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A SOCIOECONOMIC PERSPECTIVE ON SUICIDE CASES: STUDIES ON A GROUP OF MIDDLE-INCOME COUNTRIES

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Abstract

Suicide is a phenomenon that poses a danger to all parts of society. It is highly likely that there is a strong correlation between socioeconomic indices and suicide rates. The study's goal is to research the relationship between suicide and socioeconomic indicators. In the study, suicide frequency for the period 1990-2017 (per 100 thousand people), per capita income, mean schooling, unemployment rate, and the share of cancer cases in the population variables of the BRICS and MIST country group members analyzed using the Panel ARDL method. According to results, suicide is negatively associated with per capita income and mean schooling. The relationship between the share of cancer cases in the population and suicide is positive. No significant relationship found between the unemployment rate and suicide. Due to certain limitations of the study and the multifaceted determinants of suicide, more studies are needed on the subject. In middle-income countries, increasing wealth and improving educational opportunities play a role in reducing suicide.

Keywords: *Economic Development, Socioeconomics, Suicide*
JEL Classification: *O11, I10, I15.*

İNTİHAR VAKALARINA YÖNELİK SOSYOEKONOMİK BİR BAKIŞ: BİR GRUP ORTA GELİRLİ ÜLKELER ÜZERİNE İNCELEMELER

Öz

İntihar toplumun tüm kesimleri için tehlike oluşturan bir olgudur. İntihar ile sosyoekonomik göstergeler arasında önemli bir ilişkinin mevcut olması kuvvetle muhtemeldir. Çalışmanın amacı intiharın sosyoekonomik göstergeler ile olan ilişkisini araştırmaktır. Çalışmada BRICS ve MIST ülke grubu üyelerinin 1990-2017 intihar sıklığı (her 100.000 kişi), kişi başına düşen gelir düzeyi, ortalama okullaşma, işsizlik oranı ve kanser vakalarının nüfus içindeki payı değişkenleri panel ARDL yöntemiyle analiz edilmiştir. Tahmin sonuçlarına göre intihar ile kişi başına düşen gelir ve ortalama okullaşma negatif ilişkilidir. Kanser vakalarının nüfus içerisindeki payı ile intiharın ilişkisi pozitiftir. İşsizlik oranı ve intihar arasında ise anlamlı bir ilişki bulunamamıştır. Çalışmanın belirli kısıtları ve intiharın çok yönlü belirleyicileri olması nedeniyle konuyla ilgili daha fazla çalışmaya ihtiyaç vardır. Gelişmekte olan ülkeler özelinde ekonomik gelişme ve intihar arasında ters yönlü bir ilişki olduğu söylenebilir.

Anahtar Kelimeler: *Ekonomik Gelişme, İntihar, Sosyoekonomi.*
JEL Sınıflandırması: *O11, I10, I15.*

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1. Introduction

More than 800,000 people die by suicide every year and many more attempt suicide. Every suicide causes a tragedy that affects families, communities and whole countries. It has long-lasting effects on the people left behind. In 2016, suicide was the second-leading cause of death among 15–29-year-olds globally. Suicide is not only a problem in developed countries, it is a global problem for the whole world. However, the fact that about 80% of the phenomenon of suicide occurs in low- and middle-income countries (WHO, 2021) - which E. Durkheim (2015) explained rather with development - leads to the questioning of the argument put forward as the inevitability of development.

Suicide rates, which affects people of all ages, are particularly high among men (Dattani et al, 2023). There is lack of conclusive evidence in the studies in literature about the relationship between suicide among women and economic development. However, it is highlighted that there has been an increase in suicide rates, particularly in economies that have shrunk as a result of the financial crisis. Suicide rates are observed to increase among men as a result of socioeconomic inequalities, in parallel with household responsibilities.

The suicide rate in the United States decreased between 1979 and 1999. Thereafter, however, the downward trend has ended and started to increase, accelerating significantly during the period that coincided with the onset of the 2007/8 financial crisis. Numerous studies contend that the rise in suicide rates at this time was caused by the crisis. Nevertheless, despite the fact that the economy has been recovering for years and the unemployment rate has greatly decreased, the upward trend in the suicide rate persisted following the financial crisis. As a function of this situation, problems related to the impact of the financial crisis on suicidality and, in particular, to the increase in the unemployment statistics came to the fore, some of which led to excessive suicide cases during the crisis. Therefore, this supports the claim that there is a significant inverse relations with economic situation and suicide statistics generally. (Abdou et al., 2020).

