# Investigation of Economic Factors Influencing GDP: An Empirical Study on European Countries

ALIG BAGHIROV[1], BASTİ ALIYEVA[2], TEYMUR SARKHANOV[2]
[1]Reserch for Monetary Economics, [2]Department of Economics and Business
[1,2]Azerbaijan State University of Economics (UNEC)
Istiqlaliyyat str.6, AZ1001, Baku
AZERBAIJAN

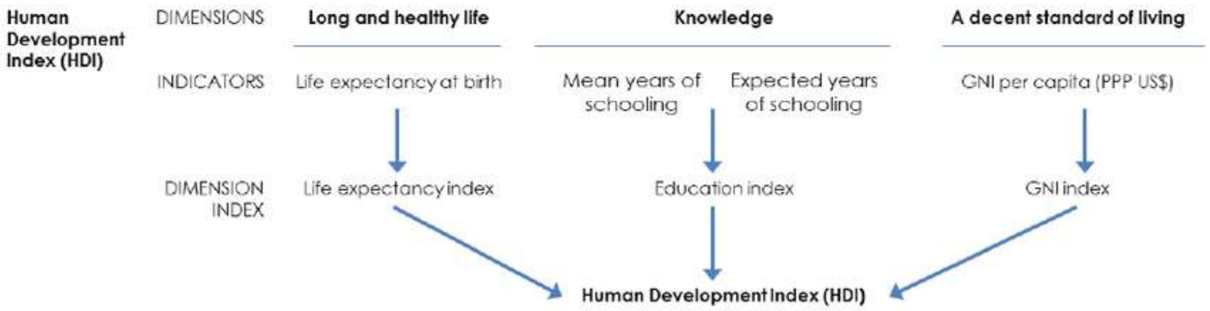
*Abstract:* In this study, it was used the long-term Pedroni cointegration test to analysis the relationship between overall turnover, the share of individuals using the Internet in the population, Human Development Index (life expectancy index, education index & GNI index), Population and GDP per capita on based annual panel data set of 12 European countries in the context of the GDP per Capita model over the period from 1998 to 2020. According to the DOLSMG results, the t statistics of turnover, human development index and population variables at the 1% significance level were found to be significant in the long run for the entire panel and turnover, human development index and variables, expect for the share of individuals using the internet in the population affect GDP per capita. Although it was insignificant in the long run for the entire panel in terms of the share of individuals using the internet in the population, except for Austria, it was significant Belgium at the 5% significance level and all other countries at the 1% significance level.

*Key-Words:* GDP per Capita, Internet Users, HDI, Durbin Hausman Cointegration test

Received: June 26, 2021. Revised: July 13, 2022. Accepted: August 9, 2022. Published: September 27, 2022.

## 1 Introduction

Since the beginning of the 1990s, individual internet users have started to increase rapidly. By the late 1990s there were approximately 10,000 Internet service providers (ISPs) around the world, the number has been more than 25 million subscribers by 2000 and 4.66 billion by 2020. In addition, globalization, rising living, and communication standards have increased the internet addiction of countries. The number of Individual Internet Users played an important role in the economic and commercial impact of the COVID 19 Pandemic. The facilitation and rapid growth of online commerce leads to an increase in the number of individual internet users, which contributes to sustainable economic growth. This has been discussed by many economic researchers around the world, for example, as Balassa (1985) hypothesized, export growth has a significant impact on economic growth [1]. Meanwhile, different views emerged on the relationship between exports and economic growth in the world [2]. Rahman and Mustafa determined the direct proportional relationship between exports and economic growth in their research on 13 countries in Asia [3]. Since 1990 Calculated using globally comparable data, the global HDI, one of variables in analysis, had three dimensions: a long and healthy life, knowledge, and a decent standard of living. HDI indicator is calculated as below [4] A country's growth rate is revealed in its Gross Domestic Product (GDP) per Capita. The influence of manpower resources is shown in the HDI value, which can affect the level of economic growth in GDP [5].




The randomly selected European Union countries for this study, Austria, Belgium, Czech, Estonia, Finland, Greece, Norway, Hungary, Iceland, Latvia, Luxembourg and the Netherlands can be summarized as follows: Observations that a broader conclusion can be drawn about how changes in the proportion of Internet users, total trade volume, and the Human Development Index can alter the impact on GDP in these selected countries: the recent COVID 19 pandemic has led to an increase in internet users' online commerce and increased interest in commerce in countries with industrialized and developed economies that are members of the European Union. In 2019, the share of the European Union in GDP per capita was approximately 15.4 percent and the total turnover volume with the world was 29 percent. While the share of world average internet users in the population was 56.73%, this figure was 83.84% in European Union countries in 2019.

In this study, we investigated the relationship between GDP and Internet users, total trade volume and Human Development Index in the example of some European countries with the long run cointegration test. We suppose to contribute to the literature on the following points mentioned in the study: i) the number of articles in the literature for European countries where important incentive policies have recently been implemented in relevance to internet users, Human Development Index and turnover at macroeconomic level is comparatively small; we expect that this study will make an important contribution to the literature at the point of eliminating this deficiency; ii) instead of a single model in the study, a multivariate model is used, including overall turnover, the share of individuals using the Internet in the population, Human Development Index (Life Expectancy Index, Education Index & GNI Index) and Population; This article consists of 5 Sections: In Section 2, the literature is presented, in Section 3, the data and methodology are introduced, in Section 4, the findings, Findings are presented according to the results of the analysis and finally, the conclusions and policy recommendations are offered.

## 2 Literature Review

When macroeconomic performance and sustainable development goals are examined in a rapidly globalizing economy, it has seen that researchers have paid more attention to this issue in recent years [6]. In other to provide a comprehensive perspective, this study aims to use the GDP per capita as an indicator of the investigation of economic factors that cause economic growth in analyzing the relationship between overall turnover, the share of individuals using the Internet in the population, Human Development Index and Population for chosen European countries. The literature is examined in four parts in the term of independent variables.

### GDP per Capita hypothesis with Overall Trade

This study worked by Mustapha Ben Hassine and Nizar Harrathi in 2017 was investigated the causal relationship between trade, renewable energy consumption and financial development and real gross domestic product for the 6 Gulf Cooperation Council countries between1980-2012 using Granger Causality and Panel Cointegration tests. As a result, it has been seen that exports have a positive effect on GDP and 1% increase in exports and 0.456% increase in GDP [7]. In this study by Perry Sadorsky in 2011, it was used panel cointegration regression techniques to examine the relationship between energy consumption, output and trade for 7 South American countries between 1980 -2007. According to the results of Panel cointegration tests, there is significant relationship between GDP and Imports, and exports for a long-run dynamics and a bidirectional feedback relationship between GDP and exports and imports for short-run dynamics [8]. Using a panel vector auto-regressive model by Walid Belazrega and Kais Mtar, it was investigated relations between financial development, innovation, trade openness, and economic growth in 27 OECD countries for the period of 2001 - 2016. According to results of analysis, there is a bidirectional relationship between economic growth and trade [9]. In this study by Serdar Birinci in 2013, it was used panel VAR regression to analysis the relationship between economic growth, the size of informal economy and trade openness on based quarterly panel data set of 12 OECD countries over the period from 1964:1 to 2010:4. As a result of the analysis, it was determined that there is a bidirectional positive relation between trade openness and economic growth [10].

