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Club Convergence Analysis: The Relationship Between Socio-Economic Development Levels in Türkiye

Kulüp Yakınsama Analizi: Türkiye'de Sosyo-Ekonomik Gelişmişlik Düzeyleri Arasındaki İlişkisi

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ABSTRACT

This study aims to analyze whether there is club convergence in Türkiye at the provincial level in terms of per capita income between 2004 and 2023. In this context, club convergence is tested using the method developed by Phillips and Sul (2007, 2009), and it is found that there is no convergence in per capita income among provinces in Türkiye during this period, while club convergence is present, consisting of 8 clubs and 5 diverging provinces. Additionally, the study correlated club memberships in provinces with the SEGE 2025 index, making it possible to determine whether club membership aligns with the socio-economic development level of the provinces. The results indicate that although some provinces have high growth potential, their socioeconomic indicators do not reflect it. In some provinces, socioeconomic indicators represent a threshold for transitioning to a higher-income club. When the results of the study are evaluated as a whole, it is evident that policies to ensure regional development should be developed with a holistic understanding and considering the structural characteristics of the provinces.

MAKALE BİLGİSİ

Makale Türü
Araştırma Makalesi

Anahtar Kelimeler
Kulüp yakınsaması
SEGE İndeksi
Bölgesel kalkınma

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ÖZ

Bu çalışma 2004 ile 2023 yılları arasında Türkiye'de il düzeyinde kişi başına düşen gelir cinsinden kulüp yakınsamasının olup olmadığını analiz etmeyi amaçlamaktadır. Bu bağlamda Phillips ve Sul (2007, 2009) tarafından geliştirilen yöntem ile kulüp yakınsamasının olup olmadığı test edilmiş ve Türkiye'de bu dönemde iller arasında kişi başına düşen gelir cinsinden yakınsamanın olmadığı, buna karşılık 8 kulüp ve 5 ayrışan ilden oluşan kulüp yakınsamasının bulunduğu sonucu elde edilmiştir. Ayrıca, çalışmada illerin kulüp üyelikleriyle SEGE 2025 indeksi ilişkilendirilmiştir; böylece, illerin sosyo-ekonomik gelişmişlik düzeyi ile kulüp üyeliğinin uyumlu olup olmadığını ortaya koymak mümkün olmuştur. Elde edilen sonuçlara göre bazı illerin yüksek büyüme potansiyeline sahip olmasına rağmen sosyoekonomik göstergeleri bu duruma eşlik etmemektedir. Bazı illerde ise sosyoekonomik göstergeler daha yüksek gelirli bir kulübe geçiş için bir eşik oluşturmaktadır. Çalışmadan elde edilen sonuçlar bütün olarak değerlendirildiğinde; bölgesel kalkınmayı sağlayacak politikaların bütüncül bir anlayışla ve illerin yapısal özelliklerini göz önünde bulundurularak geliştirilmesi gerektiği ortaya çıkmaktadır.

1. Introduction

Convergence is a frequently researched concept, both within and across countries; in this context, different concepts such as absolute, conditional and club convergence have been put forward to reveal convergence. The aim of this study is to assess the convergence patterns in terms of club convergence in per capita real GDP of 81 provinces in Türkiye for the 2004-2023 period. Due to the data limitations, the club convergence analysis is conducted for this period. The analysis uses the Phillips and Sul (2007, 2009) method to align with this purpose and incorporate developments in the literature. Many papers investigated club convergence in Türkiye at both the

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regional and provincial levels, and the results are inconclusive. This study, unlike many others in the literature, links the club convergence analysis to the provinces' SEGE Index rankings. To the best of the author's knowledge, this is the first study to conduct a club convergence analysis in relation to the ranking of the provinces' SEGE Index. When the relationship between the SEGE index and club convergence analysis is established, this evaluation is made not only from a growth perspective but also from a development perspective. In other words, it becomes possible to reveal which provinces are performing faster in the current rankings, which provinces are slipping behind, and which provinces are sustaining their current status within a deeper framework that has a socioeconomic developmental lens.

