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The Socioeconomic Determinants of Suicide: A Panel Data Analysis
İntiharın Sosyoekonomik Belirleyicileri: Panel Veri Analizi

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ABSTRACT

Suicide has been a major public health issue worldwide and a growing number of researches have been conducted to unveil the association between socioeconomic factors and suicide rates. The aim of the present study is to detect if socioeconomic factors have impacts on suicide rates in age-adjusted, men, women and young people. To meet this objective, we used annual data on 47 countries for the 1996-2015 period. The results obtained from the panel data econometric analysis show that unemployment, fertility, alcohol consumption, divorce, women's working rates have significant effects on suicide rates.

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ÖZ

İntihar, dünya çapında önemli bir halk sağlığı sorunu olmuş ve sosyoekonomik faktörler ile intihar oranları arasındaki ilişkiyi belirlemek için artan sayıda araştırma yapılmıştır. Bu çalışmanın amacı, sosyoekonomik faktörlerin yaşa göre ayarlanmış, erkekler, kadınlar ve gençlerde intihar oranlarını etkileyip etkilemediğini tespit etmektir. Bu amaca ulaşmak için 1996-2015 dönemi için 47 ülkeye ait yıllık verileri kullanılmıştır. Panel veri ekonometrik analizinden elde edilen sonuçlar, işsizlik, doğurganlık, alkol tüketimi, boşanma, kadınların çalışma oranlarının intihar oranları üzerinde önemli etkileri olduğunu göstermektedir.

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1. INTRODUCTION

Even though trends in suicide vary by years, countries and groups, suicide has continued to be a major global health issue. The World Health Organization (WHO) and the United Nations (UN) have support new initiatives to increase awareness of the importance of mental health for global health. The suicide mortality rate is an indicator of target 3.4 of the UN's Sustainable Development Goals (SDG). By 2030, to reduce by one third premature mortality from noncommunicable diseases through prevention and treatment and promote mental health and well-being (WHO).

Every year around 793 000 people (one person in every 40 seconds) die of suicide. In 2016, the global age-standardized suicide rate was 10.5 per 100 000. Across the world, suicide rate is higher in men than in women. Suicide was the second leading cause of death among young people aged 15-29 years. Although the rate varied by countries, 79% of the world's suicides occurred in low- and middle-income countries whereas high-income countries had the highest rate with 11.5/100 000. In 2016, the countries with the highest rates of suicide (per 100 000) are Lithuania (31.9), Russia (31), Guyana (29.2), South Korea (26.9). Belarus (26.2), Belgium (20.7), Suriname (22), Kazakhstan (22) and Japan (18.5) (WHO, 2018).

Suicide, considered to be a complex event, is affected by a potential combination of several factors. For centuries, researchers have tried to explore the potential causes of suicide behavior. Durkheim (1897) argues in addition to psychological or emotional factors, social factors have also significant impact on suicide. The Centers for Disease Control and Prevention (CDC) lists some potential factors such as family history of suicide, previous suicide attempts, history of mental disorders, history of alcohol and substance abuse, feelings of hopelessness, impulsive or aggressive tendencies, cultural and religious beliefs, isolation, loss (financial, relational, social or job), physical illness and availability of lethal methods. There is a great deal of literature investigating psychological and emotional factors influencing suicide decisions. Since the number of studies on the socioeconomic aspects of suicide are very limited, large-data-set empirical researches may further be conducted for a better understanding of socioeconomic factors' role in suicide.

In this study, we focus on the socioeconomic aspects of suicide and aim to determine the socioeconomic factors that have effects on the suicide rates of age-adjusted, men, women and 15-29 age group. Among the socioeconomic factors, considered to be potential causes of suicide, are rates of divorce, alcohol consumption, unemployment, household debt, fertility, female labor force participation and gross domestic product. These variables are chosen mostly based on Durkheim's concept of social integration and regulation, and economic anomie.

The latest studies on the determinants of suicide have been conducted on single country and/or regional group basis with psychological and sociological aspects. To the best of our knowledge, the present study is the first to analyze the relationship between socioeconomic factors and suicide rates through 47-country data including the household debt ratio variable, which has often been neglected in previous studies. Furthermore, this study is expected to make important contribution to the relevant literature by providing existence of differences among subgroups (age-adjusted, men, women and 15-29 age group) in terms of the nexus between socioeconomic factors and suicide rates. In the next sections, we provide a comprehensive literature review, data collection and descriptive statistics, introduce econometric methods and empirical models and provide empirical results and finally give summary and conclusions.

In the literature, several studies have analyzed the association between suicide and socioeconomic factors and found there is a significant relationship between suicide and both social and economic factors. Milner et al. (2013) and Chen et al. (2012) provided a comprehensive review of articles regarding the relationship between suicide and socioeconomic factors.

Higher income can bring higher standards of living and greater satisfaction with life and consequently lower the tendency to commit suicide (Chen et al., 2012). Obtaining various results about the GDP and suicide association, most previous studies have found a negative relationship between real GDP and suicide rate. Yin et al. (2016) found GDP per capita had significant impact (negative relationship) on suicide rates in People's Republic of China. Virén (1996) analyzed the association between business cycles and suicide using time series data on the 1978-1994 period and detected suicide rate was inversely related to the GDP growth in Finland. Chuanc & Huang (1997) found an increase in income per capita would reduce suicide rates in Taiwan. Conducting an international cross-sectional study for 30 countries, Jungeilges & Kirchgässner (2002) analyzed the association between suicide and real income and found both real income per capita and real income growth had positive impact on suicidal tendency whereas the relationship might vary by age groups and genders. High level of income may expectedly reduce suicide rates.

