stack and Bowman 2014). Finance folklore alludes to traders jumping out of windows following the 1929 crash,[1] although some commentators question the accuracy of these accounts (Galbraith 1997, p. 128).[2] Despite the controversy, there has been no rigorous investigation as to whether stock market collapses compel people to take their own lives. In a society where success is measured in material terms, one might suppose that a substantial loss in wealth could lead to such a desperate act. However, this supposition remains untested in the academic literature, and our article attempts to address this gap.

Suicide represents and creates intense suffering and results in a tragic loss of life. It is estimated that 788,000 deaths were attributable to suicide in 2015, translating into 1 death every 40 seconds (World Health Organization [WHO] 2017). The WHO has identified suicide as a public health priority, tasking its member states with achieving a 10% reduction in their rates by 2020. If they are to achieve success, prevention strategies have to address the underlying causes and motivations behind suicide itself. The purpose of our inquiry is to contribute to the understanding of what may induce an individual to kill himself or herself. If stock market fluctuations drive these desperate decisions, policies on mental health need to take into account market movements and the consequent financial strain.

The literature indicates that there may be a link between financial distress and the health status of individuals. The findings of Currie and Tekin (2015) tell us that foreclosures are traumatic events that can induce heart attacks, strokes, and psychiatric difficulties, as is evidenced by an increased number of hospital visits. Lin et al. (2013) support this notion by documenting that a fall in house prices is linked to increased use of medications to treat depression. As economic strain becomes more recognized as a factor that negatively affects mental well-being, it is crucial to realize the hazards that stock price fluctuations present. Exposure stretches beyond those who are directly invested in equities, as large swathes of the general populace are dependent on pension funds for their retirement income. Furthermore, stock prices can mirror the general economic circumstances and the financial standing of employers. As adverse movements in equity values can be considered a stressor, the question arises as to whether this may propel individuals to commit suicide.

It is important to note that the stock market index is usually considered a leading indicator, capable of predicting future macroeconomic trends (Stock and Watson 1989; Estrella and Mishkin 1998). Thus, if individuals are forward looking, stock returns may be

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[1]Will Rogers, "Will Rogers says New York Has Had a "Wailing Day," *New York Times* (October 25, 1929), https://www.nytimes.com/1929/10/25/archives/will-rogers-says-new-york-has-had-a-wailing-day.html

[2]Bennett Lowenthal, "The Jumpers of '29," *Washington Post* (October 25, 1987), https://www.washingtonpost.com/archive/opinions/1987/10/25/the-jumpers-of-29/17defff9-f725-43b7-831b-7924ac0a1363/

a better predictor of suicide rates than the aggregate economic indices, which offer only a retrospective view of the situation. If sudden changes in stock prices signal future financial hardship, careful monitoring of market conditions could help policy makers design and implement proactive strategies to manage potential suicide epidemics.

In what follows, we develop a theoretical model that traces the relation between national suicide rates and stock market movements. We test the model empirically by using a panel data set of 36 countries. More specifically, we verify whether the current and lagged stock index returns affect changes in suicide rates. In doing so, we consider data aggregated within a given country, as well as statistics separated by gender. A wide range of control variables is included to capture the business cycle and corresponding socioeconomic conditions. We find that contemporaneous returns and their previous values drive the changes in suicide rates for the general population. This finding persists when the data are broken down by gender. Among the macroeconomic control variables, changes in unemployment and inflation appear to exert the strongest influence. Increases in female labor market participation and prior health expenditure stave off growth in male suicide rates. Women decrease their proclivity to commit suicide whenever they have a greater tendency to bear children and when the consumption of alcohol in the general population falls.

Our article could best be described as ecological analysis in that it uses aggregated behavioral data. In our judgment, this is the most appropriate lens through which to view the problem, as individual-level analysis is infeasible to apply in this context. Fusing investor holdings data from brokerage houses with information from coroner's inquest reports is impracticable because of data protection regulations. Nevertheless, analysis at the macroeconomic level has its own utility, as it is required to inform policy direction reliably.

II. Literature Review

A long-standing scientific question is whether material riches can affect the level of individual happiness and mental health. Higher income results in greater purchasing power, which allows one to fulfill many desires and affords more personal freedoms. The academic literature focusing on individual-level data has reported modest positive correlations between income and subjective well-being (see, e.g., Mullis 1992; Frey and Stutzer 2000; Blanchflower and Oswald 2004a, 2004b). The relation between income and happiness, however, appears to be nonlinear in that the satisfaction derived from additional cash inflow is lower at higher income levels (Frey and Stutzer 2000). Furthermore, as people tend to compare themselves with others, it may be their relative rather than absolute income that determines how satisfied they are with their lives (Luttmer 2005).

When examining these questions, the direction of causality may not always be clear. Does money buy happiness, or are happy and healthy people more productive? The reverse causality problem is mitigated in situations where sizable exogenous income shocks transpire. Using this logic, Lindahl (2005) examines a sample of Swedish lottery winners and shows that sudden income augmentation leads to improved health status and lower mortality. Gardner and Oswald (2007) and Apouey and Clark (2015) observe the salubrious effects of lottery prizes on the mental well-being of British people. However, the general health level is not improved, as winners engage in more social drinking and smoking (Apouey and Clark 2015). Another paper focusing on windfalls by Kim and Ruhm (2012) finds that bequests create no substantial health effects, despite recipients increasing their expenditures on health care.

Another strand of research has been conducted using aggregated data on subjective well-being. Robust evidence has been found in a cross-section of countries showing that individuals living in wealthier nations tend to be happier on average (Inglegart and Rabier 2000; Diener and Biswas-Diener 2002). Time-series investigations, however, conclude that despite a sharp increase in real gross domestic product (GDP) per capita over time, the average happiness level has remained largely unaltered, an observation popularly referred to as the Easterlin paradox (Easterlin 1974, 1995; Blanchflower and Oswald 2004b). One rationalization for this phenomenon is related to the fact that people undergo a process of adaptation and have continuously growing aspirations (Frey and Stutzer 2002).

Happiness aside, a strand of the health economics literature suggests that mortality and morbidity are related to the business cycle. Ruhm (2000, 2005) argues that the general state of physical health within the population improves during recessions when the opportunity cost of time is lower. This allows individuals to engage more in health-promoting activities, such as exercise and other preventative behaviors. Financial constraints inhibit indulgent and self-destructive tendencies like overeating, as well as excessive alcohol and tobacco use. In recessionary periods, the pressures placed on an individual's health owing to working longer hours are alleviated, resulting in a lower level of exertion. One notable exception to this countercyclicality of health that Ruhm (2000) identifies relates to suicide, which is the only proxy for mental health used in his study.

Mental health is undermined through financial adversity. Ganzini, McFarland, and Cutler (1990) show that adults who suffer a catastrophic financial loss are more susceptible to developing significant bouts of depression. Recent data from the credit crunch period reveal that both a decline in housing wealth and difficulties with mortgage repayments are significant contributors to psychological distress (Gili et al. 2012; Yilmazer, Babiarz, and Liu 2015). Evidence on the role that financial stressors play in the development of mental illness is also obtained in a natural disaster context. Galea et al. (2008) show that individuals who suffered financial losses caused by Hurricane Katrina are more likely to suffer from posttraumatic stress disorder.