The remainder of the paper is organized as follows: Section 2 presents the theoretical background of the convergence concept. Section 3 presents relevant empirical literature, Section 4 outlines the econometric methodology, and the empirical results are provided in Section 5. Section 6 presents the relationship between the club convergence analysis and the 2025 SEGE index rankings of the provinces. The study ends with a conclusion.

2. Theoretical Background

The neoclassical growth model provides the theoretical foundation for the convergence concept. Solow (1956) put forward that a country's per capita growth rate tends to be inversely related to its initial level of per capita income; consequently, poor countries or regions grow quicker than rich ones. According to this model, diminishing returns to capital is the main cause of this convergence. In this context, low capital-to-labour ratios in developing nations or regions lead to high marginal capital products and rapid growth (Barro, 1991). Durlauf and Johnson (2008: 219) emphasised that there is no agreed-upon definition of convergence, but on the other hand, there is a classification frequently used in the literature. According to this classification, there are three types of convergence. The absolute convergence hypothesis states that countries converge to one another in the long run independently of their initial conditions. According to the conditional convergence hypothesis countries that share similar structural characteristics, such as preferences, technologies, rates of population growth, and government policy, converge to one another in the long run independently of their initial conditions. Lastly, the club convergence hypothesis states that countries that are similar in their structural characteristics converge to one another in the long run if their initial conditions are similar as well (Galor, 1996).

In brief, in the standard neoclassical growth model, the convergence concept assumes a unique equilibrium. All aspects of economics in the unconditional convergence approach the same equilibrium level. When conditional convergence occurs, each economy's equilibrium is different, and each one approaches a different but distinctive equilibrium. *"The idea of club convergence*" is based on models that produce many equilibria, in contrast to these two ideas. The equilibrium that an economy will reach relies on its starting point or some other factor. If a group of nations shares the beginning position or attribute corresponding to a given equilibrium, they may approach it. Club convergence results from this framework (Islam, 2003:315).

Phillips and Sul (2009: 1154) state that neoclassical growth theory does not accommodate such enormous differences in observed income growth as the world economy has witnessed in the success of the Asian Dragons or the growth disasters of sub-Saharan Africa in relation to other developing countries, because this model assumes homogeneous technological progress, so that in a cross-section setting, all economies experience technological improvements at the same rate over time, while operating at different initial levels. In other words, under such homogeneity in technology, observed cross-section income heterogeneity is difficult to explain. In this context, Bernard and Durlauf (1996) emphasised that to make accurate convergence estimations and capture these structural differences, transition dynamics should be taken into consideration; otherwise, the results of the tests may be invalid. Consistently, Phillips and Sul (2003) make a

similar warning and state that if the heterogeneity in the speed of convergence is not included in the analysis, econometric specifications may imply either convergence or divergence.

3. Related Empirical Literature

There is a massive amount of literature about economic convergence, both for Türkiye and for developing and developed countries. Moreover, the empirical literature on convergence is contradictory. Stiglitz (2015) goes much further and emphasises that the evidence about convergence has been disappointing. Conducting a comprehensive literature review is challenging; therefore, some studies related to Türkiye are presented in a table format. Table 1 shows the selected studies about convergence in Türkiye.

Table 1: Selected Convergence Literature for Türkiye

Author(s)	Level	Time Span	Result
Filiztekin (1998)	NUTS3	1975-1995	Conditional convergence
Doğruel and Doğruel (2003)	NUTS3	1987-1999	Divergence
Gezici and Hewings (2004)	NUTS3 and 16 functional regions	1980-1997	No convergence
Aldan and Gaysız (2006)	NUTS3	1987-2001	No convergence
Yıldırım et al. (2009)	NUTS1	1987-2001	β-convergence
Gömleksiz et al. (2017)	NUTS2	2004-2014	Convergence
Gündem (2017)	NUTS2	1987-2001 & 2004-2011	Convergence
Aksoy et al. (2019)	NUTS3	1987-2017	Club convergence
Karahasan (2020)	NUTS3	1975-2017	Club convergence
Yazgan and Ceylan (2021)	NUTS2	2004-2018	Club convergence
Coşkun and Demir (2022)	NUTS2	2004-2019	Club convergence and conditional convergence
Ursavaş and Mendez (2023)	NUTS3	2007-2019	Club convergence
Bolkol (2023)	NUTS1 and NUTS2	2004-2017	No income convergence
Kartal and Karşıyakalı (2023)	NUTS2	2004-2020	Club convergence
Sakarya et al. (2024)	NUTS3 and NUTS2	2004-2022	Club convergence
Eriş-Dereli and Pınar (2025)	NUTS2	2005-2022	Club convergence for skilled labour force

