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- RESEARCH ARTICLE -

CONVERGENCE OF OUTPUT PER WORKER IN G7 COUNTRIES: EVIDENCE FROM THE CLUB CONVERGENCE TEST

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Abstract

The Convergence Hypothesis, which is the most important inference of the Neoclassical Growth Model, argues that the differences in output per worker / per capita income levels between economies at the global level or within a region will decrease and eventually disappear over time. In applied studies investigating the phenomenon of convergence at the global level, it is seen that the convergence either simply does not occur or findings of convergence are rarely obtained. It is stated that this happens because heterogeneous country groups are evaluated in the studies in question, ignoring the differences in the initial conditions. These results obtained in applied studies cause researchers to conduct research on more similar/homogeneous countries where convergence is theoretically considered more likely. In studies employing stochastic or deterministic approach or the ones where a combination of the two are used, it is seen that the findings on the power of convergence vary depending on the methodology applied, countries selected and the time period examined, but generally support the Convergence Hypothesis. In this context, the G7 Countries are considered a group of countries that dominate today's world in terms of economic development, are technologically identical and have similar structural characteristics in terms of macroeconomic indicators. It can be thought that it would not be surprising to find a convergence between these countries in terms of output per worker/labor force. However, it is considered that there may be countries that dissociate from others even among a group of countries with a homogeneous structure. In this study, it is aimed to put forward the club convergence hypothesis within the framework of the output per worker indicator, using annual data of the G7 countries for the period 1950-2018. Therefore, using the convergence test proposed by Phillips and Sul (2007), it is analyzed whether output per worker levels demonstrate convergence clubs. According to the analysis of Phillips and Sul (2007), it is determined that there is no general

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convergence club for all countries and there are different convergence clubs. As a result of Phillips and Sul (2007) analysis, two output per worker convergence clubs and one divergence club are determined.

Keywords: *Club Convergence Hypothesis, Log t Regression Analysis, G7 Countries.*

JEL Codes: *C33, O47.*

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G7 ÜLKELERİNDE KİŞİ BAŞI ÇIKTI YAKINSAMASI: KULÜP YAKINSAMA TESTİNDEN KANITLAR[3]

Öz

Neoklasik Büyüme Modelinin en önemli çıkarımı olan Yakınsama Hipotezi, küresel düzlemde veya bir bölge içerisindeki ekonomiler arasında bulunan, çalışan başına çıktı/kişi başına düşen gelir farklılıklarının zaman içerisinde azalacağını ve nihayetinde ortadan kalkacağını ileri sürmektedir. Küresel düzeyde yakınsama olgusunu araştıran uygulamalı çalışmalarda ise yakınsama olgusunun ya gerçekleşmediği ya da nadiren bir yakınsama bulgusuna ulaşıldığı görülmektedir. Bu durumun, söz konusu araştırmalarda, ülkelerin başlangıç koşullarının farklılığını ihmal edilerek heterojen yapıdaki ülke gruplarının ele alınmasından kaynaklandığı ifade edilmektedir. Uygulamalı çalışmalarda elde edilen bu sonuçlar, araştırmacıların yakınsama olgusunun teorik olarak daha olası olduğu düşünülen daha benzer/homojen ülkeler üzerine araştırma yapmalarına neden olmaktadır. Yakınsamanın stokastik, deterministik ve söz konusu iki yaklaşımın sentezi üzerine kurgulanan metodolojik yaklaşımların kullanıldığı çalışmalarda, yakınsamanın gücüne ilişkin bulguların, uygulanan metodolojiye, seçilen ülkelere ve incelenen zaman dilimine bağlı olarak çeşitlilik göstermekle birlikte genel olarak Yakınsama Hipotezini destekleyen sonuçlara ulaşıldığı görülmektedir. Bu kapsamda G-7 Ülkeleri, günümüz dünyasını ekonomik gelişmişlik yönünden domine eden, teknolojik açıdan özdeş olan ayrıca makroekonomik göstergeler bakımından da benzer yapısal özellikler taşıyan ülkeler grubu olarak değerlendirilmektedir. Söz konusu bu ülkeler arasında işgücü/çalışan başına çıktı kriteri bakımından yakınsama bulgusu elde etmek şaşırtıcı olmayacağı düşünülebilmektedir. Ancak, bu kadar homojen yapıda olan ülkeler topluluğunda bile ayrışan ülkeler olabileceği değerlendirilmektedir. Bu çalışmada, G7 ülkeleri için 1950-2018 dönemine ait yıllık veriler kullanılarak kulüp yakınsama hipotezinin, çalışan başına çıktı göstergesi çerçevesinde ortaya konması amaçlanmaktadır. Bu nedenle, Phillips ve Sul (2007) tarafından ileri sürülen yakınsama testi kullanılarak çalışan başına çıktının yakınsama kulüpleri gösterip göstermediği analiz edilmektedir. Phillips ve Sul (2007) analizine göre tüm ülkeler için genel bir yakınsama kulübünün bulunmadığı ve farklı yakınsama kulüplerinin olduğu tespit edilmektedir. Phillips ve Sul (2007) analizi sonucunda 2 adet çalışan başına çıktı

