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WILL THE MEMBERSHIP OF TÜRKİYE TO THE EU SPUR CONVERGENCE OF GDP PER CAPITA TO HIGH-INCOME ECONOMY?

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Abstract

By examining the economic performances of the new members of the EU in the 2000s, it is aimed to investigate possible developments in the Turkish economy, in case Turkey becomes a full member of the European Union (EU). The study covers thirteen member countries that were accepted as full members of the EU in the 2000s and Turkey, which is a candidate country for the EU. Eight (there were seven members when the study was done) of the new members are also in the Euro Area (Eurozone). While eleven of the new members are located in Central and Eastern Europe, Malta and Cyprus are two island countries located in the Mediterranean. The correlation between the countries' GDP per capita was investigated after testing the normality of the data for the country set. The growth performance was investigated with a growth convergence equation. Different unit root tests for time series and panel data were applied to analyse the breakpoints within the GDP per capita of the EU member countries considering the membership. Time series data were used for individual member state analysis whereas panel data were used for income convergence analysis of the country set. Lithuania has the best performance in income per capita increase in the 1995-2021 period whereas Romania has the second and Latvia has the third best performance. Due to the convergence theorem, new member countries have the highest growth rate than the EU and Eurozone in income per capita in the 1995-2021 period.

Keywords: *GDP per Capita, Convergence, Breakpoints, EU Membership.*

TÜRKİYE'NİN AB ÜYELİĞİ KİŞİ BAŞINA GSYİH'NİN YÜKSEK GELİRLİ EKONOMİYE YAKINSAMASINI SAĞLAYACAK MI?

Öz

Bu çalışma, AB'ye yeni üye olan ülkelerin 2000'li yıllardaki ekonomik performanslarını inceleyerek, Türkiye'nin Avrupa Birliği'ne (AB) tam üye olması durumunda Türkiye ekonomisinde yaşanabilecek olası gelişmeleri incelemeyi amaçlamaktadır. Çalışma, 2000'li yıllarda AB'ye tam üye olarak kabul edilen on üç

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üye ülkeyi ve AB'ye aday ülke olan Türkiye'yi kapsamaktadır. Yeni üyelerin sekizi (çalışma yapıldığı esnada yedi üye vardı) aynı zamanda Euro (Avro) Bölgesi'nde yer almaktadır. Yeni üyelerin 11'i Orta ve Doğu Avrupa'da yer alırken, Malta ve Kıbrıs Rum Kesimi Akdeniz'de yer alan iki ada ülkesidir. Ülke seti için yıl içi elde edilen toplam gelirin yıl ortası toplam nüfusa bölünmesi ile elde edilen kişi başına düşen gelirin normallik testi yapıldıktan sonra ülke verileri arasındaki korelasyon incelenmiştir. Üye ülkelerin üyelik öncesi ve üyelik sonrası kişi başına düşen GSYİH değerlerinin büyüme yakınsama denklemi ile büyüme performansı ve farklı birim kök testleri ile de kırılma noktaları zaman serileri ve panel verilerle analiz edilmiştir. Bireysel üye ülkelerin analizi için zaman serisi verileri kullanılırken, ülke setinin gelir yakınsaması analizi için panel verileri kullanılmıştır. 1995-2021 döneminde kişi başına düşen gelir artışında en iyi performansı Litvanya gösterirken, Romanya ikinci, Letonya ise üçüncü en iyi performansa sahip ülke olmuştur. Yakınsama teoremi nedeniyle, yeni üye ülkeler 1995-2021 döneminde kişi başına düşen gelirde AB ve Euro Bölgesi'nden daha yüksek büyüme hızına sahiptir.

Anahtar Kelimeler: *Kişi Başına Düşen GSYİH, Yakınsama, Kırılma Noktaları, AB Üyeliği.*

Introduction

Germany, France, Italy, the Netherlands, Belgium and Luxembourg signed a treaty on 18 April 1951, based on Robert Schuman's plan. The plan suggested a deeper cooperation and integration for Western Europe's coal and steel producing capacity, which were mostly used for the arms industry. The six signatory countries found the Coal and Steel Treaty beneficial and thus they wanted to expand their cooperation into other fields. Then they signed the Rome Treaty on 25 March 1957. The treaty involved the European Atomic Energy Community (EURATOM) and the European Economic Community (EEC).

The first enlargement of the Communities was on 1 January 1973 when Denmark, Ireland and the United Kingdom became new members. As a result, the number of members increased from six to nine. Then, Greece became the tenth member of the European Communities (EC) in 1981, and five years later, Spain and Portugal became new members. The EU was officially emerged by the Maastricht Treaty, which was signed on 7 February 1992. By accepting Austria, Finland and Sweden on 1 January 1995 the number of the members of the EU increased to fifteen members.

Both, the accession of ten new members, namely Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Slovakia, Slovenia and Poland in 2004, and the accession of Bulgaria and Romania in 2007, caused the distinction between Western and Eastern Europe to disappear. With the accession of Croatia, the Union, which has twenty-seven members, had 28 members on 1 July 2013. After the BREXIT, the EU became an economic integration with twenty-seven members. Member states enjoyed being in the expanding European Economic Area (EEA), with the inclusion of Iceland,

Liechtenstein and Norway, which were three European Free Trade Association (EFTA) member countries.

The EU countries have to not only align their national legislation with the relevant EU law with the Maastricht Treaty but also meet specific conditions designed to achieve economic convergence. These requirements, known as the convergence criteria for the transition to the Euro, adopted by the EU Member States in Maastricht in 1991, were put into practice to measure the preparations of the countries for the transition to the Euro. The set of macroeconomic indicators deals with:

- The stable prices (price stability which tells the harmonised consumer price inflation),
- Robust public finances (lower government deficit and debt) to ensure they are sustainable,
- Exchange rate stability shows that a member country can manage its economy without causing excessive currency fluctuations (EU's Exchange Rate Mechanism "ERM I" was replaced by ERM II on 1 January 1999 as a result of exchange rate developments),
- To assess the durability of convergence, the existence of long-term interest rates (The EC, 2022).

All the members had both a gain from intra-trade and an increase in the GDP per capita as a result of the enlargement in the EU. The number of members and average GDP per capita of the EU are correlated positively with each other and Spearman's rho correlation coefficient is 0.832. The average GDP per capita was 19,465 USD in 1995 with 14 members, whereas it has increased to 38,224 USD in 2021 with 27 members.

This study aims to investigate whether GDP per capita in the country set have breakpoints thus membership caused a positive effect on their income. Time series data were used for individual member state analysis whereas panel data were used for income convergence analysis of the country set.

1. LITERATURE REVIEW

The first empirical studies to prove the existence of convergence were conducted by Maddison (1982) and Summers and Heston (1988) based on long-term cumulative time series data of many variables for many countries. Empirical research on the concept of convergence has led to the definition of different types of convergence over time. As the theoretical framework discussed in the analyses changes, the results about convergence also change. The changes made by the researchers in the assumptions of the growth models have led to the emergence of different convergence concepts.

The view that the unconditional convergence hypothesis tested in previous studies is not valid has become dominant in the literature over time, and contradictory results have been noted for the existence of conditional

convergence. In line with the importance of economic cooperation in the process of convergence and growth, it is possible to see that there are generally significant convergences between countries in studies on economic community member countries such as OECD or the EU.

There are extensive studies in the literature on the differences between the growth rates of national economies and the convergence of these differences over time. The question of whether the income levels of different economies tend to converge began with the economic growth study of Solow (1956) and has survived to the present day. Pioneering studies such as Solow (1956), Swan (1956), and Cass (1965) show that the neo-classical growth model shows that real income differences will disappear over time between countries with similar productivity levels, savings rates and population growth, while poor countries approach the steady state, while poor countries are on average richer. The validity of the judgment that it will grow faster than other countries is questioned. For testing real income convergence, Baumol (1986), De Long (1988), Dowrick and Nguyen (1989), Barro and Sala-i-Martin (1995), Mankiw et al. (1992) and Islam (1995), on the other hand, examine this relationship based on the regression between cross-sectional data and real income growth rates of national economies and an initial income level.