**GDP per Capita hypothesis Internet Users**

In this study by Huub Meijers in 2014, it was used panel Granger causality test to analysis the relationship between Internet use, international trade, and GDP per capita on based annual panel data set of 162 countries over the period from 1990 to 2008. Initially, the positive effect of internet use on growth is confirmed, but it is seen that the positive effect of internet use on growth can be eliminated by using a precisely defined growth model. A Granger causality analysis between Internet use, international trade, and GDP per capita was predicted not to lead strong results in all cases [11]. In the article worked by Fennee Chong, Venus Khim-Sen Liew and Rosita Suhaimi it was utilized panel ARDL Dynamic Model to analysis long-run and short-run relationship between gross national income per capita and internet user on based the annual data covers of Malaysia for period of 13 years from 1997 to 2010. Empirical findings from the econometrics analysis of a thirteen years' time series found that there is a significant long-run and short-run relationship between these two variables [12]. This study by Gholizadeh, H. et al in 2014 aimed at finding the relationship among publication, gross domestic product (GDP) and internet usage among ASEAN and the world's top ten countries for period of 13 years from 1996 to 2011. According to the result of the study, a positive and significant relationship was observed between indices, GDP and internet usage for these countries [13]. In this study by Margarita Billon Jorge Crespo and Lera-Lo´pez in 2017, it was estimated using a panel-data approach to analysis the relationship between Internet use, educational inequality and economic growth on based a panel data set of 94 countries between 1995 and 2010. It is concluded that internet use has a positive and significant effect on economic growth [14].

**GDP per Capita hypothesis with Human Development Index**

In the study by Zhaohua Wan et al. it was analyzed the linking between economic growth, renewable energy consumption and human development index in Pakistan by using VECM Granger casualty approach for the period of 1990-2014. According to the result of analysis, there is a significant negative relationship between economic growth and human development index and Economic growth has decreased human development process in Pakistan during the years [15]. Khalafalla Ahmed Mohamed Arabi and Suliman Zakaria Suliman Abdalla has investigated the impact of human capital index on economic growth for Sudan over the period of 1982-2009 by using a simultaneous equation model. As result there is a positive impact of HDI on economic growth [16]. In the study by Elena Pelinescu it was analzyed the impact of human capital index on GDP per capita on based data set of some European Countries using Pooled Least Squares model for the period 2000-2012. According to result of the model it was revealed a positive and statistically significant relationship between

GDP per capita and human capital index as expected according to economic theory [17].

**GDP per Capita hypothesis with Population**

Three theories have been put forward in the literature regarding the relationship between economic growth and population growth. There is negative relationship in term of the first theory, positive relationship in term of the second theory and no relationship in term of the third theory between populations with economic growth. In the study made by Mehmet Ali Polat, the effect of population and employment increase on economic growth, which is a dimension of development, was tried to be explained by compiling 1998 – 2015 Turkey data as an Econometric time series model. According to the Johansen cointegration test, the variables are cointegrated and according to the VECM (vector error correction model), there is a long-term relationship between the variables [18]. In this study by Adem Karakaş, it was investigated the relationship between national income, population, and electricity consumption on based annual panel data set of 22 OECD countries and 22 non-OECD countries with the highest national income over the period from 1990 to 2011. According to result of analysis, there is also bi-directional causality between population and national income [19]. In the study by Mehmet Vahit Eren, it was investigated the relationship between population growth and development on based annual panel data set of sub-Saharan African countries by the panel data analysis method over the period of the 1990-2017. According to result of analysis, there is relationship between population growth and development [20].

# 3 Data, Models and Methodology

## 3.1 Data

3 models were established in the study. In the first and second models respectively, it was investigated the impact of the share of individuals using the Internet in the population, human development index, Population on GDP per capita and overall turnover and in the first, the impact of the share of individuals using the internet in the population, human development index, population, and overall turnover on GDP per capita. In order to analyze of the data collected from the sources shown in Table 1, the panel time series analysis was performed with the STATA 2017, GAUSS 16 and E-Views 12 package programs In terms of the suitability of the tests, which is a statistical and econometric program for economic sciences. In the study some data was not available for some of the years or countries, so the dataset was chosen for which all the data for all the relevant years and countries were available and It was then tested to confirm or reject the validity of the hypothesis. Thus, it was chosen the dependent and independent variable data of 15 European Countries between the period 1998-2020 and All data used in the analysis has been converted into logarithmic form. Table 1 below shows the main sources from which the data were obtained.

**Table 1. Independent and Dependent Variable by data source**

| Symbol | Definition | Unit | Source |
|---|---|---|---|
| **GDPPC** | GDP per capita, current prices (PPP; international dollars) | In U.S. dollars ($) | International Monetary Fund, www.imf.org |
| **OT** | Overall turnover with the world | In U.S. Billion dollars ($) | International Trade Centre (ITC) www.trademap.org |
| **INI** | The share of individuals using the Internet in the population | Percentage (%) | World Telecommunication/ICT Indicators Database & the World Bank, www.itu.int |
| **HDI** | Human Development Index (Life Expectancy Index, Education Index & GNI Index) | Percentage (%) (0-100) | UN Development Programme, Human Development Reports (2015-2020), www.hdr.undp.org |
| **POP** | Population | Million people | The World Bank, www.data.worldbank.org |
| **Dates and Countries using in the Analysis** | | | |
| **Name of Countries** | | | **Dates** |
| Austria, Belgium, Czech, Estonia, Finland, Greece, Norway, Hungary, Iceland, Latvia, Luxembourg and Netherlands, | | | Between 1998 – 2020 (Total 23 year) |

In our study, a balanced panel data study was established with 276 observations for all countries and series and descriptive statistic values of dependent and independent variables data using in the study, Table 2 below was shown.

**Table 2: Descriptive statistics of variables used in the model**

| Variable | Observations | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| **GDPPC** | 276 | 10.45656 | 0.4823548 | 8.954803 | 11.69925 |
| **TTO** | 276 | 11.76982 | 1.372091 | 8.702344 | 14.18777 |
| **INI** | 276 | 10.92386 | 0.7171731 | 8.077758 | 11.50595 |
| **HDI** | 276 | 6.795705 | 0.0520315 | 6.645091 | 6.878326 |
| **POP** | 276 | 8.309333 | 1.254143 | 5.613128 | 9.766579 |

## MODEL

The model in this research was established to investigate the individual and whole effect of the factors included in the analysis on GDP per capita and turnover. When N units and T number of each unit are considered together, it is a multi-panel data model. To analysis what factors identify the GDP per capita and turnover; multiple regression models include multiple linear regressions as well as multiple power regression [21]. The general form of multiple linear regressions is applied:

$$Y_{it} = b_{0it} + b_{1it}X_{1it} + b_{2it}X_{2it} + \cdots \dots \dots + b_{kit}X_{kit} + u_{it} \qquad i = 1, \dots, N; t = 1, \dots, N \quad (1)$$

or briefly

$$Y_{it} = b_{oit} + \sum_{k-1}^{K} b_{kit} X_{kit} + u_{it} \quad i = 1, \dots, N; t = 1, \dots, N \quad (2)$$

where $Y_{it}$ and $X_{kit}$ are the dependent and independent variables for each i; $b_{oit}$ and $u_{it}$ are fixed effects and error term, respectively. All the data of a dependent and all independent variables, used were converted into a logarithmic form and shown separately for the model [22]. The model investigates the factors influencing GDP per capita and is formulated as follows:

$$logGDPPC_{it} = \alpha_0 + \alpha_1 logOT_{it} + \alpha_2 logINI_{it} + \alpha_3 logHDI_{it} + \alpha_4 logPOP_{it} + u_{it} \quad (3)$$

Where $\alpha_1$, $\alpha_2$, $\alpha_3$ *and* $\alpha_4$ are the coefficients of the turnover, the share of individuals using the internet in the population, human development index and population, respectively [23]

.