Although suicidality is a multifaceted phenomenon, socioeconomic considerations are given far too much weight. Since economic factors are regarded to be changeable in lowering suicide rates, these indicators are of utmost significance (Fountoulakis, 2020). While some research in the literature shows that expansion has unfavorable effects, other studies have demonstrated that health can deteriorate during downturn or when income falls. Suicide is an important consequence of fluctuations in economic conditions (Vandoros et al., 2020).

While income growth is a crucial objective for middle-income countries, it also affects social interactions and institutions. While the changing social structure alters patterns of production and consumption, it leads to differentiation in both disease and treatment patterns across countries as well. In particular, the treatment processes of diseases such as cancer are directly related to economic development. Particularly, there is a strong link between economic prosperity and the methods used to cure diseases like cancer. On the other hand, increasing mean schooling, one of the most significant measures of economic growth, raises social consciousness and helps in the struggle with diseases. Herein, improvements in the basic factors that provide development, such as income and education increases and more employment, have an important impact on controlling cases affected by economic and social factors such as suicide. In this direction, the study examined the relationship between some socioeconomic variables and cancer and suicide and attempted to linearly explain the long-term relationships between the variables.

2. Literature Review

Suicides are a significant exception to this trend, progressively rising during economic downturns, according to research on the issue, which demonstrates that mortality rates respond cyclically to economic growth. The instability in the socioeconomic structure that formed with the disintegration of the Soviet Union is vividly described in S. Alexievich's work (2016) “Secondhand Time: The Last of the Soviets”, despite the fact that it is currently stated that suicides spread

quickly, particularly during the economic collapse. E. Durkheim, on the other hand, explained suicides resulting from such social traumas with the concept of anomic suicide. The definition of egoistic suicide also included the explanation of suicide as a long-term phenomenon, typically accompanied by feelings of social isolation and loneliness (Kızılçelik and Erjem, 1994).

Although the relationship between suicide and economic development has not been well researched, there has been an increasing amount of research on this topic recently. In particular, the impact of macroeconomic development in developed and developing societies can lead to different outcomes. At this point, it is clear that the increase in income can have different effects on societies.

One of the pioneering investigations was conducted by Anderson and Moniruzzaman (2005), which demonstrated the connection between economic growth and suicide. Research findings show that suicide-related mortality rates decline significantly with economic development as people move from middle-income to high-income levels, while suicide rates generally increase as people move from low-income to middle-income levels. While research findings suggest that suicide-related death rates decline significantly with economic development as people move from middle-income to high-income levels, suicide rates generally increase as people move from low-income to middle-income levels. The early years of the recession saw a 33% increase in suicide-related deaths in Greece, according to research by Fountoulakis (2020) on the association between austerity policy adopted during the first years (2009-2015) of the recession and suicide. The researcher concluded that one-third of these cases could be directly attributed to unemployment, one-third to the recession, and one-third to unknown causes. Zhang et al. (2010) examined the relationships between economic growth and changes in suicide rates for the period 1982-2005 in China. Their results support the hypothesis that the suicide rate has declined sharply thanks to economic development. Chang et al. (2013) examined the impact of the 2008 crisis on suicide rates in Europe and concluded that crisis-related unemployment increased suicide rates in Europe, particularly among men. Alicandro et al. (2019) used data of 1990-2015 in their study to examine whether the 2008 global crisis had an impact on suicides. Their results showed that the number of suicides declined in the 2000s, with the largest decline in some Eastern European countries. However, they discovered that in the years following the 2008 crisis, suicide rates rose once more. The pre-crisis declining trend in suicide rates was found to have ceased in the United Kingdom, Germany, Italy, and Spain. In addition, the study discovered a long-term rise in instances in Brazil, Mexico, the United States, and Australia.

Abdou et al. (2020) examined the relationship between job performance and suicide in the United States and investigated the long-run relationship between monthly S&P500 stock market data and age- and gender-specific suicide rates between January 1999 and July 2017. They find a clear positive association between business performance and suicide rates for the youngest males and females aged 15–34 years. Amini et al. (2020) studied the determinants of suicide in the Middle East and North Africa countries (MENA) countries and concluded that alcohol and drug use play a role in the occurrence of suicide in low- and middle-income countries, especially in low- and middle-income countries. In this context, they stated that more studies should be conducted in areas where suicide is considered a social stigma and crime, and that national and regional strategies should be on the agenda, depending on how accurately cases are identified. Milner et al. (2020) examined the relationship between gender equality and suicide in 87 countries for the period 2006-2016. In their results, they found that suicidality decreased as conditions for gender equality improved, especially for women, but they could not find a significant result between gender equality and suicidality among men. Alothman and Fogarthy (2020) examined gender differences in global suicide rates on the basis of religion, geographical location and other social and community factors. According to their results, although male and female ratio for deaths from suicide in predominant religious societies differ between continents, they showed that there is a strong correlation. Accordingly, they observed that male and female suicide ratio was higher in the U.S., while this ratio had a lower value in Asia and Africa. They found that the predominantly

Christian countries revealed the highest male and female suicide ratio, whereas the predominantly Hindu countries revealed the lowest.