3 Genişletilmiş Türkçe Özet, çalışmanın sonunda yer almaktadır.

yakınsama kulübü ve 1 tane de ıraksama kulübü tespit edilmektedir.

Anahtar Kelimeler: *Kulüp Yakınsama Hipotezi, Log t Regresyon Analizi, G7 Ülkeleri.*

JEL Kodları: C33, O47.

"Bu çalışma, Araştırma ve Yayın Etiğine uygun olarak hazırlanmıştır."

1. INTRODUCTION

The Convergence Hypothesis, which is the main inference of the Neoclassical Growth Model developed by Solow (1956), in its simplest form, states that initial conditions have no effect on a country's per capita income in the long run, and differences in output per worker/per capita income between economies at the global level or within a region will decrease over time and eventually disappear, so that output per worker/per capita income levels of poor countries will reach those of rich countries. The basis of the Convergence Hypothesis is the argument that under closed economy conditions, the low capital stock in poor countries has a slower decreasing marginal return than in rich countries (Ceylan, 2010a: 312).

The conceptual examination and empirical testing of the Convergence Hypothesis appears to have come to prominence with the emergence of modern growth theory in the mid-1980s. In this context, the Convergence Hypothesis, which is thought to have a very important function in revealing the mechanics of economic growth, reveals three almost competing and testable hypotheses: absolute, conditional and club convergence. The Absolute Convergence Hypothesis asserts that per capita incomes of countries will converge in the long run regardless of their initial conditions. According to the Conditional Convergence Hypothesis, per capita incomes of countries with similar structural features such as consumer preferences, technologic development, population growth rates, government policies etc. converge regardless of the initial conditions. Finally, the Club Convergence Hypothesis states that per capita incomes of countries with similar structural characteristics will converge in the long run provided that the initial conditions are identical (Galor, 1996:1056). In the absolute convergence hypothesis, there is only one equilibrium in which all economies converge, while in the conditional convergence hypothesis, the equilibrium differs each economy having its particular equilibrium. In the club convergence hypothesis, there are models that produce multiple equilibria, and which of these different equilibria the economies will reach is determined depending on the starting positions of the countries in question (Ceylan, 2010b:56-57).

When applied studies aiming to test the Convergence Hypothesis are evaluated methodologically, it is seen that three basic approaches come forward. Among these approaches, the most popular one is the convergence approach, which assumes a

deterministic trend under the convergence process (e.g. Barro and Sala-i Martin, 1992). In recent studies on the Convergence Hypothesis, it is seen that the focus is on the stochastic trend, which expresses the opposite of the deterministic trend. Analyses that employ stochastic trend (e.g. Pesaran, 2007) adopt a non-theoretical approach and take into account the time series properties of the data to capture the dynamic aspect of the economic growth process. In applied studies aiming to test the Convergence Hypothesis, it is seen that the third approach is the synthesis model (e.g. Phillips and Sul, 2007,2009) that allows both deterministic and stochastic trends (Desli and Gkoulgkoutsika, 2020:138).

In applied studies investigating the phenomenon of global convergence, it is seen that the convergence either does not occur or findings of convergence are rarely obtained. It is stated that this happens because heterogeneous country groups are evaluated in the studies in question, ignoring the differences in the initial conditions. These results obtained in applied studies cause researchers to conduct research on more similar/homogeneous countries where convergence is theoretically considered more likely. In this context, several studies in applied literature reach the conclusion that the Convergence Hypothesis is more prominent in certain groups consisting of only highly developed countries (Dowrick and Nguyen 1989; Dowrick and Gemmell 1991; Johnson and Takeyama 2001; Canova 2004; Castellacci and Archibugi 2008). In this direction, it is seen that one of the most important criteria used to reveal the homogeneous structure of the countries is the development level of the countries and the Convergence Hypothesis is tested by grouping the countries as developed / developing countries (Ceylan, 2010a:313; Desli and Gkoulgkoutsika, 2021:841).