$logGDPPC_{it}$: is the logarithm form of Gross Domestic Production per capita
$logINI_{it}$ : is the logarithm form of the share of individuals using the internet in the population
$logOT_{it}$ is the logarithm form of the overall turnover volume
$logHDI_{it}$ is the logarithm form of Human Development Index
$logPOP_{it}$ is the logarithm of population
$u_{it}$ is an error term

## 3.2 Methodology

### 3.2.1 Cross-Sectional Dependence Tests

Cross-Sectional Dependence test recommends that such because of the rapidly increasing economic cooperation and globalization of the world countries, the economic integration between countries or unions is also increasing. Increasing economic integration between countries has made countries economically dependent on each other. It is foreseen that it is inevitable that economic shocks and mobility in a country or unit will affect other countries or units at different levels [24]. When working in panel data models, the cross-sectional dependence between countries or units should be considered. If the cross-sectional dependence is not considered, serious erroneous parameters may occur in the estimation results [25]. Therefore, it is important to test both as variables and as a model to avoid erroneous parameters and to determine whether there is a cross-sectional dependence between the units [26]. In order for the cross-sectional dependence between units not to cause biased results in panel data analysis, first-generation tests in case of cross-sectional independence and second-generation tests in case of cross-sectional dependence tests and estimators should be used [27]. There are several tests in the literature to identify cross-sectional dependence. In this study, Breusch-Pagan (1980) $LM_{BP}$, Pesaran (2004) scaled LM and Pesaran (2004) CD tests were conducted to determine cross-sectional dependence.

**Breusch and Pagan (1980) Test**

It is a Lagrange Multiplier test based on the correlation coefficients of the residuals at $T \rightarrow \infty$ cases, while N is constant in the Breusch and Pagan (1980) test. $LM_{BP}$ test based on the correlation between errors bρij and the test statistics were calculated as follows model [28].

$$LM_{BP} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^2 \qquad (4)$$

$\left( X^2; \frac{N(N-1)}{2} \right)$ at Chi-square asymptotic distribution and degrees of freedom in case of (T> N).

Where, the $\hat{p}_{ij}^2$ indicates the sample predictived value of the cross-section correlation coefficients of the equation between the residuals. In Breusch and Pagan (1980) $LM_{BP}$ test, the null hypothesis of no dependence in cross-sections is tested against unit hypothesis of dependence between two cross sections.

**Pesaran scaled LM Test**

Pesaran (2004) criticized the fact that the power of the $LM_{BP}$ test decreases as the number of cross-section units (N) increases, and even the fact that the test cannot be used in the case of N→∞. Thus, he recommended by overcoming these problems thus, the following scaled version of $CD_{LM1}$ that for testing the hypothesis of cross dependence even for N and T large:

$$CD_{LM1} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\,\hat{p}_{ij}^{2} - 1) \quad (5)$$

According to Pesaran (2004) $CD_{LM1}$ test, it is assumed that there is no cross-sectional dependence when $T\rightarrow\infty$ *ve* $N\rightarrow\infty$. However, in cases where N>T, the $CD_{LM1}$ test shows significant distortions, and the deviations increase as N gets larger [29].

**Pesaran CD Test**

In order to overcome the problems of significant distortions and the increase in deviations as N gets larger, Pesaran (2004) developed the test statistics consists of the sum of the correlation coefficients between cross-section residuals. According to Pesaran (2004) $CD_{LM2}$ test, it is also assumed that there is no cross-sectional dependence when $T\rightarrow\infty$ *ve* $N\rightarrow\infty$ and the test statistic should be used in case the cross-sectional size (N) is larger than the time dimension (T) is (N >T). Pesaran CD test statistic is calculated with the following formula:

$$CD_{LM2} = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}^{2}\right) \quad (6)$$

This test statistic shows a standard normal distribution under the $H_0$ hypothesis, which shows that there is no relationship between cross-sections [29, 30].

The null and alternative hypotheses used for the cross-sectional dependence test are as follows:

$H_0$ : Cov($u_{it}$; $u_{ij}$)=0, There is no cross-sectional dependence.
$H_a$ : Cov ($u_{it}$; $u_{ij}$)≠0, There is a cross-sectional dependence.

Finally, p-values are calculated to decide about the null hypothesis [31]. According to the test results, If the calculated probability values are bigger than the significance values, the null hypothesis cannot be rejected, this means that there is no cross-sectional dependence between countries. In this case, the analysis should be continued with first generation panel unit root tests. In contrast, If the calculated probability values are smaller than the significance values, the null hypothesis rejected, this means that there is cross-sectional dependence between countries. In this case, the analysis should be continued with second generation panel unit root tests [32].

### 3.2.2 Homogeneity Tests

Before performing a cointegration test, it is necessary to learn whether the slope coefficient present in the cointegration equation is homogeneous or heterogeneous to reach reliable findings from this analysis. For determining homogeneity or heterogeneity, slope homogeneity tests recommended by Pesaran Yamagata (2008) based on DELTA tests, as well as the Swamy S test (2071) were used.

**Swamy S Homogeneity Test**

To test the Random Coefficients model, the difference between the unit-specific least squares estimator and the weighted mean matrices of the within-group estimator, which ignores the panel structure of the data, can be looked at. Swamy test statistics formula is shown below [33]:

$$\hat{S} = x^2_{k(N-1)} = \sum_{i=1}^{N}(\hat{\beta}_i - \bar{\beta}^*)' \frac{X_i' M_t X_i}{\hat{\delta}_i^2}(\hat{\beta}_i - \bar{\beta}^*) \quad (7)$$

Where, $\beta_i'$ is OLS estimators from regressions by units, $\bar{\beta}^*$ is weighted WE estimator and $\frac{X_i' M_t X_i}{\hat{\delta}_i^2}$ is difference between the variances of the weighted WE estimator and OLS estimator. The test statistic has an $X^2$distribution with N(N-1) degrees of freedom [34]. If there is no statistically significant difference between the OLS estimators and the WE mean matris it means that the parameters are homogeneous. In contrast, if there is statistically significant difference between the OLS estimators and the WE mean matris it means that the parameters are hetrogeneous [35].