One of the most regrettable and irreversible decisions undertaken by those mentally affected by a substantial monetary loss is that of taking their own life. Hamermesh and Soss (1974) present an economic theory that propounds that individuals commit suicide when their discounted lifetime future utility falls below an acceptable threshold. Future utility is a function of several variables, among which permanent income level features prominently. In situations of financial catastrophe, the benefit a person may derive from life circumstances can diminish beyond the point that they can endure. An earlier theory of suicide published by Durkheim (1897/1951) embraces sociological paradigms and refers to the concept of *anomie*, the state of being where there is a disjuncture between a person's life expectations and the reality of their existence. The level of anxiety resulting from a lack of social integration reaches a point where it creates within the individual an urge to take his or her own life. Important in this explanation is the departure from seeing suicide as a consequence of insanity and instead viewing it as a side effect of socioeconomic disquiet. Anomie, argues Durkheim, is a condition that reflects the failure of value-based norms and standards, leading to a sense of purposelessness and lack of integration. In the empirical model that follows, we employ a wide range of controls that capture the social conditions within which suicides occur. A more focused link between economic circumstances and destructive human behavior is offered by Henry and Short (1954) who propose their frustration-aggression theory. This theory postulates the idea that a negative impact on individual personal economic circumstances may induce a person to engage in acts of aggression that are often self-targeted. An improvement in economic conditions, therefore, lessens the degree of frustration felt by individuals and thus the tendency to do themselves harm. This allows Henry and Short to coherently argue for a link between suicide rates and business cycles.

Several scholars have investigated the nexus between macroeconomic fluctuations and suicide (for a literature review, see Oyesanya, Lopez-Morinigo, and Dutta 2015). However, no explicit attempt to model the prevalence of voluntary deaths as a function of stock market returns has been made. Where work has been completed, it is in tracing the relation between mental health and the vagaries of the market. McInerney, Mellor, and Nicholas (2013) link the 2008 stock market collapse with the diagnosis and treatment of depression. Engelberg and Parsons (2016) examine hospital admissions for psychological conditions in California and find that they are inversely related to stock returns. In a similar vein, Cotti, Dunn, and Tefft (2015) show that negative returns trigger risky health behavior, such as excessive use of tobacco and alcohol. What is surprising is that the literature neglects to consider suicide in this context, even though wealth decreases caused by market gyrations have the potential to affect the mental state of investors.

III. Determinants of Suicide Rates

A broad range of socioeconomic factors has been proposed in the literature to account for suicide rates. Variables related to business cycles, labor market status, family structure, demographics, and risky health behaviors have been considered in prior studies. In this section, we review scientific findings regarding these indicators.

Beginning with macroeconomic variables, we first consider income. In the theoretical model of Hamermesh and Soss (1974), high levels of permanent income enhance lifetime utility, discouraging suicidal acts. Conversely, a reading of Durkheim (1897/1951) suggests that failure on the part of society to integrate and regulate individuals is more likely in the presence of economic extremes. This implies a polarized relation between income and suicide rates, with maximums being reached during sharp expansions and contractions (Lester 2001). Many empirical studies examining the link between income or real GDP growth and suicide rates have found negative covariations, which lends credence to the Hamermesh and Soss (1974) model (Kimenyi and Shughart 1986; Brainerd 2001; Mathur and Freeman 2002;

Helliwell 2007; Chen, Choi, and Sawada 2009). However, some researchers report the opposite result (Simpson and Conklin 1989; Lester 1995; Freeman 1998; Jungeilges and Kirchgässner 2002). Consequently, we must conclude that both the theoretical and empirical literatures present divergent views on the effect of income.

Evidence concerning unemployment is more clear-cut, with the vast majority of studies reporting a positive association with suicide mortality (Huang 1996; Lewis and Sloggett 1998; Freeman 1998; Klick and Markowitz 2006; Barr et al. 2012; Phillips and Nugent 2014). First, unemployment reduces permanent income and, therefore, can undermine satisfaction with life. Second, people with mental health problems can be stigmatized in the labor market and experience prolonged spells of unemployment (for a full review, see Stuart 2006). The strain of joblessness can also contribute to the manifestation and progression of mental illness (Paul and Moser 2009). Third, an unemployed person may lose his or her sense of life's purpose and feeling of integration within society, echoing the anomic condition described by Durkheim (1897/1951).

An untenable cost of living may be another factor driving suicide rates. An early discussion of this notion can be found in Morselli (1882, p. 152) with reference to the price of food staples. In an economy where wages are sticky and labor contracts are periodically renegotiated, inflation in the consumer price index lowers the real income and purchasing power of individuals in the short term. The emotional distress that follows as a result, particularly among the less affluent, may lead to extreme responses. The empirical evidence regarding the link between inflation and suicide rates is mixed. Huppes (1976) finds a strong positive association between the two for the Netherlands and the United States, whereas Gavrilova et al. (2000) note that the 1992 Russian market reforms, which relaxed price controls, led to an escalating inflation rate and an increase in self-induced violent deaths.

In contrast, using an international sample, Matsubayashi and Ueda (2011) fail to find a similar statistically significant relation. Economists sometimes aggregate the level of unemployment and inflation into one indicator, which is referred to as the misery index. When considering U.S. data, Yang and Lester (1999) argue that the correlation between suicide rates and the misery index is exceptionally high.

In addition to the macroeconomic indicators, our study controls for recognized social risk factors that contribute to suicidal behavior. Durkheim (1897/1951) espouses the idea that a high degree of social integration, which can be, to some extent, captured by family ties, reduces the instance of suicide. One variable taken to proxy for familial cohesion is the fertility rate. Rodríguez Andrés (2005) uses an international sample to confirm that birth rates are negatively associated with both male and female suicides. However, we must introduce some caveats. Caring for children can exert financial and emotional strain on individuals, which can overpower this beneficial relation in certain circumstances. For instance, Mäkinen (1997) shows that illegitimate births and teenage pregnancies positively correlate with suicidal behavior across both genders. A further consideration is that when the responsibility of childrearing passes to older generations, this can intensify the pressure on grandparents, leading to increased suicidal tendencies among older men (Chen, Choi, and Sawada 2009).

Another measure of familial cohesiveness is the strength of formalized partnerships, the breakdown of which has been shown empirically to precipitate suicidal behavior (see, e.g., Burr, McCall, and Powell-Griner 1994; Minoiu and

Rodríguez Andrés 2008; Mäkinen 1997). Generally speaking, researchers agree that the emotional and financial upheaval attached to marriage dissolution can induce self-destructive behavior. The effect, however, may not be uniform across gender. Some studies show that, compared to females, males are more likely to commit suicide because of divorce (Chen, Choi, and Sawada 2009; Neumayer 2003; Koo and Cox 2008; Matsubayashi and Ueda 2011). Potential explanations for this difference are discussed in Chen et al. (2012) and relate to the fact that courts tend to favor women in decisions over custody and financial support. Also, divorce may have a more liberalizing effect on women, particularly those who are already enjoying a certain level of financial independence. Finally, in abusive relationships, an option to divorce unilaterally can empower the victim and has been shown to reduce the female suicide rate (Stevenson and Wolfers 2006).

The female demographic's engagement as part of the labor force should also be considered a factor relevant to modeling self-inflicted fatalities. Potential role conflicts and erosion of traditional preconceptions of the family structure can heighten the risk of a negative response from those adversely affected. Several studies link high female labor force participation to increased prevalence of suicides (Mäkinen 1997; Stack 1998; Neumayer 2003). However, women's supplementation of family income can ease financial household pressures and offer them opportunities to integrate into society. The ultimate net effect of female labor force participation depends on the relative importance of the drawbacks and benefits. For instance, Burr, McCall, and Powell-Griner (1994) document a reduction in suicides due to more women being at work. Similar results are reported for urbanized areas in Faupel, Kowalski, and Starr (1987). Consequently, the findings regarding female labor activity can be sample specific and depend on the cultural and economic context.

A further determinant of suicide is the rate of alcohol consumption within the general populace. Acutely intoxicated individuals exhibit overly emotive and impulsive behavior, poor decision making, and relaxed inhibitions. Taken individually or together, these behaviors could enhance suicidal urges. Additionally, chronic alcohol abuse is often embedded in the pathology of mental illness and leads to social isolation. A Canadian study by Smart and Mann (1990) reveals that suicide is linked to major proxies for alcohol problem indicators, such as dependency levels and liver cirrhosis. Similar findings are obtained in a sample of Scandinavian countries by Norström (1988) and the United States (Stack and Wasserman 1993). Landberg (2009) examines the impact of aggregate per capita alcohol consumption on suicide-related deaths broken down by gender. Although there is no statistically significant relation for the male subsample, females exhibit higher sensitivity. An increase in per capita consumption of spirits by one liter raises the female suicide rate by 16%. It is conceivable that this is a result of the distress caused by a partner who drinks heavily and the domestic violence that could ensue as a result (Leonard 2001).