In this context, this study aims to put forward the club convergence hypothesis within the framework of the output per worker in G7 countries which consist of Germany, the United States of America (USA), France, England, Japan and Canada and were a very homogenous group of developed countries in the period 1950 – 2018. The G7 Countries are considered a group of countries that dominate today's world in terms of economic development, are technologically identical, and have similar structural characteristics in terms of macroeconomic indicators. In this context, it can be thought that it would not be surprising to find a convergence between these countries in terms of output per worker/workforce, it can be thought that it would not be surprising to find a convergence between these countries in terms of output per worker/labor force. However, it is considered that there may be countries that dissociate from others even among a group of countries with a homogeneous structure. For this purpose, the convergence test developed by Phillips and Sul (2007), which enables deterministic and stochastic tendencies, is used in the study and it is analyzed whether output per worker in G7 countries demonstrates convergence clubs. In the second part of the study, following the introduction, the relevant literature is summarized. In the third and fourth sections, the methodology used in the study is explained and the findings are presented, respectively. The study is completed with the discussion and conclusion sections in which the obtained results are evaluated.

1.1. Literature Review

When the applied studies on the Convergence Hypothesis are reviewed, it is seen that the results often do not support the Convergence Hypothesis in the studies conducted at the global level, in other words, the convergence either does not occur or findings of convergence are rarely obtained. (Kang and Lee, 2005; Li et al.2016). These results lead to the conclusion that studies testing the Convergence Hypothesis should concentrate on relatively similar/homogeneous country groups, where convergence is theoretically considered more likely, rather than heterogeneous country groups. One of the criteria used in the literature to reveal the homogeneous structure of the countries in which the validity of the Convergence Hypothesis is investigated is the level of development of said countries and in this direction, the members of the Organization for Economic Cooperation and Development (OECD) or the G7 countries as an even more homogeneous group of developed countries are widely investigated in applied studies. This preference, which emerged in applied studies, initially started as a necessity due to the availability of data and therefore focused on developed countries, which were considered developed at that time and had satisfactory data volume and quality, and in the process, as the availability and quality of data about other countries increases, it is seen that research on developing and underdeveloped countries also started (Desli and Gkoulgkoutsika, 2021:841). In this context, the developing country groups are classified according to geographically defined criteria and basically consist of Asian countries (Evans and Kim, 2011), African countries (Charles, et al., 2012; Noguera-Santaella, 2017), MENA countries (Andreano et al., 2013) and Latin American countries (King and Ramlogan-Dobson, 2015). It can be asserted that in these studies, results in general were in favor of the Convergence Hypothesis. The findings obtained from these studies are crucial in showing that although the convergence hypothesis is a theoretical result derived from the Solow Model, it may be related to geographical features, technological similarities and climatic factors.

Applied studies on developed countries in the literature testing the Convergence Hypothesis are generally based on OECD countries (Liu and Ruiz, 2006; Caggiano and Leonida, 2009; Marattin and Salotti, 2011; Ceylan et al., 2013; Bahmani-Oskooee et al., 2017), The European Union (EU) and the subgroups of the countries that make up the EU (Monfort, et al., 2013; Borsi and Metiu, 2015; Ceylan and Abiyev, 2016; Chapsa et al., 2015, Cabral, et al., 2019, Bolea, et al. , 2018; Cavallaro and Villani, 2021), countries classified as high-income by the World Bank (Desli and Gkoulgkoutsika, 2021) and homogeneous country groups such as G7 countries (Cellini & Scorcu, 2000; Ceylan, 2010a). In studies employing methodological approaches based on stochastic approach, deterministic approach or the combination of the two, it is seen that the findings on the power of convergence vary depending on the methodology applied, countries selected, and the time period examined, but generally are in favor of the Convergence Hypothesis.

In this context, this study aims to put forward the Club Convergence Hypothesis within the framework of output per worker levels, using the technique developed by Phillips and Sul (2007) on annual data for the period 1950-2018 in G7 Countries, which is a homogeneous developed country group. In the applied literature, there are a limited number of studies that test the Convergence Hypothesis with respect to output per worker levels in G7 countries. In this respect, it is considered that the study will contribute to the limited literature.