**Slope Homogeneity Tests**

Slope Homogeneity Tests based on the DELTA tests are an improved version of the Swamy test for panel data with large N and T by Pesaran and Yamagata (2008). Pesaran and Yamagata (2008) developed two different test as large samples and small samples statistics to test hypotheses [36]:

For large samples: $\hat{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right)$ (8)

In the case of normally distributed errors the mean-variance bias adjusted was expressed the following way:

For small samples: $\hat{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{z}_{\hat{it}})}{\sqrt{var(\tilde{z}_{\hat{it}})}}\right)$ (9)

Where, N is cross section number, S is Swamy test statistic, $E(\tilde{z}_{\hat{it}}) - k$ is number of explanatory variables and $Var(\tilde{z}_{\hat{it}})$=2k/(T-k-1) shows to the standard error [37]. The null and alternative hypotheses used for the Slope Homogeneity test are as follows:

$H_0$: slope coefficients are homogenous
$H_a$: slope coefficients are heterogeneous

Finally, p-values are calculated to decide about the null hypothesis. According to the test results, If the calculated probability values are bigger than the significance values, the null hypothesis cannot be rejected, this means that the models are homogeneous. In contrast, If the calculated probability values are smaller than the significance values, the null hypothesis rejected, this means that the models are heterogeneous [38].

### 3.2.3 Panel Unit Root Tests

In panel unit root analysis, different unit root tests have been developed depending on whether there is a cross-sectional dependence or not. In the case of no cross-section dependence, first-generation panel unit root tests and in case of cross-section dependence, second-generation panel unit root tests are used. According to the results of Breusch and Pagan (1980) LM, Pesaran (2004) scaled LM and Pesaran (2004) CD's cross-section dependence tests shown in Table 3, Because of The calculated probability values are smaller than the significance values at 1%, 5%, and 10% the null hypothesis were rejected ve there was cross-sectional dependence between countries. Thus, in the study it will be used second generation panel unit root tests [39]. Therefore, the second-generation panel unit root tests, CADF cross sectional augmented Dickey-Fuller and cross-sectional Im, Pesaran, and Shin panel unit root test developed by Pesaran (2004, 2007) and Hadri-Kurazomi Panel unit root tests developed by Hadri and Kurazomi (2012) were used in the analysis.

**CIPS Panel unit root tests**

Pesaran CADF panel unit root tests is an expanded form of ADF regression with first differences of individual series and cross-sectional means of lag levels. CIPS and CADF tests working under the assumption of cross-section dependence can be used in cases where both $T>N$ and $N>T$. Accordingly, the CADF regression can be written as in equation (10) below [40].

$$\Delta Y_{it} = a_i + b_i Y_{i,t-1} + c_i \overline{Y}_{t-1} + d_i \Delta\overline{Y}_t + \varepsilon_{i,t} \quad (10)$$

where, $\Delta Y_{it}$ is Critical values of the individual CADF test, $Y_{i,t-1}$, $\overline{Y}_{t-1}$ and $\Delta\overline{Y}_t$ is non-constant, constant and constant trend values based on Least Squares regression, respectively and $\varepsilon_{i,t}$ is the error term. CIPS test statistics are based on cross-sectional augmented ADF (CADF) panel unit root test, which is calculated for each section unit. After calculating the CADF test statistic as given in the first equation, the CIPS value is calculated as follows [41].

$$\text{CIPS} = N^{-1} \sum_{i-1}^{N} \text{CADF}_i \quad (11)$$

The null and alternative hypotheses for the CADF and CIPS panel unit root tests demonstrate the unit root and stationarity, respectively. The calculated values are compared with the critical values created by (CIPS) and Pesaran (2007) based on Monte Carlo simulations. According to the test results, If the calculated values are bigger than the critical values, the null hypothesis cannot be rejected, this means that there is the unit root. In contrast, If the calculated values are smaller than the critical values, the null hypothesis rejected, this means that there is stationarity [42].

### 3.2.4 Durbin Hausman Panel Cointegration test

The next step after determining the stationarity of the variables subject to the analysis is to investigate the existence of a long-term relationship between the variables [43]. Durbin Hausman Panel Cointegration test, which is a second-generation Panel Cointegration test that allows heterogeneity and cross-sectional dependence and considers lag lengths, will be applied. Westerlund's Durbin-Hausman (2008) cointegration method can be used to test the existence of long-term relationships between non-stationary and cross-sectional dependence variables. Some conditions for using this method: the dependent variable must be stationary at the level, it can be used even if some of the explanatory variables are stationary, and different test statistics can be calculated for hypotheses that consider both panel homogeneity and panel heterogeneity [44]. The Durbin–Hausman group statistic is based on the heterogeneity assumption in the panel and the panel statistic is based on the panel homogeneity assumption. In the calculation of test statistics, constant and trend variables specific to the countries that make up the panel are used for panel statistics, and common constant and trend variables are used for the countries that make up the panel for group statistics. In this test, the $H_0$ hypothesis and the $H_1$ hypothesis for group statistics are established as there is no cointegration for all units and there is cointegration for some units, respectivly [45]. The Durbin–Hausman Panel Cointegration test for group statistics, which is based on error correction, is calculated based on the model below.

$$\text{DH}_g = \sum_{i-1}^{n} \widehat{S}_\iota \, (\widetilde{\phi_\iota} - \widehat{\phi_\iota})^2 \sum_{t-2}^{T} \hat{e}_{it-1}^2 \quad (12)$$

where DHg denotes panel statistics and is obtained by summing the individual terms before they are aggregated. In this test, the $H_0$ hypothesis and the $H_1$ hypothesis for panel statistics are established as there is no cointegration for all units and there is cointegration for the panel, respectivly. The Durbin–Hausman Panel Cointegration test for the panel statistic, which is based on error correction, is calculated based on the model below.

$$\mathrm{DH}_p = \hat{S}_i(\tilde{\Phi} - \hat{\Phi})^2 \sum_{i=1}^{n} \sum_{t-2}^{T} \hat{e}_{it-1}^2 \quad (13)$$

The DHp group represents the average statistic and is created by multiplying and then adding various terms [46].

### 3.2.5 The long-term Pedroni cointegration test

If a long-term relationship (cointegration) is detected, panel cointegration estimators are used to determine the direction and degree of this relationship. Therefore, in this study, the Mean Group Dynamic Least Squares (DOLSMG) Estimator, which was brought to the literature by Pedroni (2001), and the Second-generation long-run Pedroni cointegration test, which allows heterogeneity and cross-section dependence, were used. The DOLSMG estimator is based on the model shown in Equation 16 [47]:

$$y_{\mathrm{i,t}} = \mu + \beta \mathrm{X}_{\mathrm{i,t}} + \mathrm{u}_{i,t} \quad (16)$$

The model given in Equation 16 is estimated by dynamic least squares (DOLS) method by adding antecedent values and delays for each section. The values calculated for each section are then combined with the Pesaran and Smith MG approach to obtain the whole panel value, as shown in Equation 17 [48]:

$$\hat{\beta}_{\mathrm{DOLSMG}} = N^{-1}\left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(Z_{i,t}Z_{i,t}^{'})\right)^{-1}\right]\left(\sum_{t=1}^{T}\left(Z_{i,t}\,\bar{Y}_{i,t}\right)\right) \quad (17)$$

where the explanatory vector $Z_{i,t}$ is $Z_{i,t} = (X_{i,t}, \bar{X}_i, \Delta X_{i,t-k,} \ldots \ldots \Delta X_{i,t+k,})$ for $\bar{Y}_{i,t} = Y_{i,t} - \bar{Y}_i$.