Income convergence occurs when low-income countries catch up with relatively higher-income countries. It states that low-income countries grow faster than relatively richer countries, so that the income gap between the countries decreases, in other words, it catches up with high-income countries over time. High-income countries have technological diffusion, and in the process, low-income countries should benefit from their technological diffusion. Theoretically, income convergence occurs not only in the per capita income level between countries but also in the income distribution between regions within a country (Ho, 2015).

In their studies, Kutan and Yiğit (2004) and Kocěnda (2001) obtained strong findings in line with the prediction of real convergence in terms of new candidate countries to the EU, using modern panel unit root testing methods in the 1993-2004 review period. Using different panel unit root approaches, Saraçoğlu and Doğan (2005) examined the predicted validity of the income convergence for the EU members and candidate countries for the 1985-2004 period. The authors concluded that the EU members diverged from their group averages, while the candidate countries converged to their averages. In addition, considering the convergence of the countries to France, which was chosen as the leading country, the prediction that the first 15 EU countries converged to France could not be rejected.

Cabral and Castellanos-Sosa (2019) analysed the impact of the global financial crisis by applying the cross-section and dynamic panel data methodology. They examined the income convergence between the EU countries for the 1973-2012 period. The study revealed that the establishment

of the EU provided income convergence among the new members, while the old members were greatly affected by the financial crisis, which reduced the rate of convergence in the region. The difference between old and new members' income seemed to decrease before the crisis broke out, perhaps because new members caught up with the old members with technological advances.

Table ***1*** shows the highlights of related literature review of the study.

Table 1. Literature Review

Author	Method	Period	Result
Desli and Gkoulgkoutsika (2021)	Beta (β)-convergence approach, Log(t) convergence approach, Stochastic convergence approach	1980-2016	All the methods show that the high-income countries are participating in an ongoing process of convergence, even though they were hit hard by the financial crisis. Evidence for convergence tends to weaken when the underlying deterministic trend assumption is enriched by a stochastic trend and eventually abandoned.
Cartone et al. (2021)	The conditional convergence model	1981-2009	The authors examined the indicators that cause economic development in 187 regions in 12 EU member states. Empirical evidence has shown that European regions have not only investment, population growth, human capital and spillovers but also different rates of convergence. Also, convergence tends to be higher for slower-growing European regions, resulting in stronger reductions in inequalities between these regions. This result highlights how the economic performances of different EU regions differ, pointing to the need for tailored policies.
Otoiu and Titan (2015)	Coefficients of variation	since 2000	In their study, the authors investigated whether socio-economic convergence has taken place not only at both national and regional levels but EU cohesion policy has been effective as well. Most of the findings showed that the EU cohesion policy was effective in reducing socio-economic inequalities before the 2008 financial crisis and controlling the crisis due to the increasing convergence between countries. However, the unexpected difference in internal migration needs further investigation.
Kutan and Yiğit (2005)	Contemporary panel unit root testing methods	Jan 1993-Dec 2000	The authors tested the real and monetary stochastic convergence in transition economies, using macroeconomic data from January 1993 to December 2000 using Kočenda's (2004) methodology for different periods. They did not find qualitatively different implications for convergence and the results showed less nominal and real economic convergence in transition economies than those of Kočenda's ones. Besides, the results suggested that inferences about convergence between transition economies may be more

			sensitive to the constraints placed on the panel technique used rather than the data period used.
Saraçoğlu and Doğan (2005)	Panel unit root	1985-2004	The authors examined the predicted validity of the income convergence for the EU members and candidate countries for the 1985-2004 period. The authors concluded that the EU members diverged from their group averages, while the candidate countries converged to their averages. In addition, considering the convergence of the countries to France, which was chosen as the leading country, the prediction that the first 15 EU countries converged to France could not be rejected.
Andreano et al. (2013)	β-Convergence	1950-2007	In their study, the authors tried to answer the question of whether there is convergence in per capita income in MENA countries. The developments in the regional economy were mostly affected by unique factors such as energy resources, and demographic and institutional characteristics. Although the convergence process is slow compared to other developing countries, GDP per capita in 26 MENA countries for the 1950-2007 period strongly confirms the β-conditional convergence hypothesis.
Liviu-Stelian et al. (2014)	Markov chain analysis	In the first phase: 1995-2007, 2008, 2009, 1995-2010, 2011,2012	In their study, the authors analysed the effects of the global economic crisis on EU countries by considering the convergence dimension. The economic convergence was especially disrupted by the economic crisis. The results showed that the analysis based on GDP per capita is not sufficient, the economic freedom index shows a concentration of values that imply a stronger convergence in this area and can see that the crisis has a minimum effect.
Kočĕnda (2001)	Panel unit-root test	1991-1998	In the study, the author examined convergence between the transition countries located in the centre and eastern part of Europe (CEE) and found that evidence of convergence in macroeconomic fundamentals and common institutional nature and economic policies tended to be associated with a higher degree of convergence. This result is compatible with neoclassical growth theory, which supports convergence between countries with similar characteristics.
Korap (2010)	Panel unit-root tests	1970-2007	In the study, the author re-examined the neo-classical convergence growth theory for 26 OECD countries. The panel unit root tests for the 1970–2007 period indicate that the null hypothesis, which states that OECD's real income per capita converges to the USA chosen as the comparison country, cannot be rejected. The author also stated that the validity of the findings should be tested using various other panel data testing methods for a larger sample period.
Tunali and Yilanci (2010)	Nonlinear unit root tes	1950-2006	In the study, the income convergence hypothesis is analysed using time series techniques in a non-linear framework for nineteen MENA countries over the 1950-2006 period. There are significant structural

			differences between MENA countries, and according to the results obtained in the study, the incomes of the eighteen MENA countries excluding Iraq during the sampling period differ from each other. To reduce this inequality, economic cooperation between these countries should be encouraged.
Gögül and Koralp (2014)	Panel unit-root tests	1970-2012	In this study, convergence prediction based on neo-classical growth theory is tried to be re-examined by using real income per capita data of 26 OECD countries in the period 1970-2012. For the sample period, considering some contemporary panel unit root tests, the main findings show that there is a convergence of real income per capita of OECD countries to both the USA chosen as the leading country and the OECD average, so the results support the neo-classical convergence approach.
Yeşilyurt (2014)	Pesaran (2007) dual approach	1978-2010	In the study, the author investigated whether there was convergence in 27 OECD countries for the 1978-2010 period using Pesaran's (2007) dual-test approach. According to the empirical results based on pair-wise tests, there is income convergence for OECD countries, which have high economic relations with each other, and the results are in line with the expectations.
Ceylan and Abiyev (2016)	Nonlinear, nonlinear-asymmetric and LM unit root tests	1950-2015	In their study, the authors investigated whether GDP per capita in EU-15 countries approached the EU-15 average during 1950–2015. Nonlinear and nonlinear asymmetric unit root tests showed that the five members exhibited long-term or deterministic convergence with the EU-15 average. However, endogenous structural LM unit root tests show that the nine members exhibit stochastic convergence. As a result, it has been observed that the real per capita income levels of 11 EU countries are close to the EU-15 average.
Cavallaro and Villani (2021)	Convergence clustering approach	1995-2017	In the study, the relationship between real income convergence and convergence patterns of financial systems in EU28 countries for the period 1995-2017 was examined. The first result is that income inequalities have narrowed significantly in the last two decades, but the growth convergence process has lost momentum with the global financial crisis. Second, with the new EU member states having a lower financial development, the countries' financial systems show a high degree of fragmentation, confirming the existence of a two-tier Europe. In general, convergence patterns for real incomes and financial development are strongly correlated.
Cieślik and Wciślik (2020)	Phillips and Sul (2007) convergence test	1995-2017	This study focuses on empirical research into the convergence of real GDP per capita among eight Central and Eastern European countries-and the catch-up of these new members to former EU-15 members by Phillips and Sul's (2007) convergence test. The results show that CEE-8 does not converge to former EU-15 members, likewise, there are no clear