2. METHODOLOGY

In this study, output per worker levels in G7 countries during the reviewed period 1950-2018 are investigated using the club convergence technique developed by Phillips and Sul (2007,2009) which is also called the "log t convergence test". It is stated that the Convergence Hypothesis is the most important outcome of the Neoclassical Growth Model, which is based on the principle of the uniqueness of equilibrium. In the Club Convergence Hypothesis, there are models that produce multiple equilibria, and which of these different equilibria economies will reach is determined depending on the initial positions (Ceylan, 2010b:56-57). In this respect, it can be said that the theoretical foundations of the Club Convergence Hypothesis, which emerged from the empirical evidence, are based on the endogenous growth theory, which considers multiple steady-state equilibria and constant/increasing yields.

In this context, it is seen that the Club Convergence Hypothesis, which was first put forward by Baumol (1986), can be investigated with different methodologies in various studies (Quah, 1996; Corrado, et al., 2005; Phillips and Sul (2007,2009). It is observed that the most used method in recent studies is the econometric method developed by Phillips and Sul (2007, 2009). This is due to the methodological advantages of this model. The Phillips and Sul (2007) method is a time-varying factor model which allows individual and transitional heterogeneity to define convergence clubs and does not dictate certain assumptions about trend stationarity or stochastic non-stationarity (Sichera and Pizzuto, 2019). The methodological advantages of the Phillips and Sul (2007) method allows it to be used in researching convergence clubs in different areas such as energy consumption, happiness, military spending, etc. (Kourtzidis et al. (2018), Panopoulou and Pantelidis (2009), Apergis and Cooray (2016), Ivanovski et al. (2018), Apergis and Georgellis (2013) Saba and Ngepah, (2021)).

In this study, where the annual data for the G7 Countries for the period 1950-2018 were taken from *Total Economy Database* and used to put forward Club Convergence Hypothesis in the framework of output per worker levels using the technique developed by Phillips and Sul (2007), y_{it} denotes the output per worker level in each country and i=1,2,…,N and t=1,2,…,T denote the number of countries and years respectively. Following the Phillips and Sul (2007) technique, which is based on a modification of the traditional panel data decomposition of the studied variable (output per worker),

the dependent variable y_{it} in the model is divided into two components, systematic (g_{it}) and temporary d_{it}):

$$y_{it} = g_{it} + d_{it} \tag{1}$$

When equation (1) is rearranged to express the systematic and temporal components in the panel, the following equation (2) is reached:

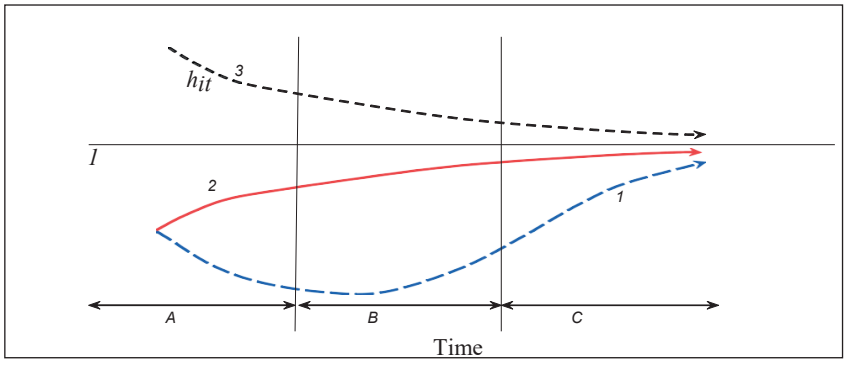
$$y_{it} = \left(\frac{g_{it} + d_{it}}{\mu_t}\right)\mu_t = \delta_{it}\mu_t, \qquad \forall i, t \tag{2}$$