Other societal characteristics may play a part in the manifestation of psychiatric morbidity. For example, some studies have noted that population density is a contributing factor to suicidal behavior. Population concentrations can affect the degree of social cohesiveness and access to mental health services. A sense of isolation may occur in highly urbanized environments, just as much as it can in remote locations. On the one hand, greater geographical distances between individuals can undermine the process of social integration and lead to higher suicide rates (Minoiu and Rodríguez Andrés 2008). On the other hand, in rural areas with low population densities, people tend to live in settlements, which increases proximity to others and may create a tightly knit community support structure (Levin and Leyland 2005; Stark et al. 2007). Similar considerations are also apposite to highly populated regions. Emotional distance and a sense of alienation can arise even when people live cheek by jowl (Burr, McCall, and Powell-Griner 1994). Taking into account the ambiguities involved, it may be challenging to make a priori predictions about the direction of the relation between suicide rates and population density.

The question that arises at this stage is to what extent can spending on health-care provision counter suicidality. No clear consensus has emerged from the studies that investigate this issue. In their U.S.-based sample, Minoiu and Rodríguez Andrés (2008) find that increased public health expenditure is associated with a decreased suicide risk for the following year. Their results imply that the effects of treatment may not be felt immediately and are primarily observed for men. Desai, Dausey, and Rosenheck (2005) support this position by tracing a link between the level and quality of mental health care and suicide mortality, and Matsubayashi and Ueda (2011) point to efficacious aspects of national suicide prevention programs. Shah and Bhat (2008) detract from this argument by showing that rates of voluntary deaths among the elderly are not affected by mental health policy and funding.

IV. Theoretical Model

In this section, we present a new theoretical framework of suicide, which extends the models proposed by Hamermesh and Soss (1974) and Koo and Cox (2008). We also derive testable hypotheses based on the model. Our first three hypotheses pertain to inflation, GDP growth, and unemployment—factors that have already received some attention in the literature. The fourth and final hypothesis introduces the concept that has not been investigated by scholars. Specifically, it posits that stock market returns influence suicide rates.

Our model assumes that an individual is motivated to commit suicide when the expected utility is lower than a given threshold utility level. The utility function of an individual at age m is dependent on that individual's permanent income (Y), which could be devoted to consumption (C) and the cost of maintaining a subsistence level of health as follows:[3]

$$U_m = U[C(m, Y) - K(m)], \tag{1}$$

where $C(m, Y)$ represents total consumption at age m that is a function of permanent income Y, and $K(m)$ denotes the cost of maintaining health at the minimum tolerable

[3]Permanent income is expressed in real terms. If we use permanent income in nominal terms, we need to include the impact of inflation. This issue is discussed later.

level. Given this notation, the expected lifetime utility at age α is given by Hamermesh and Soss (1974) and Koo and Cox (2008), and can be expressed as:

$$Z(\alpha, Y) = \int_{\alpha}^{\omega} e^{-r(m-\alpha)} U[C(m, Y) - K(m)]P(m)dm, \tag{2}$$

where $P(m)$ is the probability of survival to age m conditional on surviving to age α, r is the private discount rate, and ω is the highest attainable age. $Z(\alpha, Y)$ is a decreasing function of α and an increasing function of permanent income Y. The individual is assumed to commit suicide if the following condition is satisfied:

$$Z(\alpha, Y) \leq Z^*(\alpha), \tag{3}$$

where $Z^*(\alpha)$ is the threshold utility level.[4] To simplify the discussion, we present a version of the expected lifetime utility (equation (2)) using a discrete instead of continuous time model:

$$Z_d(m, Y) = \sum_{i=m}^{W} e^{-r(i-m)} U[C(i, Y) - K(i)]P(i), \tag{4}$$

where m is the current integer age of the individual, and W is the maximum integer age. As before, the discrete version of expected lifetime utility $Z_d(m, Y)$ is the decreasing function of m and the increasing function of Y. With the discrete version of the expected lifetime utility, an individual at age m is assumed to commit suicide if the following condition is satisfied:

$$Z_d(m, Y) \leq Z^*(m). \tag{5}$$

As mentioned earlier, permanent income is measured in real terms. Also, there is a ceteris paribus negative relation between real permanent income (Y) and the rate of inflation ($\dot{p}$). Therefore, there is an inverse link between the inflation rate and the expected lifetime utility, as follows:

$$\frac{\Delta \bar{z}_d}{\Delta \dot{p}} = \frac{\overset{+}{\Delta Z_d}}{\Delta Y} \frac{\overset{-}{\Delta Y}}{\Delta \dot{p}} . \tag{6}$$

This leads to the following hypothesis:

H1: *There is a positive relation between the suicide and inflation rates.*

[4]The threshold utility level $Z^*(\alpha)$ is assumed to be a function of the current age of individual α. If the threshold utility level is assumed to be independent at the current age, the model implies that an older individual has a higher probability of committing suicide. It is also possible that the threshold is gender dependent, so the suicide rate is different for males versus females.

We assume that the individual has two sources of nominal income: (1) that derived from labor or salary and (2) that coming from financial investment (e.g., stock market). Therefore, the nominal permanent income (Y_n) is assumed to have two parts. The first depends on the income from labor $Y_{n,L}$ and the second depends on income from financial assets $Y_{n,A}$ (i.e., $Y_n = Y_{n,L} + Y_{n,A}$). In modeling nominal permanent labor income, we follow Koo and Cox (2008) and assume that it is an increasing function of human capital h. We further assume that it is an increasing function of the general productivity rate represented by the nominal GDP growth rate g (i.e., $Y_{n,L} = Y_{n,L}(\overset{+}{h}, \overset{+}{g})$.).

Furthermore, as in Koo and Cox (2008), we assume that human capital h remains the same from year to year, so long as the individual is employed, but decreases if that person is without work. Specifically, we model the human capital of an individual at age m as follows:

$$h_m = \begin{cases} h_{m-1} \text{ if employed} \\ \beta h_{m-1} \text{ if unemployed } 0 < \beta < 1. \end{cases}$$

Ceteris paribus, if the individual is employed at age m, human capital stays the same as the previous year. However, if the person is unemployed, this decreases (human capital at age m is β times the human capital at age $m - 1$, with β positive but less than 1). Therefore, our nominal labor income argument leads to the following result:

$$\overset{+}{\frac{\Delta Z_d}{\Delta g}} = \overset{+}{\frac{\Delta Z_d}{\Delta Y}} \overset{+}{\frac{\Delta Y}{\Delta Y_n}} \overset{+}{\frac{\Delta Y_n}{\Delta g}}, \tag{7}$$

and

$$Z_d \mid \text{employed} > Z_d \mid \text{unemployed}. \tag{8}$$

The preceding arguments lead to the following hypotheses:

H2: *There is a negative relation between the suicide rate and the growth rate of GDP.*

H3: *The suicide rate is higher for unemployed individuals than their employed counterparts.*

Next, we model the nominal permanent income from financial asset $Y_{n,A}$. We assume that $Y_{n,A}$ depends on the general rate of return on investments, such as stock market return R.[5] This argument leads to the following result:

[5]This argument is justifiable if we assume that in our model, there is only one financial asset the individual can investment in. Alternatively, even if there are many financial assets the individual can invest in, it is assumed that the future (permanent) returns are better represented by the return on the whole market instead of the return on the individual's portfolio.

$$\overset{+}{\frac{\Delta Z_d}{\Delta R}} = \overset{+}{\frac{\Delta Z_d}{\Delta Y}} \overset{+}{\frac{\Delta Y}{\Delta Y_{n,A}}} \overset{+}{\frac{\Delta Y_{n,A}}{\Delta R}}. \tag{9}$$

Our final hypothesis is:

H4: *There is a negative relation between the suicide rate and the stock market return.*

V. Data

Our primary variable of interest is the suicide rate, which we source from the Organisation for Economic Co-operation and Development (OECD) Health Statistics database. This rate is expressed per 100,000 people, and annual data are available for 41 countries. For 36 of these countries, the MSCI value-weighted country stock market indices are available from Thomson Reuters Datastream.[6] Based on these indices, we compute dollar-denominated continuously compounded returns, which we subsequently use in our analysis. These two key variables define the dimensions of our primary unbalanced panel, which for some of the nations starts as early as 1970 and ends in 2014. We collect data on all of the control variables described in detail in the previous section. Table 1 lists these variables as well as their definitions and data sources.