			convergence patterns in EU15, whereas there is convergence among CEE-8 countries. However, CEE-8 seems to converge to the EU's two largest economies, such as Germany and France.
Li and Papell (1999)	Unit root hypothesis, stochastic convergence, deterministic convergence.	1900-1989	The authors examined the convergence of output per capita for 16 OECD countries over the period 1900-1989. Conventional tests of conditional and time series convergence appear to yield mixed results for similar economies. According to the test results, evidence of deterministic convergence was found for 10 out of 16 OECD countries and stochastic convergence for 14. According to the findings, II. World War was the primary cause of structural shifts in relative output.
Nahar and Inder (2002)	Testing convergence, unit root t-tests	1950-1998	This article makes several new contributions to the convergence literature. First, it is argued that for a group of countries that may share a common steady-state output level, it may be more appropriate to consider the group leader's output level to be a better choice than the group's average output level, so that for OECD countries the convergence test is a member country's output gap with the United States. becomes a test of whether it is approaching zero. Second, unit root tests give misleading signals about the existence of convergence, and convergence can be rejected in many cases where there is convergence. Contrary to previous studies, the authors found convergence by using the new method they developed in the analysis of per capita income convergence for 22 OECD countries for the period 1950-1998.
Yilanci &Canpolat-Gokce (2020)	Panel, Unit Root, SUR-ADF, Fourier, RALS.	1960-2015	In this article, a new unit root test, which is a combination of Breuer et al. (2001), Chang et al. (2012) and Im and Schmidt (2008) studies, was used to test the validity of the convergence hypothesis in per capita income for 18 OECD countries in the period 1960-2015. The existence of stochastic convergence between countries was examined, and it was concluded that stochastic convergence was valid in only seven countries.
Yaya et al. (2020)	The Fourier Unit Root test	1967-2017	In the study, the authors used a new unit root test to examine income convergence in nine Asian countries, three of which were selected as the leading countries in eastern Asia regions for the period 1967-2017.
Kvedaras and Cseres-Gergely (2020)	Monte Carlo (MC) simulations	2007-2014	In the study, the convergence of income distributions between 27 EU countries in the 2007-2014 period is statistically significant. The biggest convergence in a single year occurred just after the financial crisis. It is observed that the convergence, which was slower in a few years after the crisis, accelerated again after 2012.
Strazicich et al. (2004)	Lagrange multiplier unit root test	1870-1994	In the study, a minimum Lagrange multiplier unit root test, which endogenously determines level and trend structural breaks, was used to test whether income per capita for fifteen

			OECD countries in the period 1870–1994 stochastically converged or not. The empirical results indicated significant evidence for stochastically converging. For each OECD member, there were one or two permanent breaks in relative income which were mostly often around the two World Wars.
Ceylan et al. (2013)	Nonlinear unit root, KSS test, LNV-sollis test.	1950-2008	In the study, the convergence hypothesis for 21 OECD countries during the period of 1950-2008 was analysed by the linear and nonlinear time series methods. The nonlinear test results showed that there was not a unit root in both demanded output and the output gap from the USA series for several OECD countries, which indicates there is a convergence. However, the linear ADF test stated supportive evidence of unit root and no convergence in the outputs.
Borsi and Metiu (2015)	Club convergence concept	1970-2010	The study investigated the convergence in real income per capita in the EU in the 1970-2010 period by a non-linear latent factor framework. The results indicated that there was no overall income convergence in the EU.
Völlmecke et al. (2016)	Endogenous broad capital model, Markov chain	2003-2010	The study investigated income convergence in GDP per capita for 269 regions in the EU in the 2003-2010 period. According to the results, there was generally a weak income convergence process between EU regions. The Central and East European Countries (CICs) regions had a poverty trap so the convergence was not valid for these regions. In regions, in contrast to FDI, there was a positive correlation between human capital and higher income levels. However, both FDI and human capital positively affected income growth dynamics.
Lim and McAleer (2004)	Unit root and cointegration techniques, the time series tests.	1965-1992	The study investigated whether there is a convergence club for ASEAN-5, as well as ASEAN-5 and the USA by applying different time series tests. Using the unit root and cointegration methodology, the test results did not show a significant income convergence between pairs of ASEAN-5 countries. There was limited evidence for the income convergence between Singapore and the ASEAN-3 countries so further investigation was needed. Apart from Singapore, ASEAN-5 countries did not succeed in catching up with the USA, which was a technology leader.
Kant (2019)	β-convergence regressions	1971-2013 (42 years), and 1992-2013 (21 years). In 1971 and 1992 base years, the USA did not experience a recession	The paper aimed to measure and compare the development and income inequality between the countries. Focusing on forty-six countries, six countries in Sub-Saharan Africa and forty countries in South Asia, which were relatively homogenous, none of the regions has achieved either within group convergence or significant catching up with the leader country since 1951. Twenty-one of the twenty-eight countries, which exhibited catching up in the most recent 21-year period, fell behind the technology leader country US in the longer period.
Akkoç and Şahin (2019)	Panel data, GMM	1999-2013	In the study, the conditional convergence hypothesis was tested for 31 countries whose data could be accessed for the period 1999-

	estimation method		2013. The analysis not only focused on the speed of convergence but the presence of convergence was analysed as well as using panel data. Even the results showed a weak convergence between the countries, on the other hand, it was concluded that trade openness, investment and total factor productivity of the countries had a positive effect on the economic growth.
Akıncı and Yılmaz (2012)	difference-in-differences" analysis, time series analysis	1981-2010, 1981-1995, 1996-2010	In this study, it has been examined whether the convergence valid for countries is also valid between different income groups and regions within the country. In this direction, the convergence relations between the rich and poor classes in the Turkish economy in the 1980-2014 period by 12 sub-regions were analysed using time series analysis. The model estimation results showed that the poor converge to the poor and the rich to the rich, thus reflecting that the divergence process is dominant in the Turkish economy.
Savacı and Karşyakalı (2016)	Carlino ve Mills (1993) zaman serisi yöntemi	1960-2013	In this study, convergence analysis was made in the per capita income level between Turkey and the EU countries from 1960 to 2013. According to the test results, there has been a β-convergence between Turkey and Austria, Belgium, Denmark, Finland, France, Italy, Sweden and Portugal since the 1990s, while there is a divergence between Greece and the United Kingdom.

2. RESEARCH METHODOLOGY

In this study, the correlation of the GDP per capita, convergence (growth rate) of the GDP per capita, and breakpoints in GDP per capita were analysed for the country set, the EU, Eurozone and the world as total.

2.1. Selection of Country Set

The study covers thirteen member countries that were accepted as full members of the EU in the 2000s and Turkey, which is a candidate country for the EU. The latest member countries and their membership dates are as; Cyprus, Czechia (Czech Republic)), Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia in 2004, Bulgaria and Romania in 2007, and Croatia in 2013.

Eight (there were seven members when the study was done) of the new members are also in the Eurozone. While eleven of the new members are located in Central and Eastern Europe (CEE), Malta and Cyprus are two island countries located in the Mediterranean.

2.2. About the Data

The data were gathered for the period 1995-2021, but there was a lack of data for GDP per capita for some countries in 2021 year. The data were collected from different data sources. GDP per capita for the country set was mainly from the World Bank (2022), OECD (2022) and Eurostat (2022). Data from Eurostat were converted into USD by exchange rate data from the Bank for International Settlements (2022). The country set was analysed considering the GDP per capita (USD) for the period 1995-2021.

2.3. Methodology

In the study, the 22nd version of the Statistical Package for Social Sciences Data (SPSS) software was used to test the normality of GDP per capita and to find the correlations between the data of countries. The ninth Version of the EViews (2022) software was used to determine the stationarity of the data with unit root tests and the breakpoints and convergence rates (growth rates) of the data in the 1995-2021 period. Statistical tests were applied for both time series and panel data.

For a given data set, the normality and the stationarity of the data should be checked before the analysis.

It is necessary to investigate the cross-sectional dependence of the data. When there is cross-dependency in data, the stationarity of the data should be checked with 2^{nd} generation tests instead of 1^{st} generation tests. EU member states may face risks and opportunities together due to the EU's common policies. The effects can cause a correlation between the member countries (cross-sections) in panel data models. The existence of such a correlation, which is called cross-section dependence, will cause wrong results in the model.