Okada and Samreth (2013) examined the effects of socio-economic determinants of suicide in 13 OECD countries. In nine countries, they revealed that an increasing effect of divorce and a decreasing action of real GDP per capita on suicide rates. In four countries, in terms of fertility rates, results examine that the increase led to a decrease for suicide and a rise in one country. Leinsalu et al. (2020) studied suicide cases in the population of the Baltic countries in times of economic expansion and contraction. According to the results, it was found that the number of suicides among men with higher education levels increased in times of crisis, while the number of suicides among men with lower education levels was lower in times of recession. Coope et al. (2014) examined the association between suicide and economic development among men and women of different age groups in England and Wales for the period 2001-2011. While no evidence was found in the results for women, it was observed that unemployment, especially among young men, rose monotonically with the 2008 crisis period. Male suicide rates in low-development regions have shown signs of decline for a decade. At the same time, suicide rates in the lowest-development regions are very low compared to other low-development regions. Bray and Gunnell (2006) examined the relationship between suicide and life satisfaction and happiness and claimed that the relationship is negative between the variables.

3. Dataset and Method

The data set for the study was obtained from the databases of World Bank and Our World in Data. Data for the period 1990-2017 were used for the study. Since it was not possible to collect all middle-income country data in a healthy manner, certain countries were included in the study. In this framework, it was planned to conduct a study specifically for the BRICS group of countries and MIST. Another important detail of the investigation is that South Korea, which belongs to this group of countries, was not included in the model due to its high per capita income. Instead of Korea, Argentina and Ukraine were added to the model from the developing country group. Therefore, the study of the relationship between suicide and the other economic and social factors, and behavior in countries with a similar economic structure that belong to the category of middle-income countries can be cited as another important reason for not including a country with a relatively high per capita income in the model. Of the variables for the study, per capita income and the unemployment rate taken from the World Bank, and the percentage of cancer cases in the population and the mean schooling were taken from the Our World in Data database. The model was built by taking the logarithms of the variables. However, the study was conducted without the logarithmized values of suicide incidence, and the analyzes were performed by creating a semi-logarithmic model. However, since the logarithm of the proportion of cancer cases in the population includes negative values, a constant was added to the model, as shown in the formula below, in this way.

$$y = \ln(x + \sqrt{x + (x^2 + 1)} \quad (1)$$

In the study, a model was created to investigate the impact of cancer on income and income distribution, and the behavior of the influence of the Kuznets model on cancer and income distribution in middle-income countries was investigated. The rise in cancer cases at young ages, particularly in underdeveloped and developing country group, and the rise in cases as the population expands are two of the most crucial processes in the origin of this study. While creating the data of the study, studies in the literature were utilized. Variables were created based on Zhang et al. (2010), Chang et al. (2013), Antonakakis and Collins (2018), Leinsalu et al. (2020), Lari and Seifddashti (2023).

The model used in the study is as follows:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 t_{it} + \beta_3 z_{it} + \beta_4 m_{it} + \varepsilon_{it} \quad (2)$$

In the model used in the study, the following values refer to the meaning given next to them;

"y_{it}" : suicide rate in the middle-income countries, (Logint)

"x_{it}" : GDP per capita, (Loggdp)

"t_{it}" : unemployment rate, (Logis)

"z_{it}" : mean schooling, (Loguni)

"m_{it}" : the share of cancer cases in the population, (Logcancer)

"β" : the coefficient of the independent variables,

i: cross-sectional level,

t: time level.

The tests used in the study of the model are the unit root test, the cointegration test, the Hausman test, and the estimator test. In this direction, the Autoregressive Distributed Lag (ARDL) estimator is used to estimate the model, depending on the results of the unit root test.