Table 2 provides basic summary statistics and displays results of panel unit root tests proposed by Im, Pesaran, and Shin (2003) and Maddala and Wu (1999). The problem of potential nonstationarity is of great importance, as the presence of unit roots can render our regression results spurious. It is evident that suicide rates exhibit a stochastic trend and need to be transformed to eliminate this problem. Pierce (1967) notes that residuals from suicide rate models exhibit an exceptionally high degree of autocorrelation, which leads to estimation difficulties. This is a perceptive comment, made before the concept of nonstationarity was introduced into the econometric literature by Dickey and Fuller (1979). Guided by these considerations, we do not focus on the data in levels but instead compute percentage change in the suicide rate. This indicator acts as a dependent variable in the econometric specifications that follow. Other explanatory variables are also expressed as a percentage rate of change to remove unit roots and make our analysis logically consistent. GDP growth and inflation do not need to be transformed, as they are already expressed as a rate of change.

The averages reported in Table 2 shed light on the socioeconomic trends transpiring across societies. First, the incidence of suicide within the general population is around 15 per 100,000 people annually and this rate has increased over time. Although men are 3.2 times more likely to complete a suicidal act than women, this statistic has to be interpreted with caution, as Mościcki (1994) notes that the majority of suicide attempters are female. The observed average stock market return of 6.3%

[6]The 36 countries in our study are: Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Israel, Italy, Japan, Lithuania, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Republic of Korea, Russia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, and United States.

TABLE 1. Definitions of Variables and Their Data Sources.

Variable	Definition	Data Source
Suicide_Overall	Total suicide rate per 100,000 persons	Organisation for Economic Co-operation and Development (OECD) Health Statistics
Suicide_Male	Suicide rate per 100,000 men	OECD Health Statistics
Suicide_Female	Suicide rate per 100,000 women	OECD Health Statistics
pcSuicide_Overall	Percentage change in *Suicide_Overall*	OECD Health Statistics
pcSuicide_Male	Percentage change in *Suicide_Male*	OECD Health Statistics
pcSuicide_Female	Percentage change in *Suicide_Female*	OECD Health Statistics
Returns	U.S. dollar-denominated, continuously compounded return on country-level capitalization-weighted MSCI stock market index	Thomson Reuters Datastream
GDP_Growth	Annual growth in the gross domestic product (GDP)	World Development Indicators
pcUnemployment	Percentage change in the unemployment rate (national estimate)	World Development Indicators
Inflation	Inflation in consumer prices	World Development Indicators
pcFertility	Percentage change in the fertility rate (defined as births per female)	World Development Indicators
pcFemPart	Percentage change in female labor force participation rate for females above the age of 15 (international labour organization estimate)	World Development Indicators
pcAlcohol	Percentage change in pure alcohol consumption per person age 15 years and over	OECD Health Statistics
pcDensity	Percentage change in population density (people per square kilometer of land area)	World Development Indicators
pcDivorces	Percentage change in crude divorce rates	OECD Family Database, Eurostat
pcHealth	Percentage change in health expenditure to GDP ratio	World Development Indicators

materializes in an environment characterized by growing GDP and consumer prices. The relatively high mean and standard deviation of inflation is a result of hyperinflationary periods in Mexico, Poland, Brazil, Chile, Israel, Russia, Turkey, and Lithuania. Increasing female labor force participation coincides with declining fertility rates and more frequent marriage dissolutions. Both the unemployment rate and alcohol consumption trend upward during our sample period. Finally, the population density increases and the cost of supporting healthcare relative to GDP escalates over time.

Table 3 reports estimates of correlation coefficients between the percentage changes in suicide rates and our explanatory variables. We also consider *Returns* and *pcHealth* at a lag, because the impact of health-care spending on suicides may not be immediate (Minoiu and Rodríguez Andrés 2008) and because stock market returns tend to reflect anticipated future economic circumstances (Stock and Watson 1989; Estrella and Mishkin 1998). Most striking, Table 3 highlights a strong negative association between stock market fluctuations and changes in voluntary death incidence. The caveat to interpreting this preliminary finding is that a simple correlation analysis does not control for other important factors that are likely

TABLE 2. Summary Statistics.

				Panel Unit Root Tests	
Variable	Obs.	Average	Std. Dev.	IPS Test	MW Test
Suicide_Overall	1,627	15.0701	9.3924	1.5633	68.5279
Suicide_Male	1,627	24.0269	15.8163	0.8848	71.3459
Suicide_Female	1,627	7.4970	4.9841	0.3154	80.3992
pcSuicide_Overall	1,574	0.0033	0.1258	−37.1509***	945.1013***
pcSuicide_Male	1,574	0.0046	0.1302	−38.6336***	985.4478***
pcSuicide_Female	1,574	0.0062	0.1820	−39.9707***	10,32.2587***
Returns	1,149	0.0630	0.3376	−28.2801***	774.0019***
GDP_Growth	1,660	0.0337	0.0336	−19.9533***	521.9543***
pcUnemployment	1,312	0.1141	1.8529	−102.6341***	13,60.4409***
Inflation	1,701	0.1795	1.1743	−16.2874***	495.5152***
pcFertility	1,944	−0.0108	0.0335	−13.9637***	371.6729***
pcFemPart	864	0.0053	0.0214	−19.2169***	535.5727***
pcAlcohol	1,797	0.0053	0.0639	−32.5910***	936.1828***
pcDensity	1,869	0.0080	0.0080	−5.3122***	171.9607***
pcDivorces	1,363	0.0246	0.1208	−30.0115***	821.1738***
pcHealth	684	0.0142	0.0493	−16.2029***	326.5228***

Note: This table presents basic summary statistics for the variables used in the study. Variables are defined in Table 1. IPS test stands for the panel unit root test proposed by Im, Pesaran, and Shin (2003), and MW test is based on a methodological approach outlined in Maddala and Wu (1999).
***Rejection of the null hypothesis of unit root at the 1% significance level.

to affect suicide rates. The estimates also support the theory propounded by Hamermesh and Soss (1974), as some of our evidence demonstrates that suicide rates decline in times of rising income and falling unemployment. *pcFertility* and *pcDivorces*, which proxy for family cohesiveness, or lack thereof, appear to significantly affect suicidality within the population.

TABLE 3. Pearson Correlation Coefficients.

Variable	*pcSuicide_Overall*	*pcSuicide_Male*	*pcSuicide_Female*
Returns	−0.0802***	−0.0737**	−0.0440
Returns_Lagged	−0.1041***	−0.0852***	−0.0745**
GDP_Growth	−0.0504*	−0.0578**	−0.0166
pcUnemployment	0.0760***	0.0699**	0.0305
Inflation	0.0307	0.0400	0.0078
pcFertility	−0.0869***	−0.0746***	−0.0760***
pcFemPart	−0.0140	−0.0401	0.0191
pcAlcohol	0.0350	0.0259	0.0292
pcDensity	0.0655**	0.0610**	0.0758***
pcDivorces	0.0800***	0.0879***	0.0349
pcHealth	0.0746*	0.0643	0.0449
pcHealth_Lagged	-0.0162	−0.0158	−0.0060

Note: This table reports correlation coefficients between the variables with the corresponding significance level. Variables are defined in Table 1. *Returns_Lagged* and *pcHealth_Lagged* represent the original variables lagged by one period.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

Additionally, the correlation analysis suggests that rising population density contributes to suicidal tendencies for both genders.