Household borrowing has increased substantially in a number of developed countries (France, Japan, United Kingdom, Australia and Netherlands) over the past two decades (Debelle, 2004). The same situation is also observable for developing countries. Aldwin & Revenson (1986) stated substantial debt and difficulty in repayment can be considered as one of the indicators of economic stress affecting psychological welfare adversely (From Hintikka et al., 1998). In their survey-based study conducted in Great

Britain, Brown et al. (2005) argued household heads in outstanding credit report had significantly lower levels of psychological welfare than those in no debt. Unmanageable amounts of debt rise suicidal tendency in financially distressed individuals with lower life satisfaction and higher anxiety. After reviewing the methodological approaches toward the relationship between personal debt and mental health, in particular suicidal ideation, Meltzer et al. (2011) stated indebtedness was a potential risk factor for suicidal consideration, and for successful/ unsuccessful suicide attempts. For example, home repossessions cause a more than twofold increased rate of depressive symptoms and generalized anxiety disorder (McLaughlin et al., 2012). In their multivariate logistic regression analysis, Meltzer et al. (2011) found debt had a significant impact on suicidal thoughts. Morgan et al. (1975) and Hatcher (1994) found financial difficulties had an impact on self-harming behaviors. Using a nationwide sample, Hintikka et al. (1998) studied on the debt and suicidal behavior association in Finland and concluded having difficulty in repayment of debts was independently associated with suicidal ideation. The comparison of non-suicidal people with those who reported to have had suicidal ideation showed the tendency to commit suicide was higher in those suffering from debt repayment difficulties, alcohol abuse, spousal problems and divorce in the recent 12 months, unemployment and high housing loans. Haider & Haider (2002) investigated the relationship between the seriousness of suicide attempts and the depth of individuals' financial problems in 160 Pakistani patients who once attempted suicide, finding those individuals yielded higher suicidal intention scores than those who were not in debt. In this study, we hypothesize an increase in household debt will lead to a rise in suicide rates.

Based on maximization of individual lifelong utility, unemployment rate is related to suicides in the economic theory of Hamermesh & Soss (1974). In the analysis, age and permanent income are taken as functions of utility. Income is mainly represented by work-raised funds. An unemployed person is unable to afford consumption due to the lack of funds, which causes low utility and probably increases the risk of suicide. They reveal that an economic expansion (in terms of a decrease in unemployment rate) is more likely to reduce young suicide rates (15–24 and 25–34 years old) and middle age groups (35–44 and 45–54 years old) than other age groups. The relationship between suicide and unemployment have been analyzed on the basis of two hypothetical models, the vulnerability model and the indirect causative model (DeFina & Hannon, 2015; Lin & Chen, 2018; Luo et al., 2011). The vulnerability model approaches the circumstance in a way that unemployment rises the risk of suicide after losing supportive resources (e.g., friends, coworkers, health professionals, and on-the-job counselors) to cope with stress-

ful events. The second model explains the association between the two, focusing that financial problems, relationship difficulties and diminishment of social status due to unemployment may create sufficient stress to commit suicide (DeFina & Hannon, 2015; Lin & Chen, 2018; Luo et al., 2011).

Most of these studies found a significant relationship between unemployment and suicide mortality (Breuer, 2015; Chang et al., 2017; Chen et al., 2010; DeFina & Hannon, 2015; Fountoulakis et al., 2014; Laanani et al., 2015; Nordt et al., 2015; Norström & Grönqvist, 2015; Swinscow, 1951; Weyerer & Wiedenmann, 1995). Weyerer & Wiedenmann (1995) examined the relationship between economic factors and suicide for the 1881-1989 period in Germany and found that the most robust correlation was between suicidal tendencies and decreased real income and increased unemployment. Using state-level panel data for the 1979–2010 period for USA, DeFina & Hannon (2015) found a positive and statistically significant coefficient for unemployment indicating that especially in recent decades unemployment played a significant role in suicide. Lin & Chen (2018) found a positive relationship between unemployment and suicide in the 1928–2013 period in USA. Neumayer (2004), on the other hand, reached opposite conclusions in his panel-data study analyzing the 1980–2000 period, stating unemployment and suicide rates in men and women were negatively associated in Germany. Using time series data on the 1959-2007 period, Chen et al. (2010) found the association between unemployment and suicide rate was significantly positive in men and slightly positive in women in Taiwan. Thus, sociological and microeconomic theories and findings of empirical studies point to the existence of a positive association between unemployment and suicide.

Of many social and financial problems that may be attributed to alcohol consumption are traffic accidents, workplace-related problems, domestic issues (Klingemann & Gmel, 2001), and health concerns including chronic physical and mental health problems such as liver damage, cardiovascular disease, anxiety and depression. Wasserman et al. (1994) found a significant relationship between alcohol consumption and suicide in the former USSR. Using the data from the 1970-2005 period, Razvodovsky (2009) provided evidence that alcohol consumption has significant impact on the fluctuation in suicide mortality rates in Russia in the recent decades. Nemtsov (2003) reported that alcohol consumption played a vital role in the suicide rate (a 1-liter rise in alcohol consumption might increase suicide rates by 12% for the total population) in Russia. Using time series data from 1980 to 2005, Razvodovsky (2011) found a significant association between alcohol consumption and suicidal tendency in both men and women in Russia. Graham & Schmidt (1999) found that there was a positive association between quantity and

volume of alcohol and poorer psychological health in older people (65 and above). Rodgers et al. (2000) found a positive association between high levels of alcohol use and symptoms of anxiety and depression in Australia. Considering the findings of previous studies, we expect that an increase in use of alcohol triggers suicide rates.