Pesaran (2004) proposed the Cross-section Dependence (CD) test rather than standard tests to check the cross-section dependency when the number of the cross-section (N, thus new member countries is 13) is larger than the period (T, 27 years. The cross-section dependency of the residual series formed by the equation should be tested by Pesaran's CD test. The hypotheses are as:

H_0: No cross-section dependence (correlation); 1^{st} generation tests should be used

H_1: The cross-section dependence (correlation) exists; 2^{nd} generation tests should be used

In this study, the normality and stationarity of the data were tested at first with different statistical tests. Then convergence (growth) of the data in the 1995-2021 period was measured. Finally, different breakpoint tests were also applied for the GDP per capita data of the country set. Zivot-Andrews and Perron unit root statistical tests were applied to check the breakpoints in the data.

2.4. The Normality of the Data

Normal distribution for data is very important in statistical analysis. In this study, the normality of the data was tested by the Shapiro-Wilks (SW) test and the Kolmogorov-Smirnov (KS) test using IBM-SPSS (2022) software.

The Jarque and Bera (JB) test statistic follows the chi-square distribution with 2 df, for the null hypothesis which states that the residuals are normally distributed (Gujarati and Porter, 2009).

[1] $JB = n^* \left(\frac{S^2}{6} + \frac{(K-3)^2}{24}\right)$, where S is skewness and K is kurtosis.

For the normally distributed data, the parametric Pearson correlation test, and for nonnormal distributed data non-parametric Spearman rho correlation test should be used to detect whether there is a correlation between the data or not (Minitab, 2015; IBM, 2022).

For testing the normality of the data, the null and alternative hypotheses are as:

H_0: The data show normal distribution (so that parametric tests should be applied)

H_1: The data do not show a normal distribution (so that non-parametric tests should be applied)

If the estimated t-statistics of the data exceeds the critical value, the null hypothesis can be rejected with a 95 per cent confidence interval, thus it can be said that the data are not normally distributed. If the estimated t-statistics of the data is less than the critical value, the null hypothesis is not rejected with a 95 per cent confidence interval, thus it is concluded that the data are not normally distributed. If the probability (p) obtained as a result of the test is less than the critical value (0.05), the null hypothesis can be rejected with a 95 per cent confidence interval, so it can be said that the data are not normally distributed. If the probability (*p*) is greater than the critical value (0.05), the null hypothesis is not rejected with a 95 per cent confidence interval, thus it is concluded that the data are not normally distributed (Khatun, 2021).

2.5. Break Points

Shrestha and Bhatta (2018) have defined a structural break as a sudden jump or fall in a time series due to a change in policy direction, regime, and external shocks. While some time series are stationary, it can be concluded that they have a unit root and are not stationary due to the structural breaks. Today, there are many test statistics to test whether a time series has one or more structural breakpoints. Structural breakpoints analysis allows the identification of events that may have fed structural changes and helps to compare the estimated breakout date with the effective date of a policy change or a policy implementation (Bai and Peron, 1995). Bai and Perron (1998) have

analysed the issues related to multiple structural changes, occurring at unknown dates, in the linear regression model estimated by least squares. In business cycles, the structural changes, which may be sometimes in the slope and sometimes in the intercept, and sometimes in both of them, may differ from one to another (Gujarati and Porter, 2009). Perron (1989) defined three different structural break models as Models A, B and C. "Model A" describes a one-time change in level or intercept "crash", "Model B" describes a sudden change in the slope of the trend function "changing growth", and "Model C" describes a change in level (intercept) and trend simultaneously.

2.6. Growth Convergence Equation

The Growth Convergence Equation (World Economic Forum "WEF" 2014) can be formulated as,

[2] $ln\ (y_{it}) = \propto + (1-\beta) * ln\ (y_{it-n}) + u_t$ where, *y:* GDP per capita data, *ln*: natural logarithm of the data, *t:* current time, *t-n*: n time before current time, *i*=1,2,3…13 (thirteen member countries in the EU).

The equation above indicates the relationship between the natural logarithm values of the variables at time "*t"* and the natural logarithm values of the variable at "*n*" time before time "*t"*. If the natural logarithm values of the variable "*y"* for the *"t-n*" period are added to both sides of the equation, the following equation is obtained and the expression on the left side of the new equation shows the change in the variable (growth rate). After the simplification, the new equation is as;

[3] $ln\ (y_{it}) - ln\ (y_{it-n}) = \propto -\beta * ln\ (y_{it-1}) + u_t$ where ln (y_{it})-ln (y_{it-n})

3. RESULTS

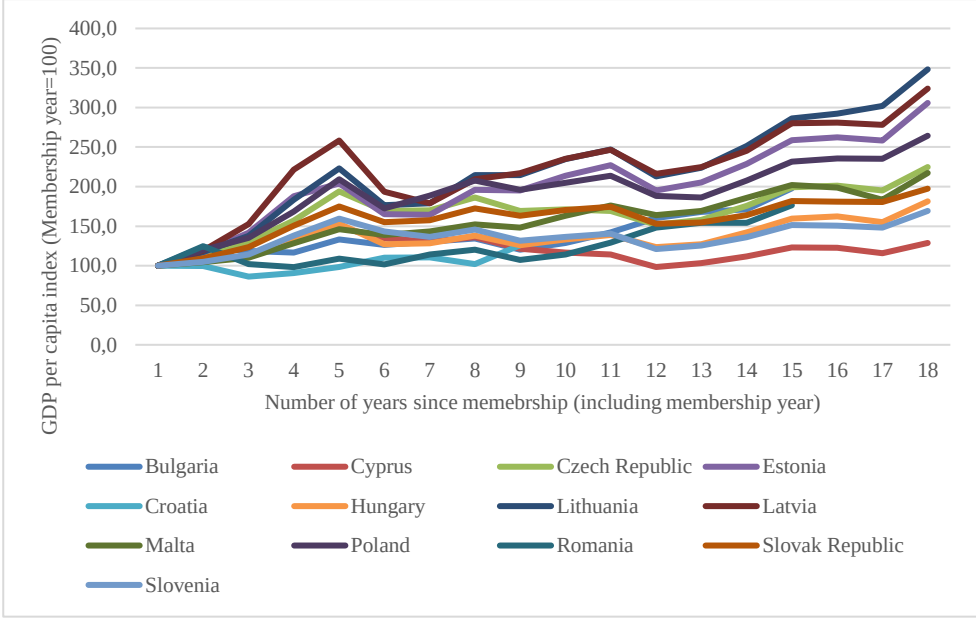
GDP and GDP growth rate alone are not sufficient to describe the welfare of a country. How many people produce this income, that is, the per capita GDP (income) value is also very important. Alpha-convergence tells whether the world income gap among countries will decrease over time, while Beta-convergence tells the mobility of different economies within a given global income distribution. Absolute beta (β) convergence exists if countries with low per capita income tend to grow faster than countries with high per capita income. If the distribution of real GDP per capita in countries tends to decrease over time, there is alpha (α) convergence (Sala-i-Martin, 1995). Both α–convergence and β–convergence were analysed in this study.

In 2021, Malta has the highest income per capita with 33 thousand dollars among thirteen new members, Cyprus with 30.7 thousand dollars and Slovenia with 29.2 thousand dollars income per capita have followed Malta. The EU has 34.1 thousand dollars, and the Eurozone has 42.2 thousand dollars in income per capita on average. Turkey has 9.5 thousand dollars in income

per capita as a candidate country. Lithuania has the best performance in income per capita increase in the 1995-2021 period whereas Romania has the second and Latvia has the third best performance. Cyprus, Slovenia and Malta have the worst performance in increasing their income per capita in the same period (Table 8). In 1995-2021 period, the growth in income per capita in the EU was 96% and 78.2% in the Eurozone. Turkey has a growth rate of 229.2% in income per capita. Due to the convergence theorem, new member countries have the highest growth rate than the EU and Eurozone in income per capita in the 1995-2021 period.

To analyse the performance in their income per capita of the country set after their membership to the EU, the income per capita value at the membership date was accepted as the base value (100). In Graph 1, the GDP per capita index of member countries since their membership can be seen for the period their membership started until 2021. Lithuania was ranked at the top with the growth rate from the membership date to 2021. Latvia, Estonia, Poland and Czechia have followed Lithuania in order. Cyprus has the worst performance in the country set and Croatia has the second worst performance in income per capita increase after their membership.