VI. Empirical Results

Because our data have an unbalanced panel structure, we use panel data methods in our modeling. The simplest estimation approach available in this setting is pooled ordinary least squares, which assumes that countries' unique attributes are not present and that the regression parameters are identical for all cross-sectional units. One could explicitly incorporate the heterogeneity between different nations by considering either a random- or fixed-effects panel model. In our modeling, however, the Hausman (1978) test indicates that residuals from a random-effects model are correlated with the regressors in many of the specifications, implying that this method does not produce consistent estimators of the true population parameters. Consequently, we use fixed-effects panel techniques, which deliver in terms of consistency and allow the regression intercept to vary over cross-sectional units. Formally, the baseline regression equation can be written as:

$$pcSuicide\_Overall_{i,t} = \alpha_i + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \sum_{j=1}^{k} \beta_{2+j} Control_{i,t}^{j} + \varepsilon_{i,t}, \tag{10}$$

where α_i is a country-specific intercept, βs denote regression slopes, *Returns* and *Returns_Lagged* are the main explanatory variables of interest, and $Control^j$ stands for the jth control variable in the model. These controls are selected from a set of {*GDP_Growth, pcUnemployment, Inflation, pcFertility, pcFemPart, pcAlcohol, pcDensity, pcDivorces, pcHealth*}. The number of controls included (k) varies from one specification to another. The term $\varepsilon_{i,t}$ stands for regression residual and the subscripts i and t represent the country and year, respectively. Although the master equation (10) models suicidal tendencies in the overall population, when we consider modeling female and male populations separately, we replace *pcSuicide_Overall* with either *pcSuicide_Female* or *pcSuicide_Male.*

Several considerations emerge when selecting the appropriate estimation method for the fixed-effects panels. First, the quality of suicide data may not be uniform across nations. Where there is societal stigmatization for suicide for cultural or religious reasons, the coroner may be persuaded to misreport the cause of death, a phenomenon first reported by Morselli (1882). These country-specific measurement errors could become reflected in residuals and lead to cross-sectional heteroskedasticity. To counter this problem, we estimate our fixed-effects panel specifications using a feasible generalized least squares approach. This method permits us to assign lower cross-sectional weights to countries with high residual variances, which may, to some extent, reflect the inaccuracies inherent in the data. The second potential hindrance is the serial correlation of residuals, which can lead to an incorrect estimation of parameter standard errors and test statistics. To address this issue, we use the Arellano (1987) estimation technique, which leads to correct inferences even in instances when errors for a cross-section are heteroskedastic and autocorrelated.

TABLE 4. Determinants of the Percentage Changes in the Overall Suicide Rate.

		Fixed-Effects Panel		
Variable	Pooled OLS (1)	(2)	(3)	(4)
Intercept	0.0035			
	(0.0026)			
Returns	–0.0230***	–0.0158***	–0.0215***	–0.0157**
	(0.0078)	(0.0055)	(0.0066)	(0.0064)
Returns_Lagged	–0.0280***	–0.0227***	–0.0191*	–0.0285***
	(0.0076)	(0.0061)	(0.0113)	(0.0065)
GDP_Growth			–0.2936**	
			(0.1307)	
pcUnemployment			0.0366*	0.0441***
			(0.0212)	(0.0143)
Inflation			0.2644*	0.1822***
			(0.1552)	(0.0179)
pcFertility			0.0536	
			(0.1004)	
pcFemPart			–0.4619**	–0.5020***
			(0.1964)	(0.1405)
pcAlcohol			–0.0439	
			(0.0633)	
pcDensity			–0.0082	
			(0.5579)	
pcDivorces			0.0006	
			(0.0305)	
pcHealth			0.0414	
			(0.0649)	
pcHealth_Lagged			–0.0918	–0.1325***
			(0.0697)	(0.0468)
Obs.	1,067	1,067	470	571
R^2	1.8951%	8.1774%	25.8740%	25.0106%
F-statistic	10.2767	2.4767	3.3716	4.3032
Prob (*F*-stat.)	0.0000	0.0000	0.0000	0.0000

Note: The dependent variable in the regressions reported in this table is the percentage change in the total suicide rate. Column 1 applies a pooled ordinary least squares (OLS) estimation approach, and columns 2–4 employ fixed-effects panels with cross-sectional weighting and White (1980) period standard errors. The panel regressions can be expressed as:

$$pcSuicide\_Overall_{i,t} = \alpha_i + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \sum_{j=1}^{k} \beta_{2+j} Control\_Variable_{i,t}^{j} + \varepsilon_{i,t}.$$

Variables are defined in Table 1.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

TABLE 5. Determinants of the Percentage Changes in the Male Suicide Rate.

Variable	Pooled OLS (1)	Fixed-Effects Panel (2)	(3)	(4)
Intercept	0.0053*			
	(0.0030)			
Returns	−0.0245***	−0.0154***	−0.0209***	−0.0132*
	(0.0091)	(0.0057)	(0.0076)	(0.0070)
Returns_Lagged	−0.0270***	−0.0207***	−0.0246**	−0.0264***
	(0.0088)	(0.0065)	(0.0122)	(0.0067)
GDP_Growth			−0.1509	
			(0.1482)	
pcUnemployment			0.0615**	0.0550***
			(0.0238)	(0.0163)
Inflation			0.3049*	0.2067***
			(0.1637)	(0.0184)
pcFertility			0.0939	
			(0.1212)	
pcFemPart			−0.5571***	−0.6391***
			(0.2138)	(0.1454)
pcAlcohol			−0.0103	
			(0.0714)	
pcDensity			−0.3432	
			(0.5860)	
pcDivorces			0.0225	
			(0.0330)	
pcHealth			−0.0040	
			(0.0594)	
pcHealth_Lagged			−0.0912	−0.1408***
			(0.0649)	(0.0472)
Obs.	1,067	1,067	470	571
R^2	1.4008%	6.9005%	24.3537%	17.3951%
F-statistic	7.5583	2.0613	3.1097	3.9276
Prob (*F*-stat.)	0.0006	0.0002	0.0000	0.0000

Note: The dependent variable in the regressions reported in this table is the percentage change in the male suicide rate. Column 1 applies a pooled ordinary least squares (OLS) estimation approach, and columns 2–4 employ fixed-effects panels with cross-sectional weighting and White (1980) period standard errors. The panel regressions can be expressed as:

$$pcSuicide\_Male_{i,t} = \alpha_i + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \sum_{j=1}^{k} \beta_{2+j} Control\_Variable_{i,t}^{j} + \varepsilon_{i,t}.$$

Variables are defined in Table 1.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

Table 4 presents regressions linking the percentage change in total suicide rates to a range of explanatory variables, and Tables 5 and 6 show analogous estimations broken down by gender. The first two models reported in the tables differ in their econometric approach, but essentially represent the simplest specification where all controls are omitted. In contrast, the fixed-effects model in column 3 includes a full set

TABLE 6. Determinants of the Percentage Changes in the Female Suicide Rate.