3.1. ARDL Process

The ARDL form for the first model is as follows:

$$\text{Suicide}_{it} = \alpha_i + \sum_{j=1}^{m-1} \beta_{ij}\Delta\text{Suicide}_{i,t-j} + \sum_{l=0}^{n-1} \varphi_{il}\Delta\text{GDPPC}_{i,t-1} + \sum_{r=0}^{p-1} \gamma_{ir}\Delta\text{Unemployment Rate}_{i,t-r} + \sum_{u=0}^{s-1} \theta_{iu}\Delta\text{Mean Schooling}_{i,t-u} + \sum_{w=0}^{v-1} \delta_{iw}\Delta\text{Cancer}_{i,t-w} + \sigma_1\text{CancerS}_{i,t-1} + \sigma_2\text{GDPPC}_{i,t-1} + \sigma_3\text{Unemployment Rate}_{i,t-1} + \sigma_4\text{Mean Schooling}_{i,t-1} + \sigma_5\text{Cancer}_{i,t-1} \quad (3)$$

3.2. Unit Root, Cointegration Test and PMG Process

With respect to macroeconomic data, it is of great importance that the series are stationary. In order to create a reliable estimation method for the regression, unit root tests should be performed. In this direction, the first-generation unit root tests of Im, Pesaran&Shin (IPS), and Levin, Lin & Chu (LLC) are applied in research.

The unit root test of Levin, Lin & Chu uses error terms with heterogeneous serial correlations in the model that assume homogeneous first-order autoregressive parameters. It validates the restriction between equations on the partial first-order autocorrelation coefficients of the LLC null hypothesis. This provides more meaningful results than performing different unit root tests for each segment in the name of the LLC test. The LLC also assumes homogeneous autoregressive coefficients for each cross-section (Barbieri, 2005).

The LLC unit root test is expressed in the following form:

$$\Delta y_{it} = \rho y_{it-1} + \alpha_{0i} + \alpha_{1i}t + u_{it} \quad (4)$$

i = 1,2,..., N , t = 1,2,...,T

While α_{1it} represents the time effect in the model, α_i indicates the cross-sectional effects. The deterministic components in the model are important for the homogeneity of the model. This is because the coefficient on the lagged dependent variable is homogeneously constrained in all units of the panel. However, the LLC test is subject to certain limitations. For example, the LLC test is not applied when there is intercept dependence (Barbieri, 2005).

$$t_p^* = \frac{t_{p=0}\text{-}N\tilde{T}\hat{S}_N\hat{\sigma}_{\tilde{\varepsilon}}^{-2}\text{RSE}(\hat{\rho})\mu_{m\tilde{T}}^*}{\sigma_{m\tilde{T}}^*} \quad (5)$$

In the model, $\mu_{m\tilde{T}}^*$ and$\sigma_{m\tilde{T}}^*$ are the correction values for mean and standard deviation. The IPS unit root test suggests a new one, flexible, and have easy procedure for unit root tests that using the panel probability framework. Moreover, this test allows for cross-slice heterogeneity and error

variances with serial inter-slice correlation. The model IPS can be expressed in the following form: (Barbieri, 2005)

$$\Delta y_{it} = \alpha_{0i} + \rho_i y_{it-1} + \sum_{j=1}^{\rho_i} \varphi_{ij} \Delta y_{it-j} + \varepsilon_{it} \quad (6)$$

After applying the unit root test in the study, Pedroni cointegration test is applied, where the long relationship is examined as a function of the stationarity of the series in I(1). Pedroni proposed analytical methods in 1997, 1999, 2000, and 2004 that support the formation of a heterogeneous structure. The Pedroni test differs from the Kao test by allowing a cross-sectional assumption trend and multiple explanatory regressors. (Asteriou and Hall, 2007). This allows the using of more variables in the model.

The advantages of the Pedroni test over other tests can be summarized as follows:

1) Allows for more than one explanatory variable,

2) Diversifies the cointegration vector along the cross sections,

3) Allows for heterogeneous behavior of the errors along the sections (Asteriou and Hall, 2007).

In the Pedroni test, seven different analyzes were created to express the intra- and intersectional effects. While four tests are created in the intra-sectional analysis, three tests are formed in the intersectional analysis.

The Pedroni cointegration analysis is expressed in the following form

$$y_{i,t}=\alpha_i+\delta_i t+\beta_{1i}x_{1i,t}+\beta_{2i}x_{2i,t}+\ldots+\beta_{mi}x_{mi,t}+\varepsilon_{it} \quad (7)$$

Where α : fixed effect parameter, δ : deterministic time trend, β : slope coefficient, t : time level, and i : section level (Pedroni, 1999).

$$y_{it}=\alpha_i+\beta_1 x_{it}+\beta_2 t_{it}+\beta_3 z_{it}+\beta_4 m_{it}+\varepsilon_{it}+\mu_{it} \quad (8)$$