Some of the studies conducted for Türkiye have investigated whether convergence has occurred using the neoclassical convergence methodology. For example, Filiztekin's (1998) analysis of Turkish provinces from 1975 to 1995 shows that convergence is conditional, unlike the absolute convergence model in developed countries. Gezici and Hewings (2004) emphasised that there was no inter-provincial and inter-regional convergence between 1980 and 1997 and that the East-West inequality persisted. Aldan and Gaysız (2006) also stated that there is no convergence for the period 1987-2001. Doğruel and Doğruel (2003) found sigma convergence in all provinces except for high-income ones.

The vast majority of studies in recent years indicate that regions do not converge to a single equilibrium point but rather form *"convergence clubs"* across different income groups. In this context, Phillips and Sul's (2007, 2009) method is frequently used. For example, Aksoy et al. (2019) found that there are five convergence clubs in 1987-2001 and six convergence clubs in 2004-2017. Moreover, initial per capita income, human capital, and total credits are key factors influencing these clubs. Yazgan and Ceylan (2021) found 8 convergence clubs and 1 divergence club for the period 2004-2018. Additionally, close neighborhood relationships and key economic sectors significantly influence the formation of these clubs. Ursavaş and Mendez (2023) found six convergence clubs for the period 2007–2019, and according to the study's results, geographic neighbours particularly impact middle- and high-income provinces, affecting club membership based on capital accumulation and structural change spillover. Kartal and Karşıyakalı (2023) found that for the period 2004–2020, there are five distinct convergence clubs and that similarities in

sectoral structures significantly influence the formation of these clubs. Sakarya et al. (2024) identified two distinct sub-periods, 2004-2016 and 2017-2022. The convergence trend observed in per capita income between provinces in the 2005–2016 period reversed into a divergence trend in the 2017–2022 period, and trends in the services sector were decisive for this divergence. Eriş-Dereli and Pınar (2025), unlike other studies, assessed the convergence of the skilled force in Türkiye from 2005 to 2022 and found no overall convergence but identified two clubs: one with high and the other with low skilled labor shares. Additionally, elevated GDP per capita, R&D investment, net migration, and a larger proportion of higher education graduates enhance the probability of membership in the high-skilled club, whereas an increased share of agricultural production diminishes it. Karahasan (2020) also found the existence of convergence clubs by using Markov chain analysis, and the analysis indicates that regions with wealthy neighbors are more likely to move towards higher income classes, while poorer regions become increasingly isolated.

4. Data and Econometric Methodology

The convergence analysis in this study is based on provincial-level real gross domestic product (GDP) per capita data (in 2009 prices) provided by the Turkish Statistical Institute (TurkStat). Since the dataset containing real GDP at the provincial level covers the years 2004–2023, the convergence analysis is performed for these years. Regarding the econometric methodology, the model developed by Phillips and Sul (2007, 2009) is used instead of the neoclassical model, because the latter does not consider heterogeneity among regions and countries, and without the consideration of heterogeneity, the results of the tests may be invalid.

In this context, Phillips and Sul (2007, 2009) proposed a model that represents the behaviour of economies in transition, allowing for a wide range of possible time paths and individual heterogeneity. To put it in more detail, this model is a nonlinear time-varying factor model that accommodates individual and transitional heterogeneity. In this context, factor representation circumvents potential endogeneity and omitted variable bias, which might arise in the use of a steady-state proxy vector (Phillips and Sul 2009, Lyncker and Thoennessen, 2017). According to this model X_{it} are decomposed as equation (1)

$$X_{it} = g_{it} + a_{it} \tag{1}$$

X_{it} shows the per capita real income for i at time where i=1,...,N and t=1,...,T and

g_{it} shows the systematic factor which includes the permanent common component and a_{it} is the transitory component.