Therefore, the DOLSMG estimator is obtained by taking the average of the DOLS estimators obtained for each i unit. The $\hat{\beta}_{\mathrm{DOLSMG}} = N^{-1}\sum_{i=1}^{N}\hat{\beta}_{\mathrm{DOLS,i}}$ and t statistics are averaged and

converted to $t_{\hat{\beta}_{\mathrm{DOLSMG}}} = N^{-1}\sum_{t-1}^{T} t_{\hat{\beta}_{\mathrm{DOLS,i}}}$ [49].

Thus, $$(t_{\hat{\beta}_{\mathrm{DOLS,i}}} = (\hat{\beta}_{\mathrm{DOLS,i}} - \beta)(\sigma_i^{-2}\sum_{t-1}^{T}(X_{i,t} - \bar{X}_i)^2)^{1/2} \quad (18)$$

The new equation has the form of the pattern shown in Equation 18 [50].

## 4 Findings

As a result of the increase in cooperation and integration between countries in the globalizing world, macroeconomic variables of countries have become interdependent and economic shocks in one country directly or indirectly affect the other country. In order to determine whether there is cross-sectional dependence, Breusch and Pagan (1980) LM, Pesaran (2004) scaled LM and Pesaran (2004) CD tests were used to test both variables and three models. In addition, Swamy S Homogeneity and Slope Homogeneity Tests are used to determine whether the models were homogeneous or heterogeneous. The results of the cross-section dependence in both the variables and the three models and the homogeneity between the variables in the three models are presented in Table 3 below.

**Table 3 Cross-section dependence and slope homogeneity tests results**

| Cross-Sectional Dependence Tests by Variables | | | | |
|---|---|---|---|---|
| Variables | Breusch-Pagan LM | Pesaran scaled LM | Pesaran CD | |
| GDPPC | 1400.794* | 116.179* | 37.372* | |
| OT | 1416.460* | 117.543* | 37.616* | |
| INI | 1431.497* | 118.851* | 37.829* | |
| HDI | 991.489* | 80.553* | 30.398* | |
| POP | 1178.217* | 96.806* | 3.381* | |
| Cross-Sectional Dependence Tests by Models | | | | |
| Model | 797.468* | 63.666* | 27.067* | |
| Homogeneity Tests by Models | | | | |
| | DELTA Test | | Swamy S Test | |
| | $\hat{\Delta}$ | $\hat{\Delta}_{adj.}$ | chi2 | Degrees of Freedom |
| Model | 17.579* | 20.447* | 6231.60 * | chi2(55) |
| *, ** and *** indicate the rejection of the null hypothesis at the 1%, 5% and 10% significance level, respectively. | | | | |

According to the results of the three cross sectional dependence tests for both of 3 models and variables in Table 3, the calculated probability values are smaller than the significance values at 1%, 5%, and 10%, so the null hypothesis were rejected, this means that there is cross-sectional dependence between countries. In this case, the analysis should be continued with second generation panel unit root tests. According to results of tests of Slope and Swamy Homogeneity tested for 3 models at 1%, 5%, and 10% of the significance values, the calculated probability values are smaller than the significance values, the null hypothesis rejected, this means that the models are heterogeneous.

According to The results of cross-sectional of Breusch-Pagan LM, Pesaran scaled LM and Pesaran CD tests and of slope homogeneity tests of Delta, Delta adj and Swamy S Tests are shown in Table 3, in all analyzed variables in this study, This study was analyzed with the second generation heterogeneous test, the CIPS unit root test. In addition, it has been investigated whether this study has constant and/or constant - trend. According to the results of the graphs shown in the appendix 1, this study does not contain trend and for the reason, have used CIPS unit root test at constant. The results of the constant CIPS unit root test is shown in table 4 below.

**Table 4: CIPS panel unit root test results**

| Variables | Level | First Differences |
|---|---|---|
| GDPPC | -0.335 | -2.327 * |
| OT | -0.313 | 1.714** |
| INI | -6.756* | -5.153* |
| HDI | 0.646 | -1.774** |
| POP | 0.765 | -3.659* |
| *, ** and *** indicate the rejection of the null hypothesis at the 1% , 5% and 10% significance level, respectively. | | |

According to results of the CIPS panel unit root test shown in Table 4, all the series except INI have a unit root for the constant model. In contrast, the series are stationary at the first differences. With the other expression the series are stationary of differences I(1).

As a result of the preliminary tests, it was understood that there is a cross-sectional dependence tests and the model contains heterogeneous parameters, so it was decided to apply Durbin Hausman panel cointegration. The results of Durbin Hausman panel cointegration test are shown in table 5 below.

**Table 5: Durbin Hausman Panel Cointegration test results**

| Tests | Value | P-value |
|---|---|---|
| Durbin Hausman for Group | 4.523 | 0.000* |
| Durbin Hausman for Panel | 7.705 | 0.000* |
| *, ** and *** indicate the rejection of the null hypothesis at the 1% , 5% and 10% significance level, respectively. | | |

It is seen that the coefficient calculated Durbin Hausman for Group and Panel in the results in Table 5 is statistically significant. In other words, when the significance of values of the Durbin Hausman for Group and Panel cointegration test is examined, it is seen that the null hypothesis is rejected, and the test statistic is significant at the 1% significance level. The result shows that there is a cointegration relationship between GDP per capita and turnover, the share of individuals using the internet in the population, human development index and population in the long run in the model.

The coefficients of this long-run relationship are determined using the Pedroni estimator, considering the results of the parameter heterogeneity and cross-sectional dependence tests. Table 6 below shows the Pedroni estimation results by countries and model.

**Table 6: Pedroni estimation test results**

| | | LTO | | LINU | | LHDI | | LPOP | |
|---|---|---|---|---|---|---|---|---|---|
| | | Beta | t-stat | Beta | t-stat | Beta | t-stat | Beta | t-stat |
| **1** | Austria | -0.44 | -13,11* | 0.15 | 13.47 * | 7.77 | 14.29* | -2.66 | -16.25* |
| **2** | Belgium | 0.92 | 22.96* | -0.06 | -2.06** | 1.29 | -5.23* | 1.89 | 13.65* |
| **3** | Czech | -0.18 | -2.89* | 0.16 | -4.08* | 6.07 | 8.39* | 8.85 | -32.41* |
| **4** | Estonia | 2.04 | 3.32* | 2.37 | 9.71* | -23.7 | -7.86* | -4.81 | -1.75*** |
| **5** | Finland | -0.05 | -3.22* | 0.06 | -5.39* | 7.38 | 26.86* | 13.04 | 18.90* |
| **6** | Greece | -1.17 | -15.62* | 0.27 | 8.69* | 0.37 | 1.31 | 7.96 | 21.10* |
| **7** | Hungary | 0.35 | 8.11* | -0.22 | -6.52* | 2.41 | 2.39* | -2.43 | -14.42* |
| **8** | Iceland | 0.65 | 16.10* | -0.42 | -9.95* | 2.38 | 3.81* | -0.85 | -6.43* |
| **9** | Latvia | 0.66 | 17.36* | -0.06 | -5.90* | 9.53 | 21.79* | 1.13 | 9.23* |
| **10** | Luxembourg | 0.77 | 12.74* | -0.09 | -1.52 | -2.32 | -5.73* | -1.53 | -13.76* |
| **11** | Netherlands | -0.53 | -6.09* | 0.37 | 8.59* | 2.76 | 18.73* | 5.63 | 5.40* |
| **12** | Norway | 1.90 | 10.69* | -0.56 | -7.15* | 9.70 | 8.68* | -2.70 | -8.18* |
| **Model** | | 0.41 | 14.54* | 0.13 | -0.61 | 1.75 | 25.24* | 0.49 | -7.19* |
| *, ** and *** indicate the rejection of the null hypothesis at the 1% (2.576), 5% (1.962) and 10% (1.646) significance level, respectively. | | | | | | | | | |