Where "ε_{it}" : error term, "μ_{it}": group effect. According to the results of the unit root test of the model, the logarithmic values of the variables suicide frequency, per capita income, mean schooling, and the share of cancer cases in the population are stationary at I(1) under different unit root tests, while the variable unemployment rate is stationary at I(0), according to the results of the LLC unit root test. In this case, as applied in the workings of Pesaran et al. (1999), Blackburne and Frank (2007), Mert and Bölük (2016), the ideal and maximum lag was equal to 1 and the ARDL equation should be indicated in the following form (Mert and Bölük, 2016).

$$\begin{aligned}\mathrm{LogINT_{it}} = {} & \psi_{10i}\mathrm{LogGDP_{it}} + \psi_{11i}\mathrm{LogGDP_{i,t-1}} + \psi_{20i}\mathrm{LogIS_{it}} + \psi_{21i}\mathrm{LogIS_{i,t-1}} + \\ & \psi_{30i}\mathrm{LogUN\dot{I}_{it}} + \psi_{31i}\mathrm{LogUN\dot{I}_{i,t-1}} + \psi_{40i}\mathrm{LogCANCER_{it}} + \psi_{41i}\mathrm{LogCANCER_{i,t-1}} + \\ & \zeta_i\mathrm{LogINT_{i,t-1}}\mu_i + \eta_{it}\end{aligned} \quad (9)$$

Based on the above equation, another type of equation regarding the error correction form should be indicated as follows:

$$\begin{aligned}\Delta Log\mathrm{INT_{it}} = {} & \emptyset_i\left(\mathrm{LogINT_{i,t-1}}\text{-}\xi_{0i}\text{-}\xi_{1i}\mathrm{LogGDP_{it}}\text{-}\xi_{2i}\mathrm{LogIS_{it}}\text{-}\xi_{3i}\mathrm{LogUN\dot{I}_{it}}\text{-}\xi_{4i}\mathrm{LogCANCER_{it}}\right) + \\ & \psi_{11i}\Delta\mathrm{LogGDP_{it}} + \psi_{21i}\Delta\mathrm{LogIS_{it}} + \psi_{31i}\Delta\mathrm{LogUN\dot{I}_{it}} + \psi_{41i}\Delta\mathrm{LogCANCER_{it}}\end{aligned} \quad (10)$$

4. Results

While per capita income and mean schooling are used in the literature as indicators of development, these two variables are expected to have a reducing effect on suicides in developing countries. As a welfare indicator, per capita income and schooling can reflect the path of economic development of developing countries, especially in the long run. On the other hand, while the unemployment rate, which is one of the most important economic problems in a social sense, most likely has an effect on suicide, the perception of despair caused by the occurrence of cancer, which

is a reflection of practices that distort nature for development, is expected to have a suicide-increasing effect. Table 1 expresses descriptive statistics of variables.

Descriptive statistics are included in Table 1. The values of the series are generally close to each other and there are 280 observations. Since the Skewness and Kurtosis values of the series are less than 3, it can be stated that series have normally distribution.

Tablo 1: **Descriptive Statistics**

	Suicide	**Loggdp**	**Loguni**	**Logis**	**Logcancer**
Mean	17.31746	3.676086	0.8627791	0.8410387	0.8143214
Min.	3.022	2.725095	0.4712917	0.024075	0.22
Max.	50.501	4.174147	1.079181	1.436624	1.78
Median	15.7215	3.838251	0.8627791	0.8228197	0.745
Std. Dev.	11.93409	0.3607469	0.1392307	0.2569982	0.3824814
Skewness	0.6892793	-0.9225289	-0.5250173	0.4578574	0.4842405
Kurtosis	2.422345	2.784075	2.672706	3.131233	2.627264
Obs	280	280	280	280	280

Table 2 shows correlation matrix results.

Table 2: **Correlation Matrix**

	Logint	**Loggdp**	**Loguni**	**Logis**	**Logcancer**
Logint	1.0000				
Loggdp	-0.5102	1.0000			
Loguni	0.2669	0.4459	1.0000		
Logis	-0.0259	0.3628	0.3906	1.0000	
Logcancer	-0.0366	0.0393	-0.1828	-0.0452	1.0000

According to results, income per capita, unemployment rate, the share of cancer cases in the population have negative correlation with suicide, while mean schooling have positive correlation with suicide. Table 3 expresses cross-sectional dependance test results. Table 4 and Table 5 express first generation unit root test results.