Graph 1. GDP Per Capita Index of Member Countries Since Their Membership (Including Membership Date)



Source: The World Bank (2022), OECD (2022), Eurostat (2022)

3.1. Normality of GDP Per Capita

As the sample size is smaller than 50, the SW test was applied to the GDP per capita data. The probability value (p) of the data is smaller than the

critical value (p=0.05) so H_0 can be rejected and the alternative hypothesis should be accepted which means GDP per capita for thirteen member countries, Turkey, the EU and the Eurozone are not normally distributed for the period 1995-2021 (Table 2).

Table 2. KS and SW Normality Test Results for GDP Per Capita in the 1995-2021 Period

	Kolmogorov-Smirnov			Shapiro-Wilk		
Country	Statistic	df	Sig.	Statistic	df	Sig.
Bulgaria	.174	27	.034	.907	27	.020
Cyprus	.180	27	.025	.892	27	.009
Czechia	.187	27	.016	.875	27	.004
Estonia	.154	27	.099	.910	27	.023
Croatia	.193	27	.011	.870	27	.003
Hungary	.191	27	.013	.887	27	.007
Lithuania	.147	27	.140	.921	27	.041
Latvia	.163	27	.063	.896	27	.011
Malta	.157	27	.085	.912	27	.026
Poland	.177	27	.030	.886	27	.006
Romania	.178	27	.028	.889	27	.008
Slovakia	.241	27	.000	.840	27	.001
Slovenia	.180	27	.024	.875	27	.004
EU	.214	27	.003	.858	27	.002
Euro Area/Eurozone (EA)	.202	27	.006	.862	27	.002
Turkey	.161	27	.070	.891	27	.008

Due to all the values of the chi-square distribution statistic with 2 df being greater than zero (thus for p=0.05 and 2 df, the critical value is 5.99), the null hypothesis which states that the residuals are normally distributed can be rejected. All the data in Table 3 are not normally distributed.

Table 3. JB Normality Test Results for GDP Per Capita in the 1995-2021 Period

Country	Skewness	Kurtosis	n	JB	Decision
Bulgaria	0.057	-1.322	27	21.025	Reject Ho, data not normally distributed
Cyprus	-0.315	-1.328	27	21.517	Reject Ho, data not normally distributed
Czechia	-0.267	-1.525	27	23.361	Reject Ho, data not normally distributed
Estonia	-0.039	-1.354	27	21.329	Reject Ho, data not normally distributed
Croatia	-0.388	-1.432	27	22.777	Reject Ho, data not normally distributed
Hungary	-0.358	-1.269	27	21.078	Reject Ho, data not normally distributed
Lithuania	0.082	-1.271	27	20.553	Reject Ho, data not normally distributed
Latvia	-0.109	-1.522	27	23.062	Reject Ho, data not normally distributed
Malta	0.081	-1.375	27	21.565	Reject Ho, data not normally distributed
Poland	-0.134	-1.584	27	23.723	Reject Ho, data not normally distributed
Romania	0.052	-1.392	27	21.716	Reject Ho, data not normally distributed
Slovakia	-0.401	-1.599	27	24.515	Reject Ho, data not normally distributed
Slovenia	-0.338	-1.478	27	23.070	Reject Ho, data not normally distributed
EU	-0.448	-1.494	27	23.623	Reject Ho, data not normally distributed
Eurozone	-0.479	-1.436	27	23.168	Reject Ho, data not normally distributed
Turkey	-0.300	-1.494	27	23.129	Reject Ho, data not normally distributed

During the 1995-2021 period, GDP per capita in thirteen member countries, Turkey, the EU and the Eurozone are positively correlated. All the member countries' GDP per capita are highly correlated with each other, EU total and Eurozone whereas their correlation coefficient is less with Turkey. It seems that membership brings a higher correlation within the EU. Slovenia has the highest correlation with the EU and the Eurozone, Croatia has the second highest rate, Slovakia has the third highest rate with the EU, and Cyprus has the third rate with Eurozone. Turkey has the highest correlation with Malta and the lowest correlation with Slovenia (Table 4).

Table 4. Correlation Coefficients of GDP Per Capita in the 1995-2021 Period*

Country	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00															
2	0.75	1.00														
3	0.94	0.85	1.00													
4	0.97	0.74	0.95	1.00												
5	0.87	0.93	0.96	0.89	1.00											
6	0.94	0.83	0.98	0.97	0.95	1.00										
7	0.97	0.73	0.95	1.00	0.88	0.97	1.00									
8	0.94	0.76	0.95	0.99	0.90	0.98	0.99	1.00								
9	0.96	0.70	0.93	0.98	0.84	0.94	0.98	0.96	1.00							
10	0.96	0.79	0.98	0.97	0.92	0.97	0.98	0.97	0.96	1.00						
11	0.98	0.75	0.95	0.98	0.90	0.96	0.98	0.98	0.97	0.97	1.00					
12	0.95	0.83	0.99	0.97	0.94	0.98	0.97	0.97	0.95	0.99	0.96	1.00				
13	0.90	0.92	0.96	0.90	0.98	0.96	0.89	0.91	0.87	0.94	0.92	0.96	1.00			
14	0.90	0.90	0.94	0.89	0.95	0.93	0.88	0.90	0.85	0.92	0.90	0.94	0.97	1.00		
15	0.87	0.92	0.92	0.86	0.95	0.91	0.85	0.87	0.82	0.90	0.87	0.92	0.97	0.99	1.00	
16	0.76	0.73	0.74	0.77	0.73	0.74	0.77	0.76	0.78	0.78	0.75	0.77	0.73	0.78	0.79	1.00

* Correlation is significant at the 0.01 level (2-tailed).

Note: 1:Bulgaria, 2:Cyprus, 3:Czechia, 4:Estonia, 5:Croatia, 6:Hungary, 7:Lithuania, 8:Latvia, 9:Malta, 10:Poland, 11:Romania, 12:Slovakia, 13:Slovenia, 14:EU, 15:Eurozone, 16:Turkey

3.2. Cross-section Dependency Test

Before testing the stationary of the data, the cross-section dependency test was checked by Breusch-Pagan Lagrange Multiplier (LM), Pesaran Scaled Lagrange Multiplier (LM) and Pesaran Cross Section Dependence (CD) tests.

In the study, the first-generation unit root tests were used to test the stationarity in the data (Table 5).

Table 5. Cross-dependency Test Results

GDP per capita (natural logarithm)					
Test	Statistic	Cross-sections included	Total panel observations	d.f.	Prob.
Breusch-Pagan LM	2,015.6	13	351	78	0.000
Pesaran scaled LM	154.1	13	351		0.000
Bias-corrected scaled LM	153.8	13	351		0.000
Pesaran CD	44.9	13	351		0.000
GDP per capita (level)					

Test	Statistic	Cross-sections included	Total panel observations	d.f.	Prob.
Breusch-Pagan LM	1,951.8	13	351	78	0.000
Pesaran scaled LM	149.0	13	351		0.000
Bias-corrected scaled LM	148.7	13	351		0.000
Pesaran CD	44.1	13	351		0.000
Convergence equation (cross-section dependence "correlation") in residuals)					
Test	Statistic	Cross-sections included	Total panel observations	d.f.	Prob.
Breusch-Pagan LM	1,377.4	13	338	78	0.000
Pesaran scaled LM	103.0	13	338		0.000
Pesaran CD	36.9	13	338		0.000

Source: The World Bank (2022), OECD (2022), Eurostat (2022), EViews (2022)

3.3. Testing Stationary of GDP Per Capita

The null and alternative hypotheses for testing the stationary of GDP per capita are as:

H_0: Country data have a unit root (the data are not stationary)

H_1: Country data have no unit root (the data are stationary)

During 1995-2021 period, GDP per capita data for Bulgaria, Croatia, Hungary and Malta are stationary since their Augmented Dickey-Fuller test results are statistically significant (*p* values are smaller than 0.05). GDP per capita data for Cyprus, Czechia, Estonia, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia, Turkey, EU and Eurozone are not stationary since their Augmented Dickey-Fuller test results are not statistically significant (*p* values are greater than 0.05). To make analysis being stationary for a given data set is important. Some time series are stationary, it can be concluded that they have a unit root and are not stationary due to the structural breaks (Table 6).