When the DOLSMG results in Table 6 are examined, the t statistics of turnover, human development index and population variables at the 1% significance level were found to be significant in the long run for the entire panel and turnover, human development index and variables affect GDP per capita. However, the t statistics regarding the share of individuals using the internet in the population variables are not significant for the whole panel in the long run at the 1%, 5% and 10% significance level and the share of individuals using the internet in the population variable does not affect GDP per capita. It is estimated that 1% increase in turnover and HDI will increase GDP by 0.41% and %49, respectfully while the effect of other variables is constant.

## 5 Conclusion and policy implementation

In this study, it was used the long-term Pedroni cointegration test to analysis the relationship between overall turnover, the share of individuals using the Internet in the population, Human Development Index (Life Expectancy Index, Education Index & GNI Index), Population and GDP per capita on based annual panel data set of 12 European countries in the context of the GDP per Capita model over the period from 1998 to 2020. In the globalizing world, positive or negative shocks in one country also affect other countries. Therefore, firstly, cross-section dependence and homogeneity, which is one of the leading problems of panel data in terms of in the model and countries, were investigated. The results of analysis illustrated that there is cross-sectional dependence in all variables and model and also there is heterogeneous. According to the results of the cross-sectional dependence tests and homogeneity tests, the CIPS test, which is one of the second-generation unit root tests, was used. CIPS panel unit root test results showed that all variables, except for the share of individuals using the Internet in the population, were stationary at 1st difference. the Durbin Hausman Panel Cointegration test which allows the cointegration test to be performed when the independent variables are stationary at the level and the 1st difference is stationary was used to investigate the existence of a long-run relationship in the model, and a long-run relationship between the variables was determined. In the model, the Pedroni estimator was used by determining the long-term relationship parameters. When the DOLSMG results in terms of turnover are analyzed based on countries, the t-statistics of the long-term parameter estimation of all countries were significant at the 1% significance level. Except for Austria, Czech, Finland, Greece and the Netherlands, the change in turnover positively affects all other countries. In accordance with the findings in terms of the long-run relationship obtained in Mustapha Ben Hassine and Nizar Harrathi, Serdar Birinci, Walid Belazrega and Kais Mtar and Perry Sadorsky's study, the results have been consistent the realtion between turnover and GDP per capita.

Although it was insignificant in the long run for the entire panel in terms of the share of individuals using the internet in the population, except for Austria, it was significant Belgium at the 5% significance level and all other countries at the 1% significance level. Except for Belgium, Hungary, Iceland, Latvia, Luxembourg and Norway, the change in the share of individuals using the internet in the population positively affects all other countries. Gholizadeh, according to the study made by H. et al, Billon, M., et al, Eren the results has been different the relationship between the share of individuals using the internet in the population and GDP per capita in term of model. It has been concluded in the Meijers`s study that GDP per capita was predicted not to lead strong results in all cases.

When the DOLSMG results in terms of human development index are analyzed on the basis of countries, the t-statistics of the long-term parameter estimation of all countries except for Greece were significant at the 1% significance level. Except for Estonia and Luxembourg, the change in human development index positively affects all other countries. According to the findings in terms of the long-run relationship obtained in Zhaohua Wan, Arabi, K.A.M., et

al, Wang, Z., et al and Elena Pelinescu 's study, the results have been consistent the relationship between HDI and GDP per capita.
When the DOLSMG results in terms of population are analyzed based on countries, the t-statistics of the long-term parameter estimation of all countries were significant at the 1% significance level and Estonia at the 10% significance. Except for Austria, Estonia, Hungary, Iceland, Luxembourg and Norway, the change in population positively affects all other countries. According to the study made by Mehmet Ali Polat and Adem Karakaş, Eren the results have been consistent the relationship between Population and GDP per capita.

*References*

[1] B. Balassa, «Exports, policy choices and economic growth in developing countries after the 1973 oil shock,» *Journal of Development Economics,* no. 18, pp. 23-35, 1985.

[2] T. Nguyen, «Impact of Export on Economic Growth in Vietnam: Empirical Research and Recommendations,» *International Business and Management ,* cilt 13, no. 3, pp. 45-52, 2016.

[3] Rahman, M., & Mustafa, M, « Dynamics of real exports and real economic growths in 13 selected Asian countries,» *Journal of Economic Development,* cilt 22, no. 2, pp. 87-94, 1997.

[4] U. H. D. R. Office, « Training Material for Producing National,» 2015.

[5] Elistia, E. and Syahzuni, B.A. , «The Correlation Of The Human Development Index (Hdi) Towards Economic Growth (Gdp Per Capita) In 10 Asean Member Countries,» *Journal Of Humanities And Social Studies,* cilt 2, no. 2, pp. 40-46, 2018.

[6] UN, «The Sustainable Development Goals Report,» New York, 2019.

[7] Hassine, M.B & Harrathi, N., « The Causal Links between Economic Growth, Renewable Energy, Financial Development and Foreign Trade in Gulf Cooperation Council Countries,» *International Journal of Energy Economics and Policy,* cilt 7, no. 2, pp. 76-85, 2017.

[8] P. Sadorsky, «Energy consumption, output and trade in South America,» *Energy Economics,* cilt 34, no. 2, pp. 476-488, 2012.

[9] Belazrega, W. and Mtar, K., «Modelling the causal linkages between trade openness, innovation, financial development and economic growth in OECD Countries,» *Applied Economics Letters,* pp. 1-4, 2019.

[10] S. Birinci, « Trade Openness, Economic Growth, Informality: Panel VAR evidence from OECD Countries,» *Economics Bulletin,* cilt 33, no. 1, pp. 694-705, 2013.

[11] H. Meijers, «Does the internet generate economic growth, international trade, or both?,» *Int Econ Econ Policy ,* cilt 11 , p. 137–163, 2014.

[12] Chong, F., Sen Liew, V.K. and Suhaimi, R., « The Relationship between Internet Usage and Gross National Income of an Emerging Economy,» *Advances in Finance and Accounting ,* pp. 16-20, 2016.