Table 3: **Cross-Section Dependance Results**

Variable	**Breusch-Pagan LM**	**Pesaran scaled LM**	**Bias-corrected scaled LM**	**Pesaran CD**
Logint	513.1332***	49.34557***	49.16039***	11.04203***
Loggdp	843.2672***	84.14475***	83.95956***	27.90820***
Loguni	1122.293***	113.5567***	113.3715***	33.48101***
Logis	150.8482***	11.15738***	10.97219***	3.522042***
Logcancer	761.7336***	75.55036***	75.36517***	23.98477***

***,**,* showed 10%, 5%, 1% significance level.

Table 4: **Unit Root Test Results (First Generation)**

Variables	**IPS (Constant)**				**IPS (Constant and Trend)**			
	I(0)	**t stat**	**I(1)**	**t stat**	**I(0)**	**t stat**	**I(1)**	**t stat**
Suicide Frequency	0.6975	0.5172	0.0000	-4.6516	0.1963	-0.8551	0.0006	-3.2175
GDP per capita	0.9935	2.4861	0.0000	-5.3727	0.1226	-1.1622	0.0008	-3.1702
Mean Schooling	0.0002	-3.6049	-	-	0.8022	0.8496	0.0000	-4.5082
Unemployment rate	0.0084	-2.3903	-	-	0.1839	-0.9008	0.0000	-4.2908
Cancer Case/Population	0.9506	1.6505	-3.2802	0.0005	0.8852	1.2014	0.0043	-2.6315

According to the results, series are statistically significant at the 1% significance level. There is a cross-sectional dependance between the series. Accordingly, it can be stated that a shock in one cross-section will also affect other cross-sections. In cases where the relationships between the series are interdependent, unit root tests should continue with second generation unit root tests.

However, both first (IPS, LLC) and second generation unit root tests (CIPS) are applied in the model to support inter-series tests.

Table 5: **Unit Root Test Results (First Generation- Continued)**

	LLC (Constant)				LLC (Constant and Trend)			
	I(0)	**t stat**	**I(1)**	**t stat**	**I(0)**	**t stat**	**I(1)**	**t stat**
Suicide Frequency	0.2094	-0.8086	0.0000	-5.0334	0.0061	-2.5069	-	-
GDP per capita	0.1296	-1.1283	0.0000	-4.7079	0.0565	-1.5852	0.0000	-3.4702
Mean Schooling	0.0000	-7.8257	-	-	0.0886	-1.7494	0.0285	-4.7438
Unemployment	0.0474	-2.6710	-	-	0.0444	-2.7018	-	-
Cancer Case/Population	0.8321	0.9623	0.0000	-6.6038	0.9992	1.1474	0.000	-4.1197

According to the results of the IPS and the LLC unit root test, suicide frequency, incpme per capita, mean schooling, unemployment rate, and the percentage of cancer cases in the population, as well as the t-statistics are shown. The results of the IPS test show that the suicide frequency, per capita income, and the percentage of cancer cases in the population contain a unit root in both constant and trend included models at the I(0) level and that they are stabilized by the first differences at the I(1) level. Mean schholing and the unemployment rate are stationary at the I(0) level in the constant included model. According to the LLC unit root test, suicide frequency, per capita income, and the percentage of cancer cases in the population in the constant included model contain a unit root at the I(0) level and are stabilized at the I(1) level by using their first difference. Mean schooling is stationary at the I(0) level in the constant included model and is stabilized by first difference in the constant and trend included models. The suicide incidence rate is stationary at the I(0) level in both the constant and trend models. The unemployment rate, on the other hand, is stationary at the I(0) level in both the constant and trend included models. Since the model contains stationary variables at the I(0) level, after unit root test results in the model, the long-run relationship of the variables is indicated first, and the MG or PMG test is used in the next steps according to the results of the Hausman test. Table 6 shows second generation unit root test results.

Table 6: **Unit Root Test Results (Second Generation)**

	Constant			Constant+Trend		
	I(0)		**I(1)**	**I(0)**		**I(1)**
Suicide Frequency	-1.891		-2.990	-1.962		-3.942
GDP per capita	-1.948		-3.162	-2.036		-3.676
Mean Schooling	-2.694		-	-3.192		-5.076
Unemployment	-1.883		-4.222	-2.406		-4.304
Cancer Case/Population	-1.731		-3.653	-1.278		-4.015
Critic Values	10%	5%	1%	10%	5%	1%
	-2.12	-2.25	-2.51	-2.76	-2.94	-3.3

According to the results of Pesaran (2007) CIPS test, both the constant and constant+trend versions of the series contain unit roots since the test statistics of the series are smaller than the table critical values at the 5% statistical significance level in absolute terms. Only the absolute values of the test statistics for the constant+trend version of mean schooling are greater than the critical values and the series is stationary at level. Accordingly, all variables except mean schooling contain unit roots at level values, but are stationary when first differences are taken. Only mean schooling is level stationary. Critical values obtained from Pesaran (2007).