Table 6. Stationary Test Results of GDP Per Capita (Cross-section Data)

Country	Augmented Dickey-Fuller Test Result (probability)	Decision	Conclusion
Bulgaria	0.0099	Reject H_0	The country's GDP is stationary
Cyprus	0.8847	Not able to reject H_0	The country's GDP is non-stationary
Czechia	0.7334	Not able to reject H_0	The country's GDP is non-stationary
Estonia	0.3598	Not able to reject H_0	The country's GDP is non-stationary
Croatia	0.0168	Reject H_0	The country's GDP is stationary
Hungary	0.0283	Reject H_0	The country's GDP is stationary
Lithuania	0.3277	Not able to reject H_0	The country's GDP is non-stationary
Latvia	0.1293	Not able to reject H_0	The country's GDP is non-stationary
Malta	0.0194	Reject H_0	The country's GDP is stationary
Poland	0.4934	Not able to reject H_0	The country's GDP is non-stationary
Romania	0.0701	Not able to reject H_0	The country's GDP is non-stationary
Slovakia	0.8252	Not able to reject H_0	The country's GDP is non-stationary
Slovenia	0.7358	Not able to reject H_0	The country's GDP is non-stationary
EU	0.7281	Not able to reject H_0	The country's GDP is non-stationary
Eurozone	0.7439	Not able to reject H_0	The country's GDP is non-stationary
Turkey	0.9596	Not able to reject H_0	The country's GDP is non-stationary

Source: The World Bank (2022), OECD (2022), Eurostat (2022), EViews (2022)

There are many statistical tests to determine a panel data is stationary or non-stationary.

The null and alternative hypotheses for Hadri Z-stat and Heteroscedastic Consistent Z-stat tests are as:

H_0: There is no unit root in the panel data

H_1: There is a unit root in the panel data
As $p<0.05$ we reject H_0, so that panel data have unit root and data are not stationary.

The null and alternative hypotheses for Levin, Lin & Chu t and Breitung t-stat tests (all the tests assume a common unit root process) are as:

H_0: There is a unit root in the panel data

H_1: There is no unit root in the panel data
As $p>0.05$ for Levin, Lin & Chu t-test, H_0 cannot be rejected so that the panel data have a unit root and data are nonstationary. As $p<0.05$ for the Breitung t-stat test, H_0 should be rejected so that panel data have no unit root and data are stationary.

There are four tests, which assume an individual unit root process. The tests are Im, Pesaran and Shin, W-stat, ADF - Fisher Chi-square, and PP-Fisher Chi-square tests. The null and alternative hypotheses for the tests are as:

H_0: There is a unit root in the panel data

H_1: There is no unit root in the panel data
As $p>0.05$ for Im, Pesaran and Shin W-stat, PP - Fisher Chi-square and ADF-Fisher Chi-square statistic tests, we cannot reject H_0, so that panel data have a unit root and data are not stationary.

As a result, statistical tests were applied to test the stationarity of the GDP per capita panel data. Six of the seven tests indicate that the data are non-stationary, and one of them states that the data are stationary (Table 7).

Table 7. Stationarity Tests for GDP Per Capita Panel Data

Null Hypothesis: Stationarity				
Method	Statistic	Prob.**	Cross-sections included: 38	Total (balanced) observations: 380
Hadri Z-stat	7.43	0.000	13	351
Heteroscedastic Consistent Z-stat	7.30	0.000	13	351
Null: Unit root (assumes common unit root process)				
Method	Statistic	Prob.**	Cross sections	Obs.
Levin, Lin & Chu t*	-0.13086	0.4479	13	320
Breitung t-stat	-1.84687	0.0324	13	307
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.80415	0.7893	13	320
ADF - Fisher Chi-square	24.6038	0.5415	13	320
PP - Fisher Chi-square	5.90385	1	13	338

Source: The World Bank (2022), OECD (2022), Eurostat (2022), EViews (2022)

3.4. Growth Convergence (β Convergence) of GDP Per Capita

[4] $ln(y_{it}) = \propto + (1-\beta) * ln(y_{it-n}) + u_t$ y: GDP per capita

OLS pooled regression: $\boldsymbol{ln\ (y_{i,t}) = 0.37 + 0.967 * ln(y_{i,t-n}) + u_{i,t}}$ hence (1-β)=0.967, β=0.033 (3.3%), GDP per capita has converges 3.3% in average in 1995-2021 period.

Fixed effect regression: $\boldsymbol{ln\ (y_{i,t}) = 0.675 + 0.934 * ln(y_{i,t-n}) + u_{i,t}}$ hence (1-β)=0.934, β=0.066 (6.6%), GDP per capita has converged 6.6% in average in 1995-2021 period.

Random effect regression: $\boldsymbol{ln\ (y_{i,t}) = 0.405 + 0.963 * ln(y_{i,t-n}) + u_{i,t}}$ hence (1-β)=0.963, β=0.037 (3.7%), GDP per capita has converged 3.7% in average in 1995-2021 period.

To test which model is appropriate Hausman test can be applied.

H_0: Random Effects Model (REM) can be applied

H_1: Fixed Effects Model (SEM) can be applied

As the Hausman test statistic is 0.0666, H_0 cannot be rejected so the Random Effects Model is appropriate.

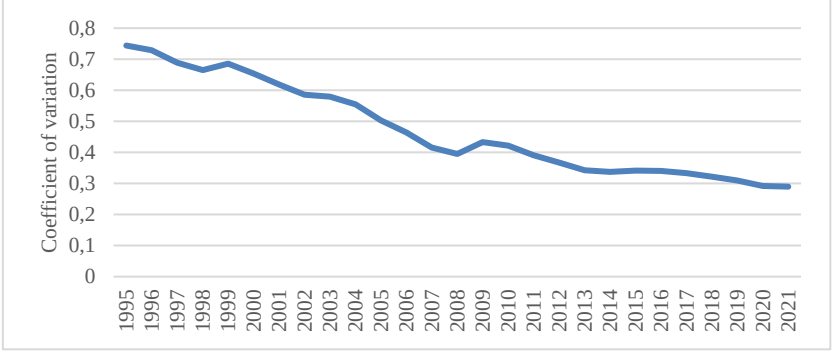
3.5. Growth Convergence (σ Convergence) of GDP Per Capita

The coefficient of variation (CV), expressed as the ratio of the standard deviation to the mean, is defined as a statistical measure of the distribution of data around the mean. A decrease in the time of standard deviation values also referred to as sigma convergence, indicates a convergence in the data set.

$Coefficient\ of\ variation\ (CV) = \frac{\sigma}{\mu}$ where σ is the standard deviation of the data set and μ is the mean of the data set.

Graph **2** shows evidence of sigma (σ)-convergence in GDP per capita in thirteen EU members, who were accepted as full members of the EU after 2000. The coefficient of variation decreased by 61.1 per cent for thirteen member countries in the 1995-2021 period.

Graph 2. Coefficient of Variation in GDP Per Capita



Source: The World Bank (2022), OECD (2022), Eurostat (2022)

3.6. Breakpoints in GDP Per Capita

As mentioned above, although some time series are stationary, it can be concluded that they are not stationary according to the test results due to structural breaks.

The EU region has experienced breaks in GDP and GDP per capita in the past. The region had breakpoints in the economy in 1974 and 1975. The Eurozone had breakdowns in 1972, 1973, 1974 and 1975. Turkey, on the other hand, experienced structural breaks in its economy in 1976, 1977 and 2008. It is seen that the global financial crisis in 2008 was a breaking point in the Turkish economy and the growth in the economy and GDP per capita in the following periods has been adversely affected by this crisis. It is seen that the ruptures in the EU and the Eurozone occur during the periods when the regional economy reaches a high-income level (Gürler, 2016).

Breakpoints change from member to member. Some members started to gain from the Instrument for Pre-accession Assistance (IPA), and some of them continued to gain after membership so that their GDP per capita has a break in a positive sense. Some members have break points in GDP per capita in one year whereas some of them have more than one year (Table 9).