Durkheim (1897) asserts that social integration affects societal suicide rates. The presence of a child or children in a family promotes social and familial ties, increasing social integration well enough to consequently reduce the tendency to commit suicide (Chuanc & Huang, 1997; Lester & Yang, 1992). The association between fertility rate and suicide may expectedly be negative. Using data span from 1970 to 1998 for 15 European countries, Andrés (2005) found that economic growth (positive), fertility rate (negative), and alcohol consumption (positive) had significant effects on both male and female suicide rates. In their time series study on the 1933-1984 period in USA, Lester & Yang (1992) found a significantly negative association between fertility and suicide rates, which supports Durkeim's thesis on the role of social integration in reducing suicide. Classen & Dunn (2011) analyzed the association between suicide rates and fertility rate in USA. Using a panel of states from 1981 to 2005, contrary to the findings of negative relationships between these two variables, they detected a positive association between suicide and fertility rates. Using pooled cross-sectional data on the1983-1993 period, Chuanc & Huang (1997) found a statistically insignificant positive relationship between fertility and suicide rates in Taiwan. Noh (2009) used 24 OECD countries' 1980-2002 data on the determinants of suicide and found that fertility rate (negative), alcohol consumption (positive), unemployment (positive) and GDP per capita (positive) had statistically significant impacts on overall male and female suicide rates. In line with the findings of previous studies on socioeconomic determinants of suicide, we expect to find a positive association between fertility and suicide rates.

Referring to the previous studies (Bierman et al., 2006; Lorenz et al., 2006; Waite et al., 2009) and Amato (2010) indicated the comparison between married and divorced individuals showed more symptoms of depression and anxiety, which are already serious risk factors for suicide. The suicide-related studies show that divorce is positively associated with suicide rates (Brainerd, 2001; Chuanc & Huang, 1997; Chuang & Huang, 2007; Leenaars & Lester, 1999; Lester & Abe, 1998; Yip et al., 2012). Simpson (1951) reported both divorced men and women had higher suicide rates than married couples (Rico-Velasco & Mynko, 1973). Wade & Pevalin (2004) found newly widowed, separated, or divorced men and women were significantly more likely to have poorer mental health compared to married individuals. Using data span from 1970 to 1998, Andrés (2005) found statistically significant and positive association be-

tween divorce rate and suicide for 15 European countries. Leenaars & Lester (1999) found a positive association between divorce and suicide rates for the 1950-1990 period in Canada. In their study, Lester & Abe (1998) found a positive association between suicide and divorce rate for the 1970-1989 period in Japan. Considering the findings of previous studies, we expect divorce rate is directly proportional to suicidal tendency.

According to Jalles & Andresen (2015), sociologists consider increasing female participation in labor force (FLFP) has significant impact on societal suicide rates. The effect of FLFP on suicide has been discussed in two opposed paradigms (Breed et al., 1965). Status integration theory suggests FLFP increases suicidal tendency due to role conflict and overload such as the failure of a husband as the sole breadwinner and women's increasing out-of-home responsibilities (Stack, 1978). However, the accumulation/expansion theory by Sieber (1974) and Marks (1977) supports that FLFP has a reducing effect on suicidal tendency thanks to its benefits such as increasing household income to outweigh the costs (Stack, 1987). The study by Chen et al. (2017) provides extensive discussion and literature review about the nexus between FLFP and suicide. The results of these studies prove the relationship between the two is ambiguous. In one hand, the findings of these studies present a positive relationship between FLFP and suicide (Davis, 1981; Fernquist & Cutright, 1998; Milner et al., 2012; Stack, 1978). On the other hand, the relationship between the two either disappeared (Stack, 1987) or became reversed since the findings became obsolete due to the lapse of time from 1960s to 1980s (Burr et al. 1997). Seeing the conclusions of previous studies, we can say the effect is ambiguous.

Today's literature provides valuable information about the causes of suicide. However, no study has examined the effects of socioeconomic factors on suicide with a wide range of countries from different parts of the world. Furthermore, they have mostly ignored the effects of such important factors in their analyses as household debt ratio, included in this study.

2. DATA AND DESCRIPTIVE STATISTICS

We used the suicide rates (crude death rate per 100 000 population) of a 4-group population including age-adjusted, men, women and 15-29 age group and obtained dependent variables from World Health Organization (WHO)'s Mortality Database. Alcohol consumption data (recorded alcohol per capita -15+ years- consumption in liters of pure alcohol) was obtained from Global Information System on Alcohol and Health database of the WHO, crude divorce rate was obtained from the OECD, household debt to GDP was obtained from economic data set of the International Monetary Fund and theglobaleconomy. com. Fertility rate (births per woman), unemployment

(total % of total labor force, modeled ILO estimate), GDP (per capita growth, annual %) female labor force participation rates (FLFP) and female participation (% of female population aged 15-64 years, modeled ILO estimate) were collected from the World Development Indicator database of the World Bank.