Based on the results of the first and second generation unit root tests, it is concluded that some variables are stationary at level in all tests. Therefore, ARDL method can be utilized in the estimation process. ARDL provides significant advantages in evaluating the relationships between

variables by making both short and long-run forecasts. Due to the long-run estimation possibility of the ARDL method, cointegration tests were not performed after the second generation unit root process. However, Pedroni and Kao cointegration tests were applied after the first generation unit root tests as also found in the literature. Table 7 and 8 indicates long-run relations.

Table 7: **Cointegration Test Results (Pedroni)**

Model	Statistics	Probability	Weighted Statistics	Probability
Panel v	-1.755930	0.9604	-2.490645	0.9936
Panel rho	-0.211138	0.4164	-2.743842	0.0030
Panel PP	-2.220741	0.0132	-5.493104	0.0000
Panel ADF	1.596371	0.9448	0.581388	0.7195
Group rho	0.629016	0.7353		
Group PP	-1.973561	0.0242		
Group ADF	0.797901	0.7875		

According to the results of the table, there is at least one cointegration relationship between the variables related to the group PP among the panel statistics among the panel PP group statistics. In this direction, it is possible to speak of a long-term relationship in the model. On the other hand, the results of the Kao cointegration test are also shown in the following table:

Table 8: **Cointegration Test Results (Kao)**

	t-statistic	Prob.
ADF	-2.479407	0.0066
Residual Variance	0.000375	

According to the results, it is possible to infer from the table's findings that the variables have a long-run relationship. Table 9 shows the Hausman test results.

Table 9: **Hausman Test Results**

	Coefficients				
	b (MG)	B(PMG)	(b-B) Difference	sqrt(diag(V_b-V_B))	b (MG)
loggdp	.6001373	-.9916741	1.591811	1.642603	.6001373
logis	.5097599	-.3076022	.8173621	1.491757	.5097599
loguni	-1.270569	-1.229226	-.0413423	2.577646	-1.270569
logcancer	-8.974569	30.07975	-39.05432	43.29829	-8.974569
loggdp	.6001373	-.9916741	1.591811	1.642603	.6001373

Prob>chi2 = 0.1897

H_0: PMG estimator is valid.

H_1: MG estimator is valid.

Table 10: **PMG Estimation Results**

		Coefficient	Std. Error	P Value
Long-run	loggdp	-0.9916741	.0678546	0.000
	Logis	-0.3076022	.0597731	0.125
	loguni	-1.229226	.2185281	0.000
	logcancer	30.07975	2.935498	0.000
Short-run	ECT	-.0752356	.0364691	0.039
	loggdp	.0709152	.1081169	0.512
	Logis	.0175601	.0085876	0.441
	loguni	-.0308789	.1559925	0.843
	logcancer	-.3216705	.4720966	0.496
	Cons_	-.3019471	.1460814	0.039

Table 11: **Short Term Error Correction Model Results (ECM)**

Model	Coefficient	Std. Error	P Value
Argentina	-0.0691567	0.0239523	0.004
Brazil	-0.0150141	0.0038857	0.000
China	-0.0293347	0.0256987	0.254
Indonesia	-0.0056783	0.0098691	0.565
India	-0.0009419	0.0020552	0.647
Mexican	-0.0204569	0.0095868	0.033
Russia	-0.2059674	0.0287307	0.000
South Africa	-0.1200064	0.0206743	0.000
Turkey	0.01997	0.0097523	0.041
Ukraine	-0.3357977	0.0360791	0.000

The test findings show that since the probability value is greater than 0.05, the null hypothesis cannot be rejected. The PMG test is used for estimation. The probability value indicates that the PMG estimator provides a more consistent result than the MG estimator. Table 10 shows Pooled Mean Group estimation result.

According to the results of the estimation with the PMG estimator, the variables do not contain significant results in the short-run, while the variables, with the exception of the per capita unemployment rate, contain significant results in the long run.

Accordingly, per capita income, mean schhooling, and cancer incidence rate are significant in the long run. When per capita income and mean schooling are interpreted as coefficients, they show a negative effect on suicide frequency in this direction.

Similar results were found with Anderson and Moniruzzaman (2005), Zhang et al. (2010), Alicandro et al. (2019), Okada and Samreth (2013), who focused on middle-income countries and predicted an inverse association between income and suicide.

It was noted that the conditional findings of Leinsalu et al. (2020) regarding the increase in suicide among the educated population in times of crisis apply here without qualification.

With respect to unemployment, on the other hand, a contrary result with Fountoulakis (2020) was obtained, while parallel results with Chang et al. (2013) and Coope et al. (2014).