[13] Gholizadeh, H. et al, «Relationship among Economic Growth, Internet Usage and Publication Productivity: Comparison among ASEAN and World's Best Countries,» *Modern Applied Science;*

*Canadian Center of Science and Education,* cilt 8, no. 2, pp. 160-170, 2014.

[14] Billon, M., Jorge Crespo, J. and Lo´pez, L., «Educational inequalities: do they affect the relationship between Internet use and economic growth?,» *Information Development* , cilt 20, no. 10, pp. 1-19, 2017.

[15] Wang, Z., et al , « Renewable energy consumption, economic growth and human development index in Pakistan: Evidence form simultaneous equation model,» *Journal of Cleaner Production,* pp. 1081-1090 , 2018.

[16] Arabi, K.A.M. & Abdalla, S.Z.S, «The Impact of Human Capital on Economic Growth: Empirical Evidence from Sudan,» *Research in World Economy,* cilt 4, no. 2, pp. 43-53, 2013.

[17] E. Pelinescu, « The impact of human capital on economic growth,» *Procedia Economics and Finance ,* cilt 22 , p. 184 – 190, 2015.

[18] M. Polat, «An Econometric Model on Economic Develeopment and Population Increase in Turkey: An Ampiric Study,» *Ağrı İbrahim Çeçen Üniversitesi Sosyal Bilimler Enstitüsü Dergisi ,* cilt 4, no. 1, pp. 205-228, 2018 .

[19] A. Karakaş, «OECD ve OECD Dişi Ülkelerde Elektrik Tüketimi, Nüfus ve Gelir İlişkisi: 1990-2011 Dönemi İçin Bir Panel Veri Analiz,» *Electronic Turkish Studies,* cilt 9, no. 2, pp. 845-853, 2014.

[20] M. Eren, « The Relationship Between Population Growth And Development: An Empirical Analysis On Sub-Saharan Africa Countries International,» *Journal of Economic and Administrative Studies,* cilt 27, pp. 141-158, 2020.

[21] K. A. Medvedeva, «Correlation and Regression analysis and its Importance in Economic and Statistical Research,» *Center for Scientific Cooperation Interactive Plus* , cilt 3, p. 243–245, 2016.

[22] Grossman, A. O., and Petrov, A. V., «Cryptocurrencies as a Social Phenomenon,» *Society; Wednesday. Development. 4 (Terra Humana),* cilt 4 , no. 45, p. 62–66, 2017.

[23] Akbulaev, N., Mammadov, I.and Hemdullayeva, M., «Correlation and Regression Analysis of the Relation between Ethereum Price and Both Its Volume and Bitcoin Price,» *The Journal of Structured Finance,* pp. 1-11, 2020.

[24] S. Demez, «Effects of Environmental Innovations, Renewable Energy Consumption and Economic Growth on CO2 Emission: Panel Data Analysis for Select G-20 Countries,» *Anemon - Journal of Social Sciences of Mus Alparslan University,* cilt 9, no. 4, pp. 1007-1017, 2021.

[25] Chudic, A. & Pesaran, A.G. , «Common Correlated Effects Estimation of Heterogeneous Dynamic Panel Data Models with Weakly Exogenous Regressors,» *Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute,* cilt 146, p. 61, 2013.

[26] B. Ugur, «The Effect of Exports on Economic Growth in Selected Emerging Market Economies: Panel Co-Integration Analysis,» *International Journal Of Economic Studies,* cilt 7, no. 2, pp. 17-29, 2021.

[27] Aydin,M. & Turan, Y. E, «The influence of financial openness, trade openness, and energy intensity on ecological footprint: revisiting the environmental Kuznets curve hypothesis for BRICS countries,»

*Environmental Science and Pollution Research,* cilt 27, no. 34, pp. 43233-43245, 2020.

[28] Breusch T.S., Pagan A.R., «Review of Economic Studies,» *The Lagrange multiplier test and its applications to model specification in econometrics,* cilt 47, no. 1, p. 239–253, 1980.

[29] M. Pesaran, «General Diagnostic Tests for Cross Section Dependence in Panels,» *CESifo Working Paper Series No. 1229; IZA Discussion Paper No. 1240.,* 2004.

[30] Guloglu, B. & Ivrendi, M., «Output fluctuations: transitory or permanent? the case of Latin America,» *Applied Economics Letter,* cilt 17, pp. 381-386, 2010.

[31] M. Aydin, «Renewable and non-renewable electricity consumption eeconomic growth nexus: Evidence from OECD countries,» *Renewable Energy,* cilt 136, pp. 599-606, 2019.

[32] B. Baltagı, «Econometric Analysis of Panel Data,» *Fourth Edi-tion, West Sussex: John Wiley & Sons,* p. 284, 2008.

[33] P. Swamy, «Efficient Inference in a Random Coefficient Regression Model Econometrica,» *Journal of The Econometric Society* , cilt 38, no. 2, pp. 311-323, 1970.

[34] F. Yerdelen, Panel Zaman Serileri Analizi, 2 dü., İstanbul: Beta Basım Yayım Dağıtım, 2018.

[35] A. Sevinc, «Heterojen Birimler ArasıKorelasyonlu Dinamik Panel Veri Modelleri: Oecd Ülkelerinde Enerji Talebinin Modellenmesi,» *T.C. İstanbul Üniversitesi Sosyal Bilimler Enstitüsü Ekonometri Anabilim Dalı Yüksek Lisans Tezi,* pp. 92-93, 2020.

[36] Pesaran, M.H & Yamagata, T, «Testing slope homogeneity in large panels,» *Journal of Econometrics,* cilt 142, no. 1, p. 50–93, 2008.

[37] Keskin, H.J & Aksoy, E., «Relationship between Income Growth and Labor Force Participation in OECD and Emerging Countries: Panel Cointegration Analysis,» *Third Sector Social Economic Review,* cilt 54, no. 1, pp. 1-20, 2019.

[38] T. Govdeli, «An Empirical Analysis for Energy Consumption, Trade Openness and Economic Growth of OECD Countries, Journal of the Faculty of Economics and Administrative Sciences,» *Journal of the Faculty of Economics and Administrative Sciences, Cankiri Karatekin University,* cilt 9, no. 1, pp. 311-323, 2019.

[39] F. Yerdelen, Panel Zaman Serileri Analizi, 3, Dü., Istanbul: Beta , 2020, pp. 21-68.

[40] M. H. Pesaran, «A Simple Panel Unit Root Test In The Presence Of Cross-Section Dependence,» *Journal of Applied Econometrics,* cilt 22, no. 2, pp. 265-312, 2007.

[41] Shahbaz, M., Rasool, G., Ahmed, K. and Mahalik, M.K., «Considering the effect of biomass energy consumption on economic growth: fresh evidence from BRICS region,» *Renew. Sustain. Energy Rev.,* cilt 60, pp. 1442-1450, 2016.

[42] Mercan, M. Osman Peker, O.and Göçer, I., « The Inflationary Effect of The Increases in Crude Oil Prices: Structural Breaks Dynamic Panel Data Analysis For Selected OECD Countries,» *Doğuş Üniversitesi Dergisi,* cilt 16, no. 2, pp. 123-137, 2015.