The panel data contains 47 countries for the 1996-2015 period. We limited the data period to 2015 since the most important data series (suicide rates) was reported until 2015. A linear interpolation was used for explaining missing time series. Interpolation was used only when less than 5 years of data was missing. Country-level data was excluded if more than 5 years were missing in a time series. The countries are Austria (AUT), Australia (AUS), Belarus (BLR), Belgium (BEL), Brazil (BRA), Bulgaria (BGR), Canada (CAN), Chile (CHL), Croatia (HRV), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hong Kong (HK), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Kazakhstan (KAZ), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Mexico (MEX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Romania (ROU), Russian Federation (RUS), Singapore (SGP), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Republic of Korea (KOR), Sweden (SWE), Switzerland (CHE), South Africa (ZAF), United Kingdom of Great Britain (GBR), United States of America (USA), Ukraine (UKR) and Thailand (THA).

Descriptive statistics are consulted frequently for analyzing the variables in hand and summarizing their changes in the relevant periods. Thus, Table 1 shows the authors-calculated descriptive statistics (mean, variance, minimum and maximum values) of the suicide variables, summarizing suicide rates of age-adjusted, men, women and 15-29 age group (15-24 age group for the USA) vary greatly from country to country. Compared to women, men have higher average suicide rates in every country. In terms of average values, the countries with the highest and lowest two suicide rates for age-adjusted, men, women and 15-29 age group are listed as follows.

For age-adjusted suicide rates, Lithuania (33,815) and Russian Federation (26,605) are the top two countries while Greece (2,96) and South Africa (0,74) are the bottom two. For male suicide rates, Lithuania (60,935) and Russian Federation (48,265) are again the top two countries whereas Greece (4,89) and South Africa (1,2) are the bottom two. For female suicide rates, South Korea (12,28) and Lithuania (10,11) are listed as the first two while Greece (1,08) and South Africa (0,32) are the last two in the list. Russian Federation (30,742) and Lithuania (30,09) are the top two and Portugal (3,706) and Greece (2,636) are the bottom two in the list of countries for the 15-29 age group.

2.1. Panel ARDL Model

Breitung (2000), Levin et al. (2002), Harris & Tzavalis (1999), Hadri (2000) and Im et al. (2003) panel unit root tests were used for examining the stationarity of series. As is seen on Table 2, we obtained mixed results from panel unit roots test for the series on hand. Therefore, we used a panel ARDL model for determining the socioeconomic factors that might have impact on suicide. In panel ARDL (p_i, q_i, k_i, m_i, n_i, r_i, w_i z_i) form, the suicide rate equation can be expressed (for the sake of simplicity, only age-adjusted suicide rate function is provided) as follows:

$$Suicide_{it} = \alpha_i + \sum_{j=1}^{pi} \beta_{ij} suicide_{i,t-j} + \sum_{j=0}^{qi} \theta_{ij} housedebt_{i,t-j}$$
$$+ \sum_{j=0}^{ki} \phi_{ij} divorce_{i,t-j} + \sum_{j=0}^{mi} \lambda_{ij} alcohol_{i,t-j} + \sum_{j=0}^{ni} \delta_{ij} fertility_{i,t-j}$$
$$+ \sum_{j=0}^{ri} \gamma_{ij} gdp_{i,t-j} + \sum_{j=0}^{wi} \omega_{ij} unemp_{i,t-j} \sum_{j=0}^{zi} \varsigma_{ij} flfp_{i,t-j} + \varepsilon_{it}$$
$$(1)$$

As argued by Pesaran et al. (1999) it is more convenient to work with the following re-parameterization of equation:

$$\Delta Suicide_{it} = \alpha_i + \beta_i^* suicide_{i,t-1} + \theta_i^* housedebt_{it}$$
$$+ \phi_i^* divorce_{it} + \lambda_i^* alcohol_{it} + \delta_i^* fertility_{it}$$
$$+ \gamma_i^* gdp_{it} + \omega_i^* unemp + \varsigma_i^* fepart + \sum_{j=1}^{pi-1} \beta_{ij}^{**} \Delta suicide_{i,t-j}$$
$$+ \sum_{j=0}^{qi} \theta_{ij}^{**} \Delta housedebt_{i,t-j} + \sum_{j=0}^{ki} \phi_{ij}^{**} \Delta divorce_{i,t-j}$$
$$+ \sum_{j=0}^{mi} \lambda_{ij}^{**} \Delta alcohol_{i,t-j} + \sum_{j=0}^{ni} \delta_{ij}^{**} \Delta fertility_{i,t-j} + \sum_{j=0}^{ri} \gamma_{ij}^{**} \Delta gdp_{i,t-j}$$
$$+ \sum_{j=0}^{wi} \omega_{ij}^{**} \Delta unemp_{i,t-j} + \sum_{j=0}^{zi} \varsigma_{ij}^{**} \Delta flfp_{i,t-j} + \varepsilon_{it}$$
$$(2)$$

where

$$\varphi_i = -(1-\sum_{j=1}^{pi}\beta_{ij}), \theta_i^* = \sum_{j=0}^{qi}\theta_{ij}, \varphi_i^* = \sum_{j=0}^{ki}\varphi_{ij}, \lambda_i^* = \sum_{j=0}^{mi}\lambda_{ij}, \delta_i^* = \sum_{j=0}^{ni}\delta_{ij}, \gamma_i^* = \sum_{j=0}^{ri}\gamma_{ij}, \omega_i^* = \sum_{j=0}^{wi}\omega_{ij}, \varsigma_i^* = \sum_{j=0}^{zi}\varsigma_{ij}$$

i=1,2,3,...,47, t=1996,...,2006, and ε_{it} is an error term which are independently distributed across i and t. In the equation above, the term φ^i represents error correction coefficient which is expected to be negative, β_i^*, θ_i^*, ϕ_i^*, λ_i^*, δ_i^*, γ_i^*, ω_i^*, ς_i^* and β_{ij}^{**}, θ_{ij}^{**}, ϕ_{ij}^{**}, λ_{ij}^{**}, δ_{ij}^{**}, γ_{ij}^{**}, ω_{ij}^{**}, ς_i^{**} are the long-run and short-run coefficients, respectively.