As it can be seen, there are two time-varying components in equation (2). The first one is μ_t, which can have both deterministic and stochastic components and represents a steady-state trend function for the group. The second one is a unit-specific element δ_t that measures the distance between the common factor μ_t and y_{it}, reflecting both time and unit specific effects. The coefficient is also a measure of the share of the common effect factor for each unit in the panel. In the Phillips and Sul (2007) method, convergence is assumed as a dynamic process. Therefore, the δ_{it} coefficient shows the transition paths, and the per capita income convergence can be tested by its temporary relative behavior. The method of Phillips and Sul (2007) projects a semi-parametric process suitable for testing the convergence hypothesis for the coefficient δ_{it}. Phillips and Sul (2007,2009) assert that additional structural constraints and assumptions should be made in the estimation of this parameter, and suggest the relative transition path defined in equation (3) below:

$$h_{it} = \frac{y_{it}}{\frac{1}{N}\sum_{i=1}^{N} y_{it}} = \frac{\delta_{it}}{\frac{1}{N}\sum_{i=1}^{N} \delta_{it}} \tag{3}$$

Here, h_{it}, represents a measure of the transition path relative to the panel mean. The relative transition path parameter may differ between countries in the short run, but for each country, as the relative transition path parameter approaches one, it suggests the inference of long-term convergence.

Figure 1. Different Transition Paths and Transition Stages



Source: Phillips and Sul (2009: 1160).

This situation is illustrated in Figure 1. It can be seen in Figure 1. that countries 2 and 3 have very dissimilar initial conditions and thus different transition paths. The relative transition path parameters of countries 2 and 3 converge monotonically. Here, country 3 represents a typical industrialized country, while country 2 represents a typical industrializing economy that has high growth rates. It can be observed in Figure 1 that countries 1 and 2 have the same initial conditions. Country 1 represents a typical developing country. While country 1 had low growth rates at the beginning (A), it started to reverse its economic performance over time (B) and converged to country 2 in the final stage (C) (Phillips and Sul, 2009: 1159).

In the Phillips and Sul (2007) method, the cross-section variance of the relative path parameter should converge to zero in order to infer long-term convergence. In this case, the assumption in equation (4) below should be made for the convergence club algorithm of t:

$$\delta_{it} = \delta_i + \sigma_{it}\gamma_{it}$$

In the equation in question $\sigma_{it} = \frac{\sigma_i}{L(t)t^a}$, $\sigma_i > 0$ and γ_{it} may be weakly dependent on time, but for each i, the function $i.i.d.(0,1)$ $L(t)$ is ascending at t, the function is ascending at and divergent as approaches infinity. In this special form of δ_{it}, the null hypothesis of convergence for all i values is $H_0: \delta_i = \delta, a \geq 0$ and the alternative hypothesis is $H_A: \delta_i \neq \delta$ or $a < 0$. or Specifically, the hypothesis tests given here can be reduced to the sign of a. When the null hypothesis of convergence is rejected for a particular group of units in the panel, this inference does not mean that related units cannot converge to other clusters in the panel. Therefore, the rejection of existence of convergence for the whole of panel indicates the presence of multiple convergence clubs in the panel.

Phillips and Sul (2007) suggest that the mentioned convergence phenomenon can be tested using the following equation:

$$log\left(\frac{H_1}{H_t}\right) - 2\,log\,L\,(t) = \hat{c} + \hat{b}\,log\,t + \hat{u}_t \qquad (5)$$

Here; $H_t = \frac{1}{N}\sum_{i=1}^{N}(h_{it} - 1)^2$ and is expressed as the square of the cross-sectional distance of the relative transition coefficients. Phillips and Sul (2007) suggest $t = [rt], [rt] + 1, \dots, T$ and $r[0.2,0.5]$ for the estimation of equation (5). Note that since in equation (5), $\hat{b} = 2\hat{a}$, the null hypothesis can also be arranged as bˆ>0 or bˆ<0. For this one-way test, if $t_{\hat{b}} < -1{,}65$, the null hypothesis which suggests the validity of the convergence hypothesis is rejected. This test can also be applied to reveal different convergence clubs in the panel. In this context, the log t convergence test proposed by Phillips and Sul (2007) includes a four-stage algorithm. At the first stage, the panel data are arranged in descending order according to the last observations. In the second step, firstly, the log t test is performed on the first $n = 2$ regions to form the core group G_n between the two regions. If $t_{\hat{\beta}}(n = 2) > -1{,}65$, it constitutes the G_n core group. Then, the log t test is performed for the next region and this core group, and if $t_{\hat{\beta}}(n = 3) > t_{\hat{\beta}}(n = 2)$, that region is added to $t_{\hat{\beta}}(n = 3) > t_{\hat{\beta}}(n = 2)$. This process is repeated until $t_{\hat{\beta}}(n) > t_{\hat{\beta}}(n - 1)$. The size of the core group is chosen to maximize the ratio of $t_{\hat{\beta}}(n)$ to the coefficient k, based on n^*, $min[t_{\hat{\beta}}(n)] > -1{,}65$. Here it is set as $2 < n^* < N$. In the third stage of the algorithm, after the core group is