Equation (1) is reformulated into a multiplicative form to distinguish the common growth trajectory from the particular transition trajectory of each i. This change isolates the time-varying idiosyncratic component. Thereby, equation (2) is rearranged from equation (1) to account for temporal transitional heterogeneity.

$$X_{it} = \left(\frac{g_{it}+a_{it}}{\mu_t}\right)\mu = \delta_{it}\mu_t \tag{2}$$

where b_{it} is the systematic idiosyncratic element that is allowed to evolve over time and to include a random component that absorbs a_{it} and μ_t is the common factor across individuals for instance, μ_t may represent a proxy for commonly available world technology. In this dynamic factor formulation, that allows to separate common from idiosyncratic components, b_{it} becomes the transition path of the economy to the common steady–state growth path determined by μ_t, in other words (b_{it}) that measure of how individual economic performance relates over time to μ_t. Particularly, the common growth component μ_t, may follow either a trend–stationary process or a non–stationary stochastic trend with drift, since a specific assumption regarding the behaviour of μ_t is not necessary (Phillips and Sul, 2009, Sichera and Pizzuto, 2019).

To trace an individual trajectory for each economy i in relation to the panel average, a relative transition path is constructed in equation (3).

$$h_{it} = \frac{X_{it}}{N^{-1}\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}}{N^{-1}\sum_{i=1}^{N} \delta_{it}} \quad (3)$$

The relative transition path describes the relative individual behavior as well as the relative departures of the i. economy from the common growth path μ_t. In the presence of convergence, there should be a common limit in the transition path of each economy, and the coefficient h_{it} should converge towards unity ($h_{it} \rightarrow 1$) for all i= 1, . . ., N, as t $\rightarrow\infty$. At the same time, the cross–sectional variation H_{it} ,which is computed as the quadratic distance measure for the panel from the common limit, should converge to zero:

$$H_t = N^{-1}\sum_{i=1}^{N}(h_{it} - 1)^2 \rightarrow 0 \qquad \text{as t} \rightarrow\infty. \quad (4)$$

In order to construct a formal statistical test for convergence, Phillips and Sul (2007, 2009) assume the semi-parametric specification of b_{it}:

$$b_{it} = b_i + \frac{\sigma_i \xi_{it}}{L(t)t^{\alpha}} \quad (5)$$

where b_i is fixed which means time invariant, the ξ_{it} are i.i.d. N(0, 1) random variables across i, but weakly dependent over t, L(t) is a slowly varying increasing function (with L(t) $\rightarrow\infty$ as t $\rightarrow\infty$), and α is the convergence rate. The null hypothesis of convergence can be written as $H_0 : b_i = b$ and $\alpha \geq 0$ versus the alternative $H_1 : b_i \neq b$ for all i, or α < 0. Under H_0, different transitional paths are possible, including temporary divergence.

To test the presence of convergence among different economies, Phillips and Sul (2007, 2009) suggest estimating the following equation model;

$$\log\left(\frac{H_1}{H_t}\right) - 2logL(t) = \alpha + \beta logt + u_t, \text{ for t = [rT], [rT] + 1, . . ., T,} \quad (6)$$

where $H^t = N^{-1}\sum_{\text{l=1}}^{N}(h_{it} - 1)^2, and\ \frac{H_1}{H_t}$ is the cross–sectional variance ratio; β is the speed of convergence parameter of b_{it};−2 log(log t) is a penalization function that improves the performance of the test mainly under the alternative; r assumes a positive value in the interval (0, 1] in order to discard the first block of observation from the estimation, and [rT] is the integer part of rT. To this regard, Phillips and Sul suggest using r ∈ [0.2, 0.3] for small sample size (T < 50) because of Monte Carlo simulations. The null hypothesis of convergence is tested through a one–sided t–test robust to heteroskedasticity and autocorrelation of the inequality $\alpha > 0$ (using the estimated $\hat{\beta} = 2\ \alpha$) and specifically it is rejected at the 5% level if t $t_{\hat{\beta}}$ <−1.65. This procedure, generally called log–t test (Sichera and Pizzuto, 2019). Convergence clubs can be iteratively merged using the log(t) test for successive clubs, as outlined in the methodologies of Phillips and Sul (2007, 2009). If the convergence hypothesis is fulfilled for club (j) and club (j + 1), they may be categorized as club (j). This process can be performed iteratively until no clubs remain eligible for merging.