Equation (2) is estimated by the mean group (MG) and pool mean group (PMG) estimators (Pesaran et al., 1999). While MG allows for heterogeneity in the short-run and long-run and derives the long-run parameters from an average of the long-run parameters obtained from individual ARDL estimates, the PMG allows for heterogeneity only for the short-run and constraints long-run parameters to be the same. By taking Pesaran et al. (1999) suggestion, a maximum likelihood approach with the "back-substitution" algorithm was adopted to estimate Equation 2. Appropriate lag length for the equations is selected by applying the Akaike Information Criterion (AIC) and to make a choice between alternative model specifications, the Hausman (1978) type test is applied to the difference between the MG

Table 1. Descriptive Statistics for Suicide Rates of Age-adjusted, Men, Women and 15-29 Age Group (Annual 1996-2015)

Suicide Variables	Statistic	AUT	AUS	BEL	BLR	BRA	BGR	CAN	CHL	HRV	CZE	DNK	EST	FIN	FRA	DEU	GRC	HK
Age-adjusted	Mean	13,245	11,265	15,67	17,297	4,71	10,137	11,58	9,795	14,705	12,145	9,765	19,945	17,54	13,785	9,565	2,96	11,24
	Variance	5,453	2,634	1,864	1,918	0,057	6,352	0,174	2,948	6,443	1,144	2,720	51,213	9,787	1,781	1,358	0,249	3,099
	Min / Max	10,2/18	9,4/14,7	13,3/17,9	14,9/19,6	4,2/5,2	6,9/14,5	10,8/12	6,4/12,2	11,4/19,3	10,2/13,7	7,6/13,6	12,4/34,3	11,7/23,2	10,7/16	8,3/11,8	2,3/4	8,8/15,4
Female	Mean	5,97	4,81	8,295	9,339	1,885	4,706	5,355	3,275	6,505	4,23	5,095	6,225	8,07	6,864	4,56	1,08	7,895
	Variance	1,432	0,228	0,430	0,461	0,027	2,613	0,185	0,908	2,029	0,424	1,083	5,183	1,336	0,738	0,377	0,085	1,299
	Min / Max	4,3/7,8	4/5,7	7,4/9,6	8,4/10,75	1,5/2,2	2,7/7,8	4,6/6,3	1,7/4,8	4,5/9,3	3,2/5,3	3,7/7,5	3,7/11	5,3/9,7	5/8,3	3,8/5,9	0,6/1,6	6/10
Male	Mean	21,395	17,755	23,465	25,855	7,81	16,211	17,915	16,74	24,25	20,69	14,665	35,845	27,295	21,481	14,98	4,89	15,045
	Variance	14,693	8,663	5,154	5,674	0,098	12,864	0,655	6,819	18,293	3,058	6,155	173,59	29,136	3,805	3,467	0,601	6,438
	Min / Max	16,4/30	14,7/23,6	19,4/26,9	21,5/29,6	7,2/8,4	11/22,7	17/19,5	11,4/20	18,5/32	17/23,3	10,7/20	22/61,7	18/37,4	17/24,5	13/18,3	3,8/6,5	11/21,4
15-29 age group	Mean	11,152	NA	12,981	23,04	NA	6,771	NA	NA	10,689	9,941	6,815	18,444	20,033	8,922	7,657	2,637	NA
	Variance	5,921	NA	4,2104	20,93	NA	3,361	NA	NA	5,682	1,034	2,779	23,697	8,087	2,284	1,148	0,262	NA
	Min / Max	7,8/15,1	NA	9,9/16	14,6/29,5	NA	4,6/10,5	NA	NA	7,9/16,6	8,4/11,7	4,4/10,2	10,3/28,6	16/26	6,4/11,8	6,7/9,6	2/3,9	NA