created, the regions that are not included in the core group are determined and added to the core group and the log t test is run. If $t_{\hat{\beta}}(n) > 0$ the new region is added to the club. In the fourth and last stage, the log t test is applied for the regions that were not selected in the third stage, and if the test statistic is greater than -1.65, these regions form another convergence club. If the test statistic is less than -1.65, the first three steps of the algorithm are repeated in this group. The last remaining countries/regions form the divergence club if the test statistic is less than -1.65.

3. RESULTS

The results obtained by applying the Phillips and Sul (2007) method, the methodology of which is explained above, to the output per worker/labor productivity per worker data of G7 countries for the period 1950-2018 are presented in Table 1. In the framework of the procedure of the method, the entire panel formed by all G7 countries is examined to see if these countries are in convergence behavior. In this context, the null hypothesis is rejected because the t-statistics calculated for the entire panel of G7 countries, -12.479, is less than the critical value of -1.65. This result shows that convergence could not be detected in the entire panel.

Table 1: Phillips and Sul (2007) Analysis Results

Category	Countries	β	t
Entire Panel	**G7 Countries**	**-0.634**	**-12.479**
Club 1	USA, Germany, Italy	0.172	2.173
Club 2	Canada, England	-0.406	-0.587
Club 3 (Divergence Club)	Japan, France	-0.748	-42.053

In the Phillips and Sul (2007) method, non-detection of convergence for the entire panel is considered a prerequisite for investigating whether there is convergence in subgroups or clubs. Within the framework of the methodology, two convergence clubs with a t-statistic value greater than the critical value of -1.65 were identified among the G7 countries. In this context, as can be seen in Table 1, USA, Germany and Italy constitute the first convergence club while Canada and England constitute the second. However, the analyses carried out within the framework of the method proposed by Phillips and Sul (2007) also reveal that Japan and France are not included in convergence clubs 1 and 2 and there is no convergence between these two countries. These two countries are in convergence behavior neither to each other nor to other G7 countries thus these two countries together form a divergence club. Among G7 countries, France is the country where the agricultural sector stands out and has the highest agricultural production. Therefore, it can be said that it differs from other countries in terms of its structural features. On the other hand, Japan differs from other G7 countries in terms of geographical, climatic, cultural conditions and even its dependence on exports. For this reason, the fact that Japan is not included in any convergence club stands as an explainable result.

4. DISCUSSION

In the study, it is investigated whether the total output per worker/labor productivity per worker levels in G7 countries are in convergence behavior in the period 1950-2018 by the club convergence technique developed by Phillips and Sul (2007,2009). In the applied literature, there are a limited number of studies that test the Convergence Hypothesis within the framework output per worker levels in G7 countries. In this respect, it is considered that the study will contribute to the limited literature. As a result of the application of the mentioned methodology, it is seen that convergence could not be detected in the entire panel formed by the G7 countries. In the second stage of the methodology applied in the study, the existence of two convergence clubs were determined, first one consisting of USA, Germany and Italy and the second one, Canada and England. In addition, the analyses carried out in the study show that Japan and France are not included in the said two convergence clubs and there is no convergence between them, and that these countries form a divergence club that converge neither to each other nor to other G7 countries. In future studies investigating the convergence behavior of total output per worker levels in G7 countries within the scope of the Club Convergence Hypothesis, it is thought that evaluating the convergence level of output per worker on the basis of three main sectors, namely agriculture, industry and services, will help better understand the dynamics of the results obtained in the study and contribute to the literature.

CONCLUSION

The Convergence Hypothesis, which is the most important inference of the Neoclassical Growth Model, argues that the differences in output per worker / per capita income between economies at the global level or within a region will decrease and eventually disappear over time. In applied studies investigating the phenomenon of convergence at the global level, it is seen that the convergence either simply does not occur or findings of convergence are rarely obtained. It is stated that this happens because heterogeneous country groups are considered in the studies in question, ignoring the differences in the initial conditions. These results obtained in applied studies cause researchers to conduct research on more similar/homogeneous countries where convergence is theoretically considered more likely. In studies employing stochastic or deterministic approach or the ones where a combination of the two are used, it is seen that the findings on the power of convergence vary depending on the methodology applied, the selected countries and the time period examined, but generally supports the Convergence Hypothesis.