4. DISCUSSION

Von Lyncker and Thoennessen (2017) investigated club convergence in per capita income in 194 European NUTS-2 regions in 15 EU member countries using a nonlinear time-varying factor model of panel data that allows for individual and transitional heterogeneity. Their results show the existence of four convergence clubs in income distribution depending on initial conditions and the evidence of geographical clustering so that there are high-income clusters for capitals, as well as a north-to-south divide.

Since the beginning of the monetary union in the Eurozone, some low-income economies from the new EU member countries have had GDP per capita converging to that of high-income economies, while this convergence has not been realized in southern European economies. It would not be correct to attribute this only to the transition to a single currency (Euro) in the EU, and it will be seen that some member states faced a "non-convergence trap" long before the single Euro years. Among other factors, total factor productivity is also important in driving real convergence in the Eurozone over time. The crucial interaction of institutional quality and “Maastricht convergence”, which are the other two basic components of sustainable economic convergence are formed real convergence. It is critical for Eurozone countries, facing convergence problems, to increase the resilience of their economic structures by improving relevant institutions and governance (Diaz del Hojo et al., 2017).

The Treaty of Rome (1957) was the starting point for the European Union to adopt common policies to promote fair economic development and

balanced expansion between its member states, one of the treaties on which the foundations were laid. In their study, Yin et al. (2003) investigated whether there is an economic convergence in real GDP per capita in the EU and how successful such policies are. In the study, they use the EU data for the period 1960-1995 to measure σ and β convergences. Apart from the 1980-1985 period, the empirical evidence supports the hypothesis of economic convergence within the EU.

The European integration process aimed to reduce the income differences between the candidate countries. Although the goal of convergence was successfully achieved in a long time, it has weakened in the last ten-twenty years and even convergence has given way to divergence.

It provides an overview of the empirical evidence for these convergence and divergence developments and develops policy implications for challenges and possible ways out (Glawe and Wagner, 2021).

Simionescu (2014) assessed the degree of convergence in the EU28 during the period 2000-2012. Although the results show a decrease in the divergence process in the EU28 in 2012 compared to 2000, there is still insufficient evidence of the closeness of an acceptable degree of convergence.

Micallef (2021) compared Malta's strong economic growth and rapid convergence after the 2008-2009 global financial crisis with the other EU economies. The author stated that Malta's convergence since 2010 is due to higher labour use. In cross-country comparison, there are three important headings for the country's convergence process:

- The dangers associated with rapid growth resulting from the accumulation of imbalances,
- The need for a flexible adjustment process after an economic shock,
- The EU and Eurozone memberships are no panacea for true convergence without institutions helping technological adoption and productivity growth.

Conclusion

Both σ and β convergence analyses show that 3.7% in average GDP per capita has converged in the 1995-2021 period. σ convergence states that the coefficient of variation decreased by 61.1 per cent for thirteen member countries in the 1995-2021 period, which implies significant evidence of sigma (σ) convergence. β convergence states that GDP per capita has converged by 3.7 per cent on average for thirteen member countries in the 1995-2021 period.

The EU countries have to not only align their national legislation with the relevant EU law with the Maastricht Treaty but also meet specific conditions designed to achieve economic convergence.

The membership will allow Turkey to access the EU's perfectly competitive single market, whereas both households and firms, hence the total

economy, will gain from the membership. Rule of law, transparency and perfectly competitive market conditions of the EU will help the Turkish exporting industries and exporting products more competitive in international markets and Turkey will attract more FDI into the country.

The highlights in the study can be listed as below.

- In 2021, Malta has the highest income per capita with 33 thousand dollars among thirteen new members, Cyprus with 30.7 thousand dollars and Slovenia with 29.2 thousand dollars income per capita have followed Malta. Turkey has 9.5 thousand dollars in income per capita as a candidate country.
- The EU has 34.1 thousand dollars, and the Eurozone has 42.2 thousand dollars in income per capita on average.
- Lithuania has the best performance in income per capita increase in the 1995-2021 period whereas Romania has the second and Latvia has the third best performance. Cyprus, Slovenia and Malta have the worst performance in increasing their income per capita in the same period.
- The growth rates in income per capita in the EU and the Eurozone were 96% and 78.2% respectively in the 1995-2021 period. Turkey has a growth rate of 229.2% in income per capita. Due to the convergence theorem, new member countries have the highest growth rate than the EU and Eurozone in income per capita in the 1995-2021 period.
- Lithuania was ranked at the top with the growth rate from the membership date to 2021. Latvia, Estonia, Poland and Czechia have followed Lithuania in order. Cyprus has the worst performance in the country set and Croatia has the second worst performance in income per capita increase after their membership.
- GDP per capita for thirteen member countries, Turkey, the EU and Eurozone are not normally distributed for the period 1995-2021.
- GDP per capita in thirteen member countries, Turkey, the EU and the Eurozone are positively correlated for the 1995-2021 period. All the member countries' GDP per capita are highly correlated with each other, EU total and Eurozone whereas their correlation coefficient is less with Turkey.
- Membership brings a higher correlation within the EU. Slovenia has the highest correlation with the EU and Eurozone, Croatia has the second highest rate, Slovakia has the third highest rate with the EU, and Cyprus has the third rate with the Eurozone. Turkey has the highest correlation with Malta and the lowest correlation with Slovenia.
- GDP per capita data are stationary for Bulgaria, Croatia, Hungary and Malta and not stationary for Cyprus, Czechia, Estonia, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia, Turkey, EU and Eurozone.
- To test the stationarity of GDP per capita for the panel data, six of the seven statistical tests indicate that the data are nonstationary, and one of them states that the data are stationary.

- The Hausman test statistic for the panel data is 0.0666, H_0 cannot be rejected so that Random Effects Model is appropriate. GDP per capita has converged 3.7% on average in the 1995-2021 period.
- Breakpoints change from member to member. Some members started to gain from the Instrument for Pre-accession Assistance (IPA), and some of them continued to gain after membership so that their GDP per capita has a break in positive sense. Some members have break points in GDP per capita in one year whereas some of them have more than one year.

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Etik Onay: Bu çalışma etik onay gerektiren herhangi bir insan veya hayvan araştırması içermemektedir.