5. Empirical Results

First of all, the log(t) regression, namely Equation 6, is estimated 2004-2023 period and Table 2 shows the results. The log(t) is negative and t statistic (-49.948) which is smaller than -1.65 and the null hypothesis of convergence is rejected at 5 % significance level which means there is no absolute and conditional convergence, on the other hand there is club convergence in Türkiye for 2004-2023 period.

Table 2: Phillips–Sul log(t) regression results

	Coefficient	Std.Err	t-stat	prob
Log (t)	-0.829	0.016	- 49.948	0.00

This result is consistent with the literature which are made for Türkiye such as Kartal and Karşıyakalı (2023), Yazgan and Ceylan (2021), Aksoy et al. (2019), and Sakarya (2024 et al). As a consequence of the log (t) test result, an algorithm is used (hereafter the PS algorithm) to investigate sub grubs in the panel. The PS algorithm initially identified 11 convergence clubs, and 5 divergent units is presented in Table 3.

Table 3: Coefficient of log(t) test according to PS algorithm

Club	N and Names	Beta Coefficient	Std. Err	t-value
1	3 Bursa, Kocaeli, Gaziantep	0.016	0.054	0.301
2	4 Adana, Mersin, Tekirdağ, Konya	0.337	0.091	3.708
3	6 Kayseri, Muğla, Balıkesir, Sakarya, Eskişehir, Mardin	0.075	0.048	1.559
4	7 Samsun, Hatay, Denizli, Aydın, Diyarbakır, Şanlıurfa, Kahramanmaraş	0.223	0.075	2.987
5	9 Trabzon, Çanakkale. Afyonkarahisar, Malatya, Ordu, Van, Aksaray, Yalova, Şırnak	0.604	0.11	5.475
6	6 Erzurum, Sivas Kütahya, Kırklareli, Elazığ, Düzce	0.519	0.118	4.385
7	11 Zonguldak, Edirne, Isparta, Bolu, Çorum, Uşak, Adıyaman, Kastamonu, Osmaniye, Batman, Hakkari	0.172	0.074	2.321
8	9 Tokat, Giresun Niğde, Karaman Erzincan Kırşehir Çankırı, Bingöl, Kilis	0.075	0.067	1.12
10	5 Artvin, Karabük, Kars, Sinop, Bartın	0.517	0.113	4.568
11	4 Gümüşhane, Tunceli, Ardahan, Bayburt	0.017	0.057	0.292
Divergent Units :5	İstanbul, Ankara, İzmir, Antalya, Manisa			

Following Sichera and Pizzuto (2019) both Phillips and Sul (2007) club merging and Lyncker and Thoennessen (2017) club merging algorithms are applied to put forward the possible club mergers. The results showed that Phillips and Sul (2007) club merging and Lyncker and Thoennessen (2017) club-merging algorithms do not have identical results in terms of the number of final clubs and mergers of the clubs. While there are 7 clubs and 5 divergences in the Phillips and Sul (2007) method, there are 8 clubs and 5 divergence provinces in Lyncker and Thoennessen (2017) method. The results according to Phillips and Sul (2007) method is given in Appendix (1) and the results according to Lyncker and Thoennessen (2017 method is given in Table 4.

According to Phillips and Sul (2009) methodology if $2> \beta>0$ there is conditional convergence and if $\beta <2$ absolute convergence can be rejected. Table 4 shows the results according to vLT method and according to the results there are 8 clubs and 5 divergence provinces. Considering the β coefficients and t values for the clubs in Table 4, it is seen that all of the regions t value is bigger -1.65 which means the null hypothesis of convergence cannot be rejected, in other words the clubs converge internally. However, some clubs (Club 1, 3,6 and 8) have very small β coefficients in other words these clubs show convergence but a very slow rate. Other remaining clubs show faster