In this context, this study aims to put forward the club convergence hypothesis within the framework of the output per worker levels in G7 countries which consist of Germany, the United States of America (USA), France, England, Japan and Canada and were a very homogenous group of developed countries in the period 1950 – 2018. The advantages of the Phillips and Sul (2007) method, such as allowing different

time paths as well as individual heterogeneity, being robust against heterogeneity and stationarity properties of the series, and therefore not imposing any assumptions about trend stationarity or stochastic nonstationarity, allows this method to be widely used in analyses of convergence characteristics of economies.

In the study, within the procedure of the Phillips and Sul (2007) method, firstly an analysis is made for the entire panel formed by the G7 countries and it is examined whether the said countries are in convergence behavior. In this context, the null hypothesis is rejected because the t-statistics calculated for the entire panel formed by the G7 countries, -12.479, is less than the critical value of -1.65. This result shows that convergence could not be detected in the entire panel. In the Phillips and Sul (2007) method, non-detection of convergence for the entire panel is considered a prerequisite for investigating whether there is convergence in subgroups or clubs. Within the framework of the methodology, two convergence clubs with a t-statistic value greater than the critical value of -1.65 were identified among G7 countries. In the study, USA, Germany and Italy constitutes convergence club 1 and Canada and England, convergence club 2. However, the analyses carried out within the framework of the method proposed by Phillips and Sul (2007) also reveal that Japan and France are not included in the said two convergence clubs and there is no convergence between them, and that these countries form a divergence club that converge neither to each other nor to other G7 countries.

In the study, the Club Convergence Hypothesis is tested in G7 countries by using the total output per worker levels in the period 1950-2018. In future studies, it is considered that evaluating the convergence of output per worker levels on the basis of three main sectors, namely agriculture, industry and services, will help to evaluate the results obtained in the study and contribute to the literature.

G7 ÜLKELERİNDE KİŞİ BAŞI ÇIKTI YAKINSAMASI: KULÜP YAKINSAMA TESTİNDEN KANITLAR

1. GİRİŞ

Çalışmada, 1950-2018 yıllarını kapsayan dönemde homojen bir gelişmiş ülke grubu olan ve Almanya, Amerika Birleşik Devletleri (ABD), Fransa, İngiltere, Japonya ve Kanada'nın oluşturduğu G7 ülkeler için, çalışan başına çıktı başka bir ifadeyle çalışan başına emek verimliliği düzeylerinin hem deterministik hem de stokastik trende izin veren ve Phillips ve Sul (2007) tarafından geliştirilen teknik yardımıyla Kulüp Yakınsama Hipotezinin test edilmesi amaçlanmaktadır.

2. YÖNTEM

Bu çalışmada, inceleme dönemi olan 1950-2018 döneminde G7 ülkelerinde çalışan başına çıktı düzeyleri "log t yakınsama testi" olarak da adlandırılan ve Phillips ve Sul (2007,2009) tarafından geliştirilen kulüp yakınsaması tekniği ile araştırılmaktadır. Son dönemde Kulüp Yakınsama Hipotezi üzerine gerçekleştirilen çalışmalarda en çok kullanılan yöntemin Phillips ve Sul (2007,2009) tarafından geliştirilen ekonometrik yöntem olduğu görülmektedir. Söz konusu yöntem, yakınsama kulüplerini tanımlamak için bireysel ve geçişsel heterojenliğe izin veren zamanla değişen bir faktör modeli olarak ifade edilmektedir. Kulüp Yakınsama analizlerinde kullanılan Phillips ve Sul (2007) yöntemi sahip olduğu, bireysel heterojenliğin yanı sıra farklı zaman yollarına izin vermesi ve heterojenliğe ve serilerin durağanlık özelliklerine karşı sağlam olması ve dolayısıyla trend durağanlığı veya stokastik durağan olmama ile ilgili herhangi bir özel varsayımı dayatmaması gibi avantajları ile literatürde ekonomilerin yakınsama özelliklerinin analizlerinde baskın bir şekilde kullanılan bir yöntem haline geldiği görülmektedir.