Variables	Statistic	HUN	ISL	IRL	ISR	ITA	JPN	KAZ	LVA	LTU	LUX	MEX	NLD	NZL	NOR	POL	PRT	ROU
Age-adjusted	Mean	20,575	11,345	11,615	5,54	5,195	17,565	25,52	21,855	33,815	10,82	4,2	8,165	12,225	10,495	13,33	6,879	10,415
	Variance	16,711	4,188	1,039	0,509	0,247	3,145	23,17	31,410	43,892	9,539	0,182	0,310	1,536	0,697	0,399	3,995	0,874
	Min / Max	13,7/27	8/17,9	9/13,5	4,1/6,5	4,6/6,3	13,7/19	16,4/32	15,4/33	25/44,3	5,5/16,5	3,6/5	6,9/9	10,8/15	9/12,4	12/14,3	3,7/10	8,8/12,2
Female	Mean	8,34	5,31	4,32	2,245	2,31	9,535	8,235	6,78	10,11	5,50	1,405	5,045	5,90	5,89	3,605	2,967	3,17
	Variance	3,021	1,229	0,297	0,171	0,093	0,555	1,308	5,431	4,898	3,765	0,084	0,205	0,468	0,277	0,138	0,908	0,214
	Min / Max	5,8/12	2,9/7,3	3,5/5,5	1,5/3,2	2/3,1	8,1/10,8	6/9,9	3,7/10,8	7/14,5	2,5/8,5	1/1,9	4,1/5,7	4,2/6,8	5,1/6,9	3/4,2	1,4/5,5	2,2/3,9
Male	Mean	34,755	17,3	18,96	9,03	8,38	25,77	45,17	39,71	60,935	16,595	7,14	11,41	18,91	15,12	23,68	11,167	18,08
	Variance	47,078	14,763	3,599	1,616	0,636	8,789	82,778	94,721	140,66	22,775	0,320	0,534	5,241	2,599	1,358	8,904	2,332
	Min / Max	22,6/26	13/30	14,6/22,6	6,6/11	7,3/10	19/29,4	28,4/57	27,7/59	45/78,3	6,8/26	6,3/8,2	9,9/13	16/23,7	13/18,4	21/25,5	6,4/17	15,6/21
15-29 age group	Mean	10,661	13,979	15,690	6,10	4,368	13,989	29,919	18,345	30,09	8,734	12,197	6,870	NA	13,207	12,047	3,706	7,215
	Variance	5,164	34,128	8,684	1,634	0,377	1,596	27,864	16,623	25,05	14,326	2,068	0,665	NA	5,139	0,261	0,684	0,457
	Min / Max	7,3/14,6	5,5/32,9	10,4/21	3,8/8	3,4/5,7	11,7/16,3	18/36,5	11/26	20/38	2/16	10,3/15	6/9	NA	9,5/18,5	11/13	2/5,3	5,8/8,4

Variables	Statistic	RUS	SGP	SVK	SVN	ESP	SWE	CHE	ZAF	KOR	GBR	USA	UKR	THA
Age-adjusted	Mean	26,605	8,315	10,34	19,425	5,955	10,735	12,8	0,74	19,775	6,345	10,62	21,946	6,268
	Variance	53,642	0,941	1,46	18,783	0,273	0,341	5,844	0,065	19,694	0,083	0,672	21,679	1,031
	Min / Max	15/36	6,6/10,5	8,1/12	13,7/26	5/6,8	10/11,8	9,2/16,7	0,2/1,1	12,7/26	5,7/6,8	9,5/12,3	15,8/29,2	5/8,1
Female	Mean	7,805	5,835	2,81	7,705	2,75	6,27	7,07	0,32	12,28	2,745	4,360	6,687	2,798
	Variance	3,568	0,977	0,32	5,581	0,087	0,218	2,094	0,011	11,659	0,028	0,377	2,087	0,338
	Min / Max	4,8/10,4	4,2/8,1	2,4/3,1	3,9/11,6	2,2/3,3	5,4/7,2	5/9,1	0,1/0,4	7,6/18,5	2,4/3,1	3,6/5,7	5,28/9,34	2,1/3,7
Male	Mean	48,265	11,09	18,666	32,205	9,435	15,305	19,01	1,20	28,57	10,035	17,215	39,879	9,913
	Variance	180,23	1,313	4,770	49,658	0,679	0,949	13,895	0,172	34,457	0,236	1,009	98,782	2,216
	Min / Max	27/65,4	9/13	14,5/22	24/43	8/11	13,5/17	13,7/25	0,4/1,8	18,5/37	9/11	16/19	17/54	8,2/13
15-29 age group	Mean	30,742	NA	7,46	14,283	4,585	10,418	11,551	NA	16,569	6,725	14,710	18,087	NA
	Variance	45,058	NA	0,88	14,448	0,988	0,926	7,398	NA	7,692	0,797	0,663	3,062	NA
	Min / Max	20,7/41	NA	5,96/9,2	9/24	3/6,3	8/12,5	8/16,5	NA	12/21,6	5,5/8,5	13,7/16	14,6/21	NA

Note: Descriptive statistics are calculated for the 1996-2015 period. Min / Max refers to minimum and maximum values. Country abbreviations were defined in the data section. NA refers to not available.

Source: Authors' Calculation.

Table 2. Panel Unit Root Test Results

Variables/statistics	T_suicide	M_suicide	F_suicide	Y_suicide	Housedebt	Divorce	Alcohol	Fertility	Gdp	Unemp	Flfp
Levin, Lin &Chu t	-5.154*	-3.943*	-2.876*	-5.281*	0.690	-7.087*	-2.029*	-15.604*	-7.863*	-7.712*	-4.251*
	(0.000)	(0.000)	(0.002)	(0.000)	(0.755)	(0.000)	(0.021)	(0.000)	(0.000)	(0.000)	(0.000)
Im, Pesaran and Shin W-stat	-6.301*	-0.547	-2.428*	-8.631*	5.665	-5.434	-3.438*	0.025	-10.316*	-3.469*	-2.316*
	(0.000)	(0.292)	(0.008)	(0.000)	(1.000)	(0.000)	(0.000)	(0.510)	(0.000)	(0.000)	(0.010)
Breitung t-stat	-0.909	2.068	0.826	-5.506*	9.105	-0.330	1.669	6.209	-7.373*	1.713	2.470
	(0.187)	(0.981)	(0.796)	(0.000)	(1.000)	(0.371)	(0.952)	(1.000)	(0.000)	(0.957)	(0.993)
Harris–Tzavalis	-5.586*	0.864	0.741*	0.248*	1.031	0.591*	0.662	0.738	0.262*	0.751	0.706
	(0.000)	(0.629)	(0.000)	(0.000)	(1.000)	(0.014)	(0.535)	(0.995)	(0.000)	(0.998)	(0.935)
Hadri LM	24.867*	66.247*	55.901*	11.743*	43.087*	23.806*	29.752*	33.616*	10.128*	33.096*	34.020*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Null Hypothesis: Series includes unit root (Non-stationary) except Hadri LM test (the null is stationary). T_suicide, M_suicide, F_suicide and Y_suicide refers to age -adjusted, male, female and 15-29 age group suicide rates, respectively. The above results for the variables show that all tests together cannot reject the null hypothesis of non-stationarity. Values in brackets show the p-values.

and the PMG estimators.