[43] Köksel, B. and Yilmaz, H., «The relation between human capital and economic

growth: a study on groups of the countries which have different incomes,» *Journal of Life Economics,* cilt 8, no. 2, pp. 157-171, 2021.

[44] J. Westerlund, «“Panel Cointegration Tests of the Fisher Effect,» *Journal of Applied Econometrics ,* cilt 23, no. 2, pp. 193-223, 2008.

[45] Acaravci, A., Bozkurt, C. and Erdoğan, S., «MENA Ülkelerinde Demokrasi-Ekonomik Büyüme İlişkisi,» *İşletme ve İktisat Çalışmaları Dergisi,* cilt 3, no. 4, pp. 119-129, 2015.

[46] S. &. A. M. Gormus, « Revisiting the environmental Kuznets curve hypothesis using innovation: new evidence from the top 10 innovative economies,» *Environmental Science and Pollution Research,* cilt 27, p. 27904–27913, 2020.

[47] P. Pedroni, «Purchasing Power Parity Tests in Cointegrated Panels,» *Review of Economics and statistics,* cilt 83, no. 4, pp. 727-731, 2001.

[48] Kiliç, E., Yavuz, E., Pazarci, S. and Umur A., «Analysis of the Effect of Energy Consumption on Current Account Deficit Using Panel Data: Evidence from the Organization of the Black Sea Economic Cooperation,» *Journal of Economic Policy Researches, Istanbul University,* cilt 8, no. 2, pp. 277-291, 2021.

[49] Alev, N. and Erdemli, M., «Elektrik Enerjisi Tüketimi Ve Ekonomik Büyüme İlişkisi: Avrupa Birliği Ülkeleri Ve Türkiye İçin Bir Analiz,» *ASSAM International Refereed Journal,* cilt 6, pp. 66-85, 2019.

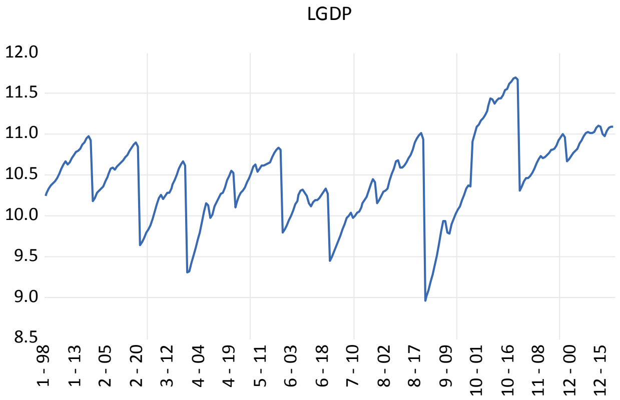
[50] F. Yerdelen, Panel Zaman Serileri Analizi, cilt 3, İstanbul: (Beta Basım Yayım Dağıtım A.Ş., 2017, pp. 233-234.

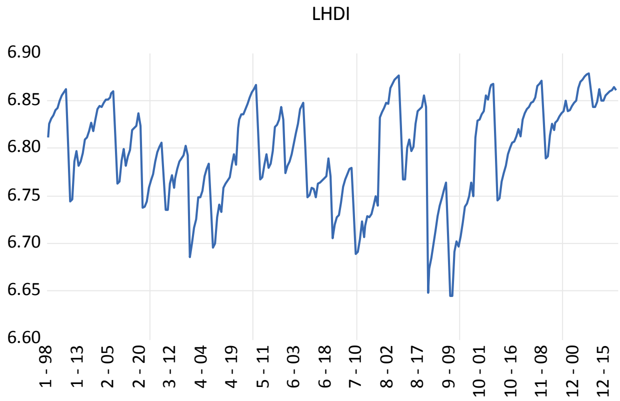
[51] Dural, F. and Sarioğlu, S.E., « Kredi Temerrüt Swaplari ve Gelişmekte Olan Ülkeler Üzerine Karşilaştirmali Bir Analiz,» *Uludağ Journal of Economy and Society,* cilt 39, no. 2, pp. 87-118, 2020.

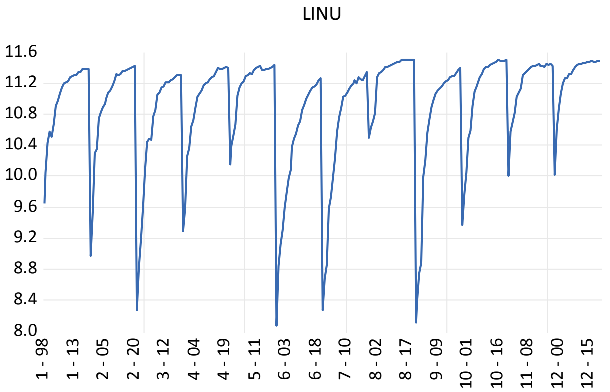
[52] Gengenbach, C., Urbain, J.P. and Westerlund, J. , «Error Correction Testing In Panels With Common Stochastic Trends,» *Journal Of Applied Econometrics,* cilt 31, no. 2, pp. 982-1004, 2016.

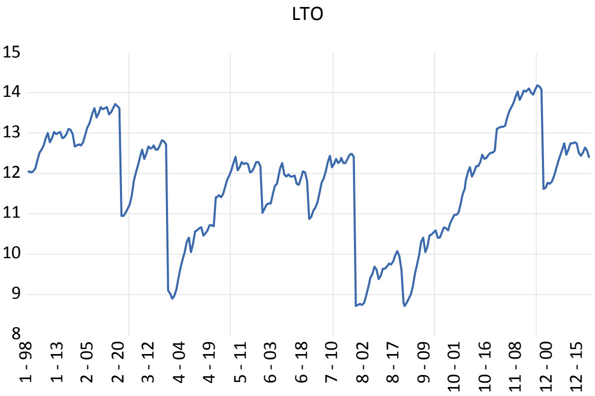
[53] F. Yerdelen, «İleri Panel Veri Analizi,» *Beta Yayım,* cilt (4 b.), pp. 205-207, 2020.

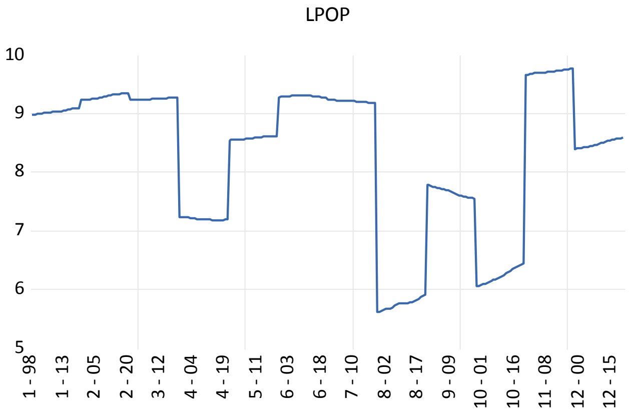
# APPENDİX 1


LGDP
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5


LHDI
6.90
6.85
6.80
6.75
6.70
6.65
6.60


LINU
11.6
11.2
10.8
10.4
10.0
9.6
9.2
8.8
8.4
8.0


LTO
15
14
13
12
11
10
9
8


LPOP
10
9
8
7
6
5