3. BULGULAR

Phillips ve Sul (2007) tarafından önerilen ve yukarıda metodolojisi açıklanan yöntemin G7 ülkelerinin 1950-2018 yıllarını kapsayan dönem için çalışan başına çıktı/ çalışan başına emek verimliliği verilerine uygulanmasıyla elde edilen sonuçlar Tablo 1'de sunulmaktadır. Phillips ve Sul (2007) tarafından yöntemin prosedürü çerçevesinde ilk aşamada tüm G7 ülkelerinin oluşturduğu tüm panel için analiz yapılarak söz konusu ülkelerin yakınsama davranışı içerisinde olup olmadığı incelenmektedir. Bu kapsamda, G7 ülkelerinin oluşturduğu tüm panel için hesaplanan t- istatistiği-12.479, kritik değer olan 1,65'ten küçük olduğu için boş hipotez reddedilmektedir. Bu sonuç panelin tümünde yakınsama tespit edilemediğini göstermektedir.

Phillips ve Sul (2007) yönteminde panelin tümü için yakınsamanın tespit edilememesi alt gruplar veya kulüplerde yakınsama olup olmadığının araştırılabilmesi için bir ön şart olarak kabul edilmektedir. Metodoloji çerçevesinde, G7 ülkeleri içerisinde t-istatistik değeri kritik değer olan -1.65'ten büyük olan ve birbirlerine yakınsayan

2 yakınsama kulübü tespit edilmiştir. Bu kapsamda Tablo 1'de görüleceği üzere ABD, Almanya, İtalya ve Kanada, İngiltere sırasıyla 1. ve 2. yakınsama kulüplerini oluşturmaktadır. Bununla birlikte Phillips ve Sul (2007) tarafından önerilen yöntem çerçevesinde gerçekleştirilen analizler ayrıca, Japonya ve Fransa'nın ise 2 yakınsama kulübüne dahil olmadığı ve aralarında da yakınsama bulunmadığı bu itibarla da ne birbirlerine ne de diğer G7 ülkelerine yakınsama davranışı içerisinde olmayan söz konusu bu iki ülkenin birlikte bir ıraksama kulübü oluşturduğu göstermektedir.

4. TARTIŞMA

Çalışmada, 1950-2018 yıllarını kapsayan dönemde G7 ülkelerinde çalışan başına toplam çıktı/ çalışan başına emek verimliliği düzeylerinin yakınsama davranışı içerisinde olup olmadıkları Phillips ve Sul (2007,2009) tarafından geliştirilen kulüp yakınsaması tekniği ile araştırılmaktadır. Uygulamalı literatürde G7 ülkeleri özelinde çalışan başına çıktı boyutuyla Yakınsama Hipotezini test eden sınırlı sayıda çalışma bulunmaktadır. Bu yönüyle çalışmanın sınırlı literatüre katkı sağlayacağı değerlendirilmektedir. Söz konusu metodolojinin uygulanması neticesinde ilk olarak, G7 ülkelerinin oluşturduğu panelin tümünde yakınsama tespit edilemediği görülmektedir. Çalışmada uygulanan metodolojinin ikinci aşamasında ise ABD, Almanya, İtalya ve Kanada, İngiltere ülkelerinden oluşan iki yakınsama kulübünün varlığı tespit edilmektedir. Bunun yanında çalışmada gerçekleştirilen analizler, Japonya ve Fransa'nın ise söz konusu 2 yakınsama kulübüne dahil olmadığı ve aralarında da yakınsama bulunmadığı ve söz konusu ülkelerin ne birbirlerine ne de diğer G7 ülkelerine yakınsama davranışı içerisinde olmayan bir ıraksama kulübü oluşturduğu göstermektedir.

SONUÇ

Çalışmada, 1950-2018 yıllarını kapsayan dönemde G7 ülkelerinde çalışan başına toplam çıktı/ çalışan başına emek verimliliği düzeyleri kullanılarak söz konusu ülkelerde Kulüp Yakınsama Hipotezi test edilmektedir. G7 ülkelerinde çalışan başına toplam çıktı düzeylerinin yakınsama davranışının Kulüp Yakınsama Hipotezi kapsamında araştıran ilerde yapılacak çalışmalarda, çalışan başına çıktının yakınsama düzeyinin tarım, sanayi ve hizmetler olmak üzere üç temel sektör bazında değerlendirilmesinin, çalışmada ulaşılan sonuçların dinamiklerinin daha iyi anlaşılmasına yardımcı olacağı ve literatüre katkı sağlayacağı düşünülmektedir.

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