Table 3 reports the estimates of the PMG model with seven independent variables including household debt ratio, rates of alcohol consumption, divorce, fertility, gdp growth, unemployment and female participation in labor force. We estimated separate panel regression models for age-adjusted, female, male and 15-29 age group suicide rates.

The comparison between MG and PMG is based on the joint Hausman test. Lag order is chosen based on Akaike Information Criterion (AIC) and found to be 1 for all variables in hand. The MG estimator suffers from too few degrees of freedom due to short lifespan of 20 years only. The Hausman test fails to reject the null hypothesis suggesting that the data do not reject the restriction of the common long-run coefficients. In other words, the PMG results are more appropriate than those of MG and therefore we focus on PMG results reported in Table 3. The negative and statistically significant error correction coefficients for all estimations reported in Table 3 indicate not only the presence of the cointegration among the variables but also the adjustment of the suicide rate to equilibrium. As in the joint Hausman test result for age-adjusted, female, male and 15-29 age group, the PMG results are more appropriate than those of MG.

The results in Table 3 reveal that all independent variables have significant impacts on age-adjusted suicide rates. Parallel to the expectations and findings of previous studies (Chuang & Huang, 2007; DeFina & Hannon, 2015; Hintikka et al., 1998; Meltzer et al., 2011; Razvodovsky, 2009), the long-run coefficients are positive and statistically significant for alcohol, divorce, household debt and unemployment variables. In line with our expectations and findings of previous studies (Andrés, 2005; Lester & Yang, 1992), the signs for coefficient of the fertility variable is negative and statistically significant. Contrary to the expectations and findings of previous studies (Virén, 1996; Yin et al., 2016), but in line with Noh (2009) and Jungeilges & Kirchgässner (2002), the coefficient for the gdp variable is positive and statistically significant.

The coefficient of the female participation in labor force variable, for which there are various results in the literature, is negative and statistically significant, indicating that a unit increase in labor force participation decreases the suicide rate by 0.224 units. This finding is in line with the findings of Stack (1987) but contrary to those of Davis (1981), Fernquist & Cutright (1998) and Milner et al. (2012), who found a positive relationship between FLFP and suicide rates. The fertility rate variable apparently has a relatively more explanatory power on age-adjusted suicide rates. In other words, a unit increase in fertility rate decreases the suicide rate by 4.427 units.

In the short run, only gdp has a statistically significant impact on age-adjusted suicide rates. The negative and statistically significant error correction coefficients indicate not only the presence of the cointegration among the vari-

Table 3. Panel ARDL Estimation Results (PMG)

Variables	Age-adjusted		Male		Female		15-29 Age group 1	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Long run coefficients								
Housedebt	0.019**	2.777	-0.050*	-5.800	-0.013*	-4.170	-0.00002	-0.003
Alcohol	0.569*	5.896	0.416*	4.100	0.092*	3.190	0.133**	2,434
Divorce	0.554**	2.421	1.057*	3.960	0.183**	2.180	-0.025	-0.138
Fertility	-4.427*	-9.628	-2.953*	-2.910	-1.971*	-6.880	-2.552*	-3.537
GDP	0.057**	2.712	0.191*	5.240	-0.038*	-3.090	0.043***	1.717
Unemp	0.188*	6.081	-0.290*	-7.790	0.002	0.180	0.040**	2.468
Flfp	-0.224*	-9.253	-0.383*	-13.250	0.025**	2.410	-0.045**	-2.402
Error Correction coefficients	-0.301*	-6.103	-0.314*	-5.930	-0.440*	-8.230	-0.480*	-8.035
Short run coefficients								
ΔHousedebt	-0.027	-0.900	-0.076	-1.630	-0.008	-0.570	-0.071**	-2.069
ΔAlcohol	-0.150	-1.079	-0.068	-0.280	-0.026	-0.290	0.077	0.482
ΔDivorce	-0.480	-1.247	-0.323	-0.520	-0.340***	-1.790	-0.974	-1.552
ΔFertility	-0.762	-0.389	1.279	0.420	-0.739	-0.810	1.292	0.456
ΔGDP	-0.033**	-2.471	-0.062*	-2.600	0.008	0.850	-0.011	-0.323
ΔUnemp	0.051	0.775	0.316*	2.520	-0.014	-0.370	-0.001	-0.008
ΔFlfp	0.011	0.140	0.001	0.010	0.019	0.310	-0.006	-0.036
Constant	7.467*	5.990	14.926*	5.860	2.901*	6.850	7.552*	8.114
Joint Hausman test	3.98 (0.78)		0.80 (0.998)		0.360 (0.998)		0.32 (0.999)	

Note: *, **, and *** stand for 1, 5 and 10% statistically significant coefficients, respectively. Cross-section F and Period F test results indicate the null hypothesis that the effects are redundant are strongly rejected. The PMG estimators are computed by back-substitution algorithm. The parenthesis on Joint Hausman test shows the probabilities. 1 15-29 age group model was estimated with 38 countries' data.

ables but also the adjustment of the total suicide rate towards equilibrium.