		Fixed Effects Panel		
Variable	Pooled OLS (1)	(2)	(3)	(4)
Intercept	0.0032			
	(0.0039)			
Returns	–0.0205*	–0.0137*	–0.0248**	–0.0152**
	(0.0118)	(0.0071)	(0.0103)	(0.0069)
Returns_Lagged	–0.0299***	–0.0225***	0.0010	–0.0215***
	(0.0115)	(0.0066)	(0.0128)	(0.0068)
GDP_Growth			–0.6026**	
			(0.2387)	
pcUnemployment			–0.0335	
			(0.0358)	
Inflation			0.1363	0.0008***
			(0.1638)	(0.0003)
pcFertility			–0.1265	–0.2106***
			(0.1101)	(0.0641)
pcFemPart			–0.1009	
			(0.3424)	
pcAlcohol			0.1533	0.1543**
			(0.0971)	(0.0612)
pcDensity			0.2017	
			(1.0496)	
pcDivorces			–0.0193	
			(0.0635)	
pcHealth			0.0652	
			(0.1003)	
pcHealth_Lagged			0.0019	
			(0.1237)	
Obs.	1,067	1,067	470	1,045
R^2	0.8363%	5.4599%	15.4210%	6.7782%
F-statistic	4.4868	1.6061	1.7611	1.8250
Prob (*F*-stat.)	0.0115	0.0129	0.0027	0.0015

Note: The dependent variable being modeled in this table is the percentage change in the female suicide rate. Column 1 applies a pooled ordinary least squares (OLS) estimation approach, and columns 2–4 employ fixed-effects panels with cross-sectional weighting and White (1980) period standard errors. The panel regressions can be expressed as:

$$pcSuicide\_Female_{i,t} = \alpha_i + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \sum_{j=1}^{k} \beta_{2+j} Control\_Variable_{i,t}^{j} + \varepsilon_{i,t},$$

where the number of controls k varies across specifications. Variables are defined in Table 1.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

of independent variables, many of which are statistically insignificant. Our parsimonious and preferred specification reported in the last column excludes all insignificant factors. The exclusion procedure is iterative in that we start with specification (3), drop the control variable with the highest *p*-value, and reestimate the model. Subsequent controls are similarly removed one by one until all of the remaining explanatory factors exhibit statistical significance. This approach is consistent with the general to specific modeling discussed in Campos, Ericsson, and Hendry (2005).

In line with our expectations, there is an inverse relation between stock market fluctuations and suicidal tendencies within society, which confirms H4. This relation is robust for both genders, as is evidenced by the statistical significance of *Returns* across the different model specifications. Interestingly, lagged stock market movements can also be considered an influential determinant. Two rationalizations can be offered to explain this delayed reaction. First, one may argue that the ultimate decision to take one's life happens after a prolonged period of emotional anguish instigated by material loss. Second, returns may predict future economic circumstances and hardship. Because stock market investors are forward looking, expectations about the future drive present returns. In our sample, we find that current returns appear to reliably predict next year's GDP growth (correlation coefficient = 0.4497, p-value = .0000). This leading indicator characteristic of stock price fluctuation could underpin the observed dynamic relation with suicide. Returns remain significant, even after controlling for economic conditions. They seem to reflect the underlying macroeconomic fundamentals and act as a useful barometer of public sentiment (Baker and Wurgler 2007). This sentiment is reflected in the suicide statistics.

Although the statistical significance of returns is difficult to refute, questions arise about the economic significance of our results. We can draw a useful illustration from the 2008 stock market crash. To estimate the number of lives lost due to crash-related suicidal acts in our sample countries, we perform a simulation based on the parsimonious model for the change in the overall suicide rate (model 4 in Table 4). To complete this exercise, we collect additional data on population size from the World Development Indicators database. According to our calculations, the 2008 stock market crash resulted in an additional 6,566 suicides across our 36 sample nations during 2008–2009.[7] This estimate is more than twice as large as the total number of people killed in the 9/11 terrorist attacks (Riedman and Warden 2017). Despite its importance, the problem described here has received little attention from the media and academic community.

The simulation related to the 2008 crisis provides important insights and prompts a deeper reflection on the marginal effect of market returns. The mean percentage change in the overall suicide rate reported in Table 2 is 0.0033 (or 0.33%). According to model 3, a 10% index return lowers the dependent variable by 0.157% in the same year, which is equivalent to a (0.157%/0.33%) = 47.58% reduction in the average suicide growth rate.

[7]We consider a two-year assessment window because of the dynamic nature of the returns–suicide nexus. Because the regression models the percentage change in the suicide rate, we convert the change as first difference and express it as follows:

Increase in suicide rate over a two-year period = (regression coefficient on *Returns* + regression coefficient on *Lagged Returns*) × (Average *Suicide_Overall* for 2008) × (Average *Returns* in 2008).

Given that the suicide rate is expressed per 100,000 people, the number of people who have taken their life as a result of the 2008 stock market crash can be computed as follows:

No. of suicides = (Increase in suicide rate over a two-year period) × (Total population in the sample countries in 2008)/100,000.

Because there is also a delayed effect, a (0.285%/0.33%) = 86.36% reduction is observed in the following year. An interesting question that arises here is how many lives does this translate to. If we assume that population before and after the stock price movement is the same and that all nations are affected by stock market fluctuations, the reduction in the lives lost over a two-year period can be calculated as follows:

$$\begin{aligned} \textit{Change in lives lost} &= (\beta_1 + \beta_2) \times \textit{Return} \times \textit{Initial suicide rate} \\ &\quad \times \textit{Total population} = (\beta_1 + \beta_2) \times \textit{Return} \\ &\quad \times \textit{Initial number of suicides}, \end{aligned} \tag{11}$$

where β_1 and β_2 are regression coefficients on *Returns* and *Returns_Lagged*, *Return* is the percentage change is the stock market index, *Initial suicide rate* is calculated as a ratio of voluntary deaths to the total population, and *Initial number of suicides* is the number of suicides globally before the stock market movement. As mentioned in the Introduction, the total number of suicides worldwide was 788,000 in 2015. Consequently,

$$\begin{aligned} \textit{Change in lives lost} &= (-0.0157 - 0.0285) \times \textit{Return} \times 788,000 = -34,829.6 \\ &\quad \times \textit{Return}. \end{aligned} \tag{12}$$

Continuing with our example where *Return* = 10%, this translates to about 3,483 lives saved. Bear in mind that this estimate is global and extends beyond our sample countries.

Further insights into suicidal behavior can be gleaned from the regression estimates for the control variables. In line with H1, inflationary pressures seem to exert a significant influence on the changing rate of suicide, regardless of whether we focus on men or women. In this respect, our findings contribute clarity to the conflicting opinions in the literature (Huppes 1976; Matsubayashi and Ueda 2011). With regard to income, GDP growth seems to lessen suicidal proclivity in the whole sample when a model with a full set of controls is considered. However, the statistical significance of this factor does not survive in the more parsimonious specification. Statistically speaking, the link is stronger for females than for males. Consequently, although there is limited evidence to support H2, specific conclusions may be determined by choice of modeling framework. For the overall sample, percentage changes in suicide rates are linked positively with rising unemployment, confirming H3. However, disaggregation according to gender reveals that men more easily succumb to suicidal urges in an economy that increasingly fails to use its workforce fully. Perhaps men feel the psychological impact more acutely as a result of the traditional cultural norms of gender roles within society.

Macroeconomic considerations aside, the evolving nature of familial structures are of consequence to our dependent variable. In line with anomic theory, where a sense of purposelessness is part of the driving impetus behind suicides, women who decide to have children tend to extract a sense of purpose from this responsibility. A similar effect is not discernible among men, as *pcFertility* is insignificant in the regressions reported in Table 5. The percentage change in female participation in the workforce has a significant bearing on male suicide, as the burden of subsistence provision no longer rests solely with men. Increased representation of women in the workforce, however, appears to be inconsequential for determining their suicidality.

When we analyze health expenditures, our results mirror those obtained by Minoiu and Rodríguez Andrés (2008). Health-care spending is efficacious in reducing suicide among men at a lag but is ineffective in altering the outcome for females. What is beneficial for women is the implementation of successful alcohol prevention programs. In taking this measure, elements targeting the externalities of alcohol consumption among the populace should feature. Our results indicate that females are adversely affected by higher alcohol use, possibly through being the victims of domestic violence (Leonard 2001), which could lead them to take their own lives. The findings for men are insignificant, and this is perhaps due to their use of alcohol as a coping mechanism (Pearlin and Radabaugh 1976).