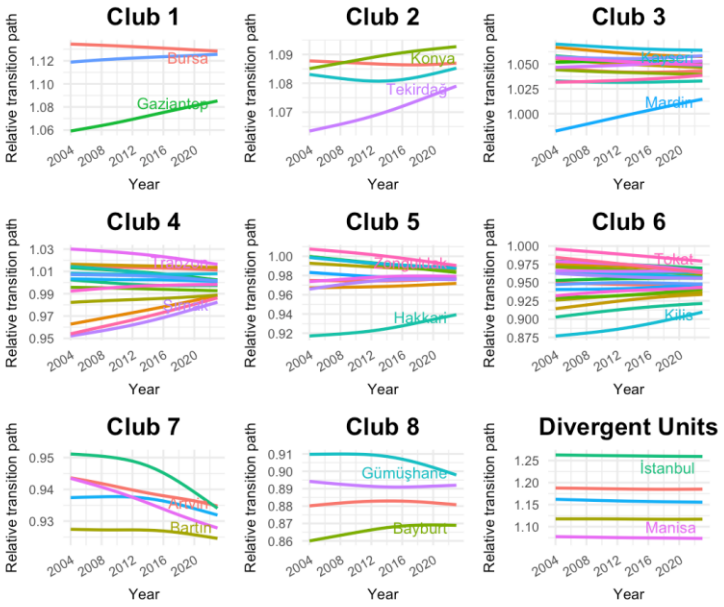
convergence rate albeit with a different magnitude. Lastly, İstanbul, Ankara, İzmir, Antalya, Manisa are divergent provinces which means they have a different growth path from other clubs.

Table 4: The Merged Club Results according to Lyncker and Thoennessen (2017) Method

Lyncker-Thoennessen method: Club	Merged Club	N and Names	Beta coefficient	Std. Err	t-value	Group
1	Clubs: 1	3 Bursa, Kocaeli, Gaziantep	0.038	0.054	0.695	Weak Convergence
2	Clubs: 2	4 Adana, Mersin, Tekirdağ, Konya	0.337	0.091	3.708	Strong convergence
3	Clubs: 3, 4	13 Kayseri, Muğla, Balıkesir, Sakarya, Eskişehir, Mardin, Samsun, Hatay, Denizli, Aydın, Diyarbakır, Şanlıurfa, Kahramanmaraş	-0.001	0.043	-0.03	Weak convergence
4	Clubs: 5, 6	15 Trabzon, Çanakkale, Afyonkarahisar, Malatya, Ordu, Van, Aksaray, Yalova, Şırnak, Erzurum, Sivas, Kütahya, Kırklareli, Elazığ, Düzce	0.596	0.105	5.657	Strong convergence
5	Clubs: 7	11 Zonguldak, Edirne, Isparta, Bolu, Çorum, Uşak, Adıyaman, Kastamonu, Osmaniye, Batman, Hakkâri	0.172	0.074	2.321	Weak convergence
6	Clubs:8,9	21 Tokat, Giresun, Niğde, Karaman, Erzincan, Kırşehir, Çankırı, Bingöl, Kilis, Bilecik, Rize, Yozgat, Amasya, Burdur, Kırıkkale, Nevşehir, Muş, Ağrı, Siirt, Bitlis, Iğdır	0.109	0.065	1.669	Weak convergence
7	Clubs:10	5 Artvin, Karabük, Kars, Sinop, Bartın	0.517	0.113	4.568	Strong convergence
8	Clubs:11	4 Gümüşhane, Tunceli, Ardahan, Bayburt	0.017	0.057	0.292	Weak convergence
Divergent Units:5	İstanbul, Ankara, İzmir, Manisa, Antalya					

Figure 1 shows the transition path process to each clubs' steady state and due to space limitations, only the names of the provinces listed at the top and bottom of the path curves could be given. Figure 1visualizes that there are multi convergence clubs with different dynamics, on one hand some clubs show strong convergence (club 2 and 4) on the other hand some clubs show weak or stagnant convergence (club 3, 5, 6, 8). Moreover, the most developed provinces' transition paths are above the average and these provinces are diverging.

Figure 1: Relative Transition Paths by Convergence Clubs



Source: Author's calculations

6. The Relationship Between Club Convergence Membership and SEGE Index

The SEGE Index is developed and published by Republic of Türkiye Ministry of Industry and Technology and the first index is published in 1966, and the last one is published in 2025, and it is updated over the years in accordance with time requirements. In the SEGE index published in 2025, there are eight main themes and fifty-two variables. The aim of the index is to put forward the development level of provinces and regions and according