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Appendices

Table 8. GDP Per Capita (Thousand $)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1995	2.26	15.26	5.82	3.13	4.92	4.49	2.17	2.33	9.86	3.69	1.65	4.82	10.73	19.46	23.72	2.90
1996	1.47	15.14	6.53	3.38	5.28	4.53	2.33	2.43	10.06	4.15	1.63	5.20	10.82	19.75	23.95	3.05
1997	1.36	14.23	6.03	3.68	5.31	4.60	2.83	2.68	9.91	4.12	1.58	5.15	10.45	18.09	21.86	3.14
1998	1.82	15.09	6.49	4.09	5.69	4.74	3.17	2.97	10.41	4.52	1.85	5.54	11.18	18.62	22.45	4.50
1999	1.66	15.29	6.34	4.14	5.25	4.79	3.11	3.15	10.63	4.40	1.60	5.64	11.45	18.48	22.27	4.12
2000	1.62	14.39	6.03	4.07	4.89	4.62	3.29	3.36	10.43	4.50	1.66	5.41	10.20	16.91	20.25	4.34
2001	1.77	14.82	6.64	4.51	5.41	5.28	3.53	3.58	10.40	4.99	1.83	5.72	10.48	17.19	20.49	3.14
2002	2.09	16.09	8.06	5.34	6.29	6.66	4.14	4.14	11.29	5.21	2.12	6.53	11.78	18.68	22.25	3.69
2003	2.72	20.25	9.82	7.20	8.13	8.42	5.50	5.15	13.67	5.70	2.68	8.71	14.85	22.92	27.24	4.76
2004	3.39	23.79	11.75	8.91	9.75	10.30	6.70	6.38	15.20	6.68	3.49	10.67	17.23	26.27	31.07	6.10
2005	3.90	24.96	13.43	10.41	10.62	11.23	7.85	7.59	15.89	8.02	4.62	11.69	18.10	27.34	32.01	7.46
2006	4.52	26.73	15.26	12.64	11.80	11.49	9.23	9.72	16.72	9.04	5.76	13.16	19.67	29.07	33.87	8.10
2007	5.89	31.24	18.47	16.74	14.05	13.94	12.29	14.11	19.49	11.25	8.36	16.09	23.79	33.55	38.82	9.79
2008	7.27	35.40	22.80	18.20	16.42	15.78	14.94	16.47	22.21	14.00	10.44	18.68	27.48	36.92	42.48	10.94
2009	6.99	32.11	19.86	14.71	14.65	13.08	11.82	12.33	21.08	11.53	8.55	16.53	24.69	33.37	38.71	9.10
2010	6.85	31.02	19.96	14.66	14.07	13.22	11.99	11.42	21.80	12.61	8.21	16.83	23.51	32.94	37.73	10.74
2011	7.85	32.40	21.87	17.46	14.76	14.24	14.38	13.34	23.16	13.88	9.10	18.41	25.10	35.72	40.61	11.42
2012	7.43	28.91	19.87	17.40	13.40	12.99	14.37	13.85	22.53	13.10	8.51	17.43	22.64	33.16	37.56	11.80
2013	7.68	27.73	20.13	19.05	13.84	13.72	15.73	15.01	24.77	13.70	9.55	18.20	23.50	34.57	39.15	12.61
2014	7.90	27.16	19.89	20.23	13.76	14.30	16.55	15.72	26.75	14.27	10.04	18.63	24.21	35.25	40.01	12.16
2015	7.07	23.41	17.83	17.40	11.93	12.72	14.26	13.78	24.92	12.58	8.97	16.34	20.88	30.47	34.47	11.01
2016	7.57	24.61	18.58	18.28	12.53	13.11	15.00	14.32	25.74	12.45	9.55	16.50	21.66	31.17	35.24	10.89
2017	8.37	26.61	20.64	20.39	13.63	14.62	16.84	15.66	28.25	13.86	10.81	17.49	23.46	33.02	37.23	10.59
2018	9.45	29.33	23.42	23.05	15.23	16.43	19.18	17.86	30.67	15.47	12.40	19.38	26.10	35.74	40.14	9.45
2019	9.88	29.21	23.66	23.40	15.31	16.74	19.58	17.93	30.19	15.73	12.90	19.30	25.94	35.08	39.19	9.12
2020	10.08	27.53	22.93	23.03	14.13	15.98	20.23	17.73	27.88	15.72	12.90	19.27	25.52	34.15	38.00	8.54
2021	11.64	30.66	26.41	27.26	17.42	18.69	23.33	20.66	33.01	17.66	14.75	21.06	29.17	38.15	42.27	9.54

Source: The World Bank (2022), OECD (2022), Eurostat (2022)

Note: 1:Bulgaria, 2:Cyprus, 3:Czechia, 4:Estonia, 5:Croatia, 6:Hungary, 7:Lithuania, 8:Latvia, 9:Malta, 10:Poland, 11:Romania, 12:Slovakia, 13:Slovenia, 14:EU, 15:Eurozone (Euro Area), 16:Turkey

Table 9. Breakpoints in GDP Per Capita

Country	Augmented Dickey-Fuller test statistic	Zivot-Andrews test statistic (probability)	Perron Unit Root Test	Lee Strazicich LM unit root test	Multiple breakpoint tests (Bai-Perron tests of L+1 vs. L sequentially determined breaks)	CUSUM	CUSUM of squares test
Bulgaria	p=0.2011; break year: 2006; conclusion: not able to reject H_0	p=0.164676; break year: 2007; conclusion: not able to reject H_0	t=-3.076277; break year: 2014; conclusion: not able to reject H_0	t=-13.19621; break year: 2014 and 2018; conclusion: reject H_0	break years: 2003, 2007, 2018	break year: 2010	break years: 2002, 2012
Croatia	p=0.1210; break year: 2006; conclusion: not able to reject H_0	p=0.164720; break year: 2007; conclusion: not able to reject H_0	t=-2.269710; break year: 2002; conclusion: not able to reject H_0	t=-7.867549; break year: 2009; conclusion: reject H_0	break year: 2005	break year: 2007	break years: 2002, 2006
Cyprus	p=0.0396; break year: 2006; conclusion: reject H_0	p=0.090795; break year: 2007; conclusion: not able to reject H_0	t=-3.779468; break year: 2006; conclusion: not able to reject H_0	t=-5.934314; break year: 2012 and 2017; conclusion: not able to reject H_0	break year: 2004	break year: 2007	break years: 2002, 2004
Czechia	p=0.4392; break year: 2006; conclusion: not able to reject H_0	p=0.125573; break year: 2007; conclusion: not able to reject H_0	t=-3.652212; break year: 2006; conclusion: not able to reject H_0	t=-8.883214; break year: 2006; conclusion: reject H_0	break years: 2002, 2006, 2018	break year: 2007	break years: 2002, 2007
Estonia	p=0.0534; break year: 2014; conclusion: not able to reject H_0	p=0.177017; break year: 2006; conclusion: not able to reject H_0	t=-3.005884; break year: 2004; conclusion: not able to reject H_0	t=-5.070847; break year: 2006 and 2017; conclusion: not able to reject H_0	break years: 2002, 2006, 2018	break year: 2008	break years: 2002, 2008, 2012
Hungary	p=0.0801; break year: 2014; conclusion: not able to reject H_0	p=0.22926; break year: 2007; conclusion: not able to reject H_0	t=-2.945372; break year: 2002; conclusion: not able to reject H_0	t=-11.03768; break year: 2010; conclusion: reject H_0	break years: 2004, 2018	break year: 2006	break years: 2002, 2006
Latvia	p=0.0410; break year: 2005; conclusion: reject H_0	p=0.027335; break year: 2006; conclusion: reject H_0	t=-5.196798; break year: 2006; conclusion:	t=-4.060970; break year: 2009; conclusion:	break years: 2006, 2018	break year: 2007	break years: 2002, 2007

			not able to reject H_0 t=-3.247803;	not able to reject H_0 t=-5.968672;			
Lithuania	p=0.1365; break year: 2014; conclusion: not able to reject H_0	p=0.005422; break year: 2015; conclusion: reject H_0	break year: 2014; conclusion: not able to reject H_0	break year: 2010; conclusion: reject H_0	break years: 2003, 2007, 2018	break year: 2008	break years: 2002, 2014
		p=0.061148; break year: 2015; conclusion: not able to reject H_0	t=-4.327822; break year: 2003; conclusion: not able to reject H_0	t=-12.80939; break year: 2009 and 2012; conclusion: reject H_0	break years: 2003, 2007, 2013, 2017	break year: 2009	break years: 2002, 2016
Malta	p<0.01; break year: 2014; conclusion: reject H_0						
		p=0.096714; break year: 2007; conclusion: not able to reject H_0	t=-3.626133; break year: 2006; conclusion: not able to reject H_0	t=-6.633625; break year: 2005 and 2013; conclusion: reject H_0	break years: 2003, 2007, 2018	break year: 2008	break years: 2002, 2008
Poland	p=0.5695; break year: 2006; conclusion: not able to reject H_0						
		p=0.098069; break year: 2007; conclusion: not able to reject H_0	t=-3.760272; break year: 2006; conclusion: not able to reject H_0	t=-9.957097; break year: 2005 and 2013; conclusion: reject H_0	break years: 2003, 2007, 2018	break year: 2009	break years: 2002, 2010, 2016
Romania	p=0.1123; break year: 2006; conclusion: not able to reject H_0						
		p=0.060356; break year: 2007; conclusion: not able to reject H_0	t=-3.741689; break year: 2006; conclusion: not able to reject H_0	t=-6.428699; break year: 2007 and 2010; conclusion: reject H_0	break years: 2002, 2006, 2018	break year: 2007	break years: 2002, 2007
Slovakia	p=0.9118; break year: 2014; conclusion: not able to reject H_0						
		p=0.099437; break year: 2007; conclusion: not able to reject H_0	t=-2.714556; break year: 2002; conclusion: not able to reject H_0	t=-8.045445; break year: 2005 and 2017; conclusion: reject H_0	break years: 2002, 2006	break year: 2007	break years: 2002, 2007
Slovenia	p=0.3652; break year: 2013; conclusion: not able to reject H_0						

Source: The World Bank (2022), OECD (2022), Eurostat (2022), EViews (2022)