VII. Further Results and Robustness Checks

The literature presents evidence that public sentiment is capable of driving stock market returns (see, e.g., Saunders 1993; Kamstra, Kramer, and Levi 2003). If sentiment also influences suicide rates, any claims about causality running from returns to suicides are erroneous. Instead, the causality exhibits a more complicated pattern that has not been considered here. To examine this issue analytically, we download consumer confidence indicators from the OECD Data website. Then, we create a new variable representing percentage change in consumer confidence (*pcCon_Conf*) and insert it as a regressor in our baseline fixed-effects panel data models. Columns 1–3 in Table 7 report the estimates. Current and lagged returns maintain their explanatory power, but *pcCon_Conf* is insignificant in all specifications. Consequently, the claim that our results are spurious because the general populace's mood drives both returns and suicide rates is not substantiated by the results. The consumer confidence indicator has not been considered in the theoretical and empirical literature on suicide, and therefore we omit it from our baseline specifications.

We add country-specific trends to our regressions. The suicide rate is nonstationary, which prompts us to model the percentage change data instead. Although the percentage change transformation attenuates much of the trend-like behavior, the question regarding the existence of deterministic trends remains a purely empirical issue. Models 4–6 in Table 7 present our baseline fixed-effects specifications including country-specific trends. The most immediate observation is that both contemporaneous and lagged stock index returns retain their statistical significance, and the main conclusions of our paper are unaffected. The evidence as to whether these time trends are needed is mixed. They appear to have some explanatory power in the specification with no controls and the parsimonious model. However, in the model with all controls, the F-test cannot reject the null hypothesis of the joint insignificance of the trends (p-value = .6958).

The next question is whether positive and negative returns exert an asymmetric impact on the suicide growth rate. Our theoretical model indicates that this does not have to be the case. Although a fall in the stock market may encourage suicidality

TABLE 7. Models Incorporating Percentage Change in Consumer Confidence and Country-Specific Time Trends.

Variable	No Controls (1)	All Controls (2)	Parsimonious (3)	No Controls (4)	All Controls (5)	Parsimonious (6)
Returns	−0.0140**	−0.0177**	−0.0207***	−0.0178***	−0.0181***	−0.0139**
	(0.0066)	(0.0086)	(0.0060)	(0.0054)	(0.0069)	(0.0059)
Returns_Lagged	−0.0312***	−0.0220*	−0.0302***	−0.0250***	−0.0191*	−0.0301***
	(0.0072)	(0.0125)	(0.0080)	(0.0059)	(0.0111)	(0.0058)
pcCon_Conf	−0.1973	−0.2489	−0.1244			
	(0.1430)	(0.2560)	(0.2072)			
GDP_Growth		−0.2960**			−0.2462	
		(0.1425)			(0.1902)	
pcUnemployment		0.0174	0.0329**		0.0253	0.0300**
		(0.0224)	(0.0147)		(0.0211)	(0.0135)
Inflation		0.2758	0.2208***		0.3656	0.1449***
		(0.1927)	(0.0238)		(0.2436)	(0.0256)
pcFertility		0.0019			0.1395	
		(0.1103)			(0.1005)	
pcFemPart		−0.5220*	−0.5825***		−0.3919*	−0.3782**
		(0.2670)	(0.2009)		(0.2304)	(0.1724)
pcAlcohol		0.0018			0.0343	
		(0.0693)			(0.0657)	
pcDensity		−0.1775			−0.2164	
		(0.5812)			(0.5557)	
pcDivorces		0.0000			0.0007	
		(0.0349)			(0.0351)	
pcHealth		0.0387			0.0896	
		(0.0701)			(0.0693)	
pcHealth_Lagged		−0.0428	−0.0734		−0.0609	−0.3782**
		(0.0758)	(0.0575)		(0.0739)	(0.1724)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	No	No	Yes	Yes	Yes	Yes
Obs.	830	421	508	1,067	470	571
R^2	10.2054%	26.6384%	24.2119%	13.6194%	30.5136%	32.5201%
F-statistic	2.5033	3.1836	3.7298	2.1447	2.2356	3.0856
Prob (*F*-stat.)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: The fixed-effects panels reported in this table model the percentage change in the overall suicide rate. Models 1–3 can be written generally as:

$$pcSuicide\_Overall_{i,t} = \alpha_i + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \beta_3 pcCons\_Conf_{i,t} + \sum_{j=1}^{k} \beta_{3+j} Control\_Variable_{i,t}^{j} + \varepsilon_{i,t}.$$

pcCons_Conf is the percentage change in consumer confidence, and all other variables are defined in Table 1. The selection of control variables closely mirrors that presented in Table 4. Models 4–6 include country-specific time trends and can be expressed generally as:

$$pcSuicide\_Overall_{i,t} = \alpha_i + \gamma_i Time\_Trend_t + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \sum_{j=1}^{k} \beta_{2+j} Control\_Variable_{i,t}^{j} + \varepsilon_{i,t}.$$

The number of controls k varies depending on specification.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

through income destruction, capital gains can dissuade people from taking their own life. Stock market profits may increase the expected discounted lifetime utility of some individuals above the minimum acceptable level, changing their perception of whether their life is worth living. Even though we do not have a priori expectations concerning the existence of asymmetry, we test for it by creating dummies for positive and negative market movements and interacting them with contemporaneous and lagged returns in our fixed-effects panel regressions. Symmetry implies that the sum of coefficients on *Returns* and *Returns_Lagged* is equal for both positive and negative stock index changes. Although the F-test rejects the null hypothesis of symmetry in a model with no control variables, it fails to do so in a parsimonious specification and one with all explanatory variables. Consequently, we conclude that the evidence in favor of asymmetric impact is weak.

Using a similar conceptual approach, we test whether extreme market drops, meaning those exceeding 20%, exert a more than proportional impact on the percentage change in the suicide rate. Evidence for this proposition is weak in our data. The null hypothesis of proportionality is rejected in the model with no controls, but not in the parsimonious specification and the one with a full set of regressors. Finally, we examine whether the sensitivity of *pcSuicides_Overall* is higher for extreme returns that take values outside the (–20%, 20%) interval. We find no empirical support and conclude that extreme market movements cause extreme but proportional shifts in the overall suicide growth rate.[8]

In the last stage of our analysis, we consider how our results vary across different subsamples. First, we split our sample according to whether the data fall into the previous or current millennium. This division leads to roughly equal subsamples (582 and 485 country-years, respectively). Because including control variables in the estimation markedly reduces the total number of observations available, our subsample estimation considers only models with no controls, which maximizes the degrees of freedom. Results for the two time frames are presented in columns 1 and 2 of Table 8. Returns are highly statistically significant in both subperiods. However, the absolute value of the coefficients is larger in the current millennium, indicating more considerable economic significance. Similarly, the fit is much closer, with the R^2 more than doubling. The stock market movements became a more critical factor in individuals' decisions to end their own life. Perhaps this may be related to the fact that the second period includes the 2008 crisis, arguably the most significant financial meltdown since the Great Depression.

The next two sample splits are designed to examine whether there is any heterogeneity in results between countries depending on their relative wealth and size of the stock market. We collect data on GDP per capita in current U.S. dollars and the ratio of stock market capitalization to GDP from the World Development Indicators. The time-series averages of these indicators are computed for each of the 36 countries included in our sample. Nations are subsequently ranked based on these averages and

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[8]Although, for the sake of brevity, we do not report the detailed results of these tests here, they can be obtained from the authors upon request.

TABLE 8. Fixed-Effects Panel Results in Different Subsamples.