The effect of the share of cancer cases in the population is positive. On the other hand, as expected, the coefficient for the short-term error correction is significant at the 1% statistical level and contains a negative value between 0 and 1. The coefficients and probability values of the terms for the short-term error correction for the sections of the model are shown in the following table.

According to the results in the table, the error correction coefficients for the cross sections are negative, negative and significant between 0 and -2 at the 1% significance level, as expected in many countries.

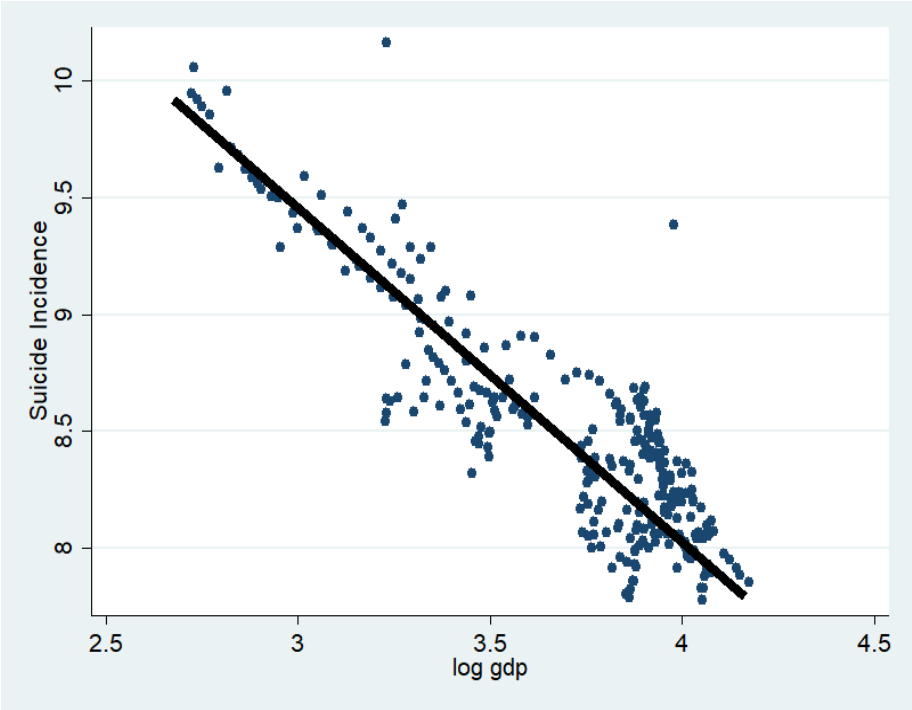
The fact that the ECM coefficient is between 0 and -2 suggests that the shocks that occur in the trend stabilize in less than 1 year (Olczyk and Kordalska, 2016).

However, the error correction coefficients in Argentina, Brazil, Mexico, Russia, South Africa, Turkey, and Ukraine are significant at the 5% level. However, the error correction coefficient in Turkey is positive and will not recover in the event of a shock.

In other sections, according to the estimation results, the impact of a shock that may occur in the model will pass in less than 1 year and the model will return to equilibrium.

According to the PMG estimation results, the relationship between per capita income and the suicide frequency is presented in a graph. The relationship between suicide frequency and per capita income is negative.

Graph 1: **Relationships Between Suicide and GDP Per Capita**



5. Conclusion

In middle-income countries, the increase in income leads to a decrease in suicides. This shows that the increase in social welfare also gives hope for life and supports the improvement of life expectancy. If mental health problems are excluded, it can be concluded that suicide is closely related to economic conditions. However, there are many studies on suicide with different dimensions in the literature. However, it contains a strong phenomenon in the economic dimension. On the other hand, the decrease in suicide with mean schooling is a sign in another dimension that the increase in social education level reduces harmful factors such as suicide. Higher education increases the number of conscious individuals in society, which contributes to the development of human capital and social consciousness. The fact that the increase in income together with the level of education has a negative effect on the suicide rate shows that middle-income countries continue their development process and that they continue their structural changes during the process of income increase. On the other hand, the increase in economic development will improve the individual quality of life in developing countries, leading to an improvement in average life expectancy and an increase in social welfare. Factors such as the development of technology, increased awareness, and medical developments have brought certain benefits to low- and middle-income societies in reducing suicides. However, one of the important points drawing attention to cancer is that most of the research and spending on cancer is done by high-income countries. However, the fact that cancer has a positive impact on suicide rates shows that middle-income countries need to move forward in the fight against the disease. The continued hope of a cure, especially for fatal diseases, is likely to discourage people from committing suicide. Moreover, treatment success will be both an indicator of economic development for middle-income countries and help reduce the loss of social capital.

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