In the model of male suicide rates, the coefficient of the alcohol, divorce and gdp variables are positive and statistically significant. Contrary to the expectations, except fertility variable, the coefficients of household debt, unemployment fertility and female labor force participation variables are negative and statistically significant.

The estimation results for female suicide rates model reveal the alcohol, divorce and female labor force participation variables are statistically significant and have positive effects on female suicide rates while coefficient of the fertility, household debt and gdp are statistically significant and negatively effective on suicide rates. Surprisingly, the coefficient of the unemployment rate variable is positive but statistically insignificant. We have found a positive relationship between labor force participation of women and suicide rates, which is consistent with the findings of Milner et al. (2012) and Stack (1978), who found a positive association between female suicide and female working.

The results for 15-29 age group suicide variable show the coefficient of alcohol, gdp and unemployment variables

are positive and statistically significant while fertility and female labor force participation variables are negative and statistically significant. Different from the other three models, household debt and divorce variables' coefficients are statistically insignificant.

In four models, the fertility rate variable is the most influential on suicide rate. For instance, in age-adjusted suicide rates, this variable seems to have a relatively more explanatory power and a unit increase in fertility rate decreases the suicide rate by 4.427 units. Divorce rate is the second most influential variable in the male suicide model, indicating that as stated in the literature divorce has significant impact on men's suicide rates.

3. SUMMARY AND CONCLUSION

The existing studies have examined the effects of psychological, emotional and socioeconomic factors on suicide. However, no study has so far examined the effects of socioeconomic factors on suicide with large data set including countries from different parts of the world. Furthermore, previous studies have neglected some other variables that may have significant impact on suicide rates, such as

household debt ratio.

In this paper, using ARDL panel data analysis, we empirically investigate the relationship between suicide and a number of socioeconomic variables -which are household debt, alcohol, divorce, fertility, female labor force participation and unemployment with a panel of 47 countries for the 1996-2015 period. In addition to modeling the age-adjusted suicide rate, we also use separate models for female, male and 15-29 age group to see whether socioeconomic determinants of suicide will differ across groups.

The findings show the effects of socioeconomic factors on suicide are varied for age-adjusted, male, female and 15-29 age group. The estimation results show only alcohol consumption and fertility rates have statistically significant and respectively positive and negative impact on suicide rates of all groups. Except for 15-29 age group, divorce increases suicidal tendency, which has satisfied our expectations. Except female suicide rates (existence of statistically significant and negative relationship between the two), gdp has statistically significant positive impact on suicide rates. Unemployment has a positive effect on age-adjusted and 15-29 age group suicide rates while it has negative impact on male suicide rates and no impact on female suicide rates. We have found an increase in household debt has a diminishing effect on female and male suicide rates and increasing impact on age-adjusted suicide rates.

Suicide rates can hardly be attributed completely to the above-mentioned variables. As mentioned in the introduction section and Stone et al. (2017) and U.S. Department of Health and Human Services (HHS) Office of the Surgeon General and National Action Alliance for Suicide Prevention (2013) there are such other factors unquestionably responsible for suicide rates as biological, psychological, interpersonal, environmental and societal influences that may interact with one another. However, the findings of this study are expected to make remarkable contribution to the suicide-related literature and decision makers may make use of our findings for the examination of the relationship between socioeconomic factors and suicide.

As indicated in the previous studies cited above, suicidal tendencies are diminishable through a combination of strategies or approaches that will all focus on personal, familial and communal matters, and social status of individuals working in both public and private sectors. Governments play a vital role in the reduction of suicidal risk by creating national strategies in cooperation with multiple stakeholders. In the light of our findings, policy makers and other stakeholders such as civil society organizations can develop strategies to prevent suicide. As for alcohol use, implementing effective public policies and interventions with appropriate legal frameworks can diminish the harmful use of alcohol. Since fertility rate has negative impact on suicide rates, the introduction of community engagement activities, parental skills and family

relationship programs for people in need may have lower the suicidal risk. As is seen in our findings, household debt and unemployment have significant impacts on the risk of suicide and establishing economic support systems can reduce the suicidal risk for those in harsh debt and unemployment for long enough to create stress and anxiety. Providing this support may reduce stress, anxiety and outbreak of a potential crisis and thereby prevent suicide (Stone et al., 2017).

Our findings regarding the effects of women's participation in labor force on suicide are appeared to be paradoxical in the way that such a participation increases suicide rates for women but decreases for age-adjusted, men and 15-29 age group. We can explain these contradictory results as women's engagement in labor force may create stress inside the family, reduce social integration, decline the quality of family and deteriorate the relationship between parents and children and consequently lead to higher suicide rates. Some institutional arrangements, such as shorter working hours, may lower stress on working women. Thus, suicide rates may decline subsequently. However, women's labor force participation may increase household income and thus reduce the suicidal tendency since it will improve family's welfare.

The results show increasing divorce rates augment suicidal tendencies, except for 15-29 age group. Leading effects of divorce on stress and anxiety lead to high suicide rates. Thus, political steps should be taken for divorced people with suicidal behaviors. To encourage and support healthy marriages, effective policies should be adopted to lower divorce rates through marital education, family counseling and gaining communication and problem-solving skills.

For a healthier assessment of the determinants of suicide, future studies may add more countries and periods in case of releasing new suicide data by WHO after 2015. Furthermore, some index variables such as income distribution and life satisfaction can be added to models to assess their impacts on suicide rates.

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