Variable	Data up to 1999 (1)	Data from 2000 (2)	Richer Countries (3)	Poorer Countries (4)	Countries with Large Stock Market (5)	Countries with Small Stock Market (6)
Returns	–0.0131***	–0.0231***	–0.0210***	–0.0079	–0.0186***	–0.0146*
	(0.0047)	(0.0045)	(0.0070)	(0.0068)	(0.0069)	(0.0079)
Returns_Lagged	–0.0086***	–0.0316***	–0.0212***	–0.0229**	–0.0164	–0.0276***
	(0.0020)	(0.0069)	(0.0076)	(0.0092)	(0.0100)	(0.0069)
Obs.	582	485	694	373	617	450
R^2	9.4343%	20.4396%	5.5243%	13.1130%	4.6691%	11.2839%
F-statistic	1.7299	3.1037	2.0742	2.8039	1.5389	2.8785
Prob (F-stat.)	0.0078	0.0000	0.0047	0.0001	0.0668	0.0001

Note: The fixed-effects panel models in this table are estimated in various subsamples. To maximize the subsample sizes, control variables are eliminated and the equations are of the following form:

$$pcSuicide\_Overall_{i,t} = \alpha_i + \beta_1 Returns_{i,t} + \beta_2 Returns\_Lagged_{i,t} + \varepsilon_{i,t}.$$

Variables are defined in Table 1. The estimation procedure uses cross-sectional weighting and White (1980) period standard errors. Columns 1 and 2 present results for two subsamples: (1) from the beginning of the sample to 1999 and (2) from 2000 to the end of the sample. The countries are consequently ranked by average gross domestic product (GDP) per capita denominated in current U.S. dollars and split into two groups depending on their positioning vis-à-vis the median. Columns 3 and 4 provide estimates for these two groups, labeled "richer countries" and "poorer countries." Finally, the nations are sorted by the ratio of their average stock market capitalization to GDP and are split into two subsamples of 18 countries each. The findings for these two subsamples are presented in columns 5 and 6.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

divided into "poorer" and "richer" groups as well as into large and small stock market groups. Because the median is the separation point for each sorting, both groups include 18 countries. Estimation results for the basic fixed-effects models with no controls in each subsample are given in columns 3–6 of Table 8. One noteworthy phenomenon unveiled by these estimates is that for the poorer nations and those with a smaller stock market, the suicide growth rate tends to react to stock price changes with a delay. Because wealth fluctuations resultant from movements of small markets domiciled in poorer countries are nominally less overwhelming, their immediate influence on suicide behavior is expected to be relatively modest. The stronger delayed impact probably arises from to the fact that stock prices predict future macroeconomic conditions, which affect the well-being of the entire population.

VIII. Practical Implications

A deeper reflection on the ramifications of this empirical investigation is warranted. According to our findings, financial advisors and portfolio managers may need to bear in mind that to act fully in the clients' best interests may require additional consideration of their emotional and psychological well-being. A practical difficulty arising here is that finance professionals are not licensed to practice medicine and are therefore unable to make pronouncements on a person's state of mental health. They are not in a position to diagnose psychological conditions or give salutary advice. Medical records of their clients are inaccessible to them. Although it would be prudent to recommend a low-risk portfolio underweighted in stocks to psychologically vulnerable individuals, identifying these individuals poses serious challenges. However, it is indisputable that investment advisors and stockbrokers have information that could be valuable in the context of suicide prevention. They are aware of losses made by their clients and may be able to observe the strong emotional reactions that result. Because of the regulations that govern data protection, such details are unavailable to medical practitioners. Patients may volunteer information about their recent investment failures to doctors, but there is no compulsion. These barriers to information flow are particularly worrying, as unlike other factors underlying suicidal tendencies, financial losses suffered in the stock market may be relatively difficult for mental health experts to observe.

In our opinion, steps should be taken to bridge the informational divide. A pragmatic way to do this would be for financial institutions to keep a trained psychiatrist on their payroll. Distressed clients could be offered a consultation to evaluate their level of suicide risk. From the financial institutions' perspective, such an approach, which is redolent of a corporate social responsibility exercise, could enhance their image and may reduce potential legal exposure. An alternative solution could be to establish a suicide helpline offering first-line counseling to those who suffer catastrophic financial losses. Financial institutions could refer their emotionally distraught clients to such a service and potentially cover some of its operating costs.

Awareness of the issues described in this article should be raised with finance and medical experts alike. A fuller recognition of the threat to life that failed stock market investment presents should be taken into consideration when formulating strategies to reduce suicides. Mental health professionals should be aware of financial market performance and pay particular attention whenever a significant drop in stock market performance is observed. Furthermore, associations of investment professionals could collaborate with mental health specialists to come up with clear guidance on how to identify and refer vulnerable individuals for care. While doing so, each profession should be cognizant of their respective boundaries and data protection issues.

Psychiatrists confronting the issue of suicide need to be aware that it is not only investors who are affected by adverse market fluctuations. Even individuals who do not have a stock brokerage account and who do not continuously monitor the size of their pension pot can undergo a period of considerable psychological distress. Valuation of stocks includes an element of anticipation. Therefore, a stock market dip tends to herald a time of economic contraction that brings about financial pressures. The hardship that individuals experience may take many forms, ranging from disruptions in work continuity, to crumbling career prospects, to diminished earning potential. All of these factors could drive voluntary deaths.

This predictive mechanism remains important, particularly in poorer countries with underdeveloped stock markets where suicide statistics exhibit a strong delayed response to financial turmoil. In a context where the markets offer some foresight, preventative measures can be put in place with a reasonable expectation of success. For instance, government spending on mental health could be, to some extent, conditioned upon stock market performance. Additional resources could be made available following market crashes to help affected individuals cope with the associated financial distress. Because stock returns are the antecedent of economic change, such spending would be countercyclical and act as an automatic fiscal stabilizer. If taken together, these proposals could contribute toward creating a safer investment environment.

IX. Conclusions

In this article we identify a new important determinant of suicide, namely, stock market returns. This factor has not received any attention from the academic community. To clarify the underlying mechanisms, we advance a theoretical understanding of this phenomenon by extending the existing economic models of suicide. Our framework predicts that suicide rates will increase in times of asset price decline and correlate with other macroeconomic indicators. We then verify this theoretical understanding empirically.

According to our results, movements in stock markets have a clear and recognizable effect on percentage change in suicide rates across 36 countries, both contemporaneously and at a lag. The fact that the relation is dynamic suggests a causality in the Granger (1969) sense. The result is robust to different econometric specifications and consistent across both genders. Although traditional finance theories articulate the financial uncertainties associated with stock investing, they overlook the risk inherent at the human level. This article widens the analytical lens in this respect and points out that financial markets have a greater resonance within society than initially envisaged by the theories.

As we establish a relation at the aggregate level and understand that an element of predictability exists, researchers should move toward completing the picture by mapping the interactions between investment professionals, medical practitioners, and at-risk individuals. An expanded understanding in this regard would allow us to formulate effective approaches that could better deal with extreme financial distress at an individual level. Doing this would help limit the human cost that accompanies investment failures.

Future research could explore the related issue of whether the progressive loss of defined benefit retirement plans affects suicide rates. Loss of pension income due to market collapse could be psychologically distressing, particularly to those who struggle to supplement their income through participation in the labor market. The reasonableness of calls for placing a floor on retirement income, perhaps through the introduction of hybrid defined benefit/defined contribution plans, could be evaluated in conjunction with suicide prevention strategies.

Another interesting research avenue to pursue could be an examination of whether the return-suicide nexus is altered by the context and the rationale underpinning stock market movements. This is because regret associated with a failed investment could be dependent on the self-attribution of responsibility. For instance, in a case where an individual deliberately takes on speculative risks in a market that follows a bubble path, a substantial loss will provoke a strong feeling of guilt. If, in contrast, portfolio losses are attributable to a set of unpredictable exogenous shocks, the investor will be more likely to blame it on forces beyond his or her control. To disentangle these issues cleanly, a return-generating process would need to be specified and additional econometric models estimated. We would like to encourage our fellow researchers to investigate this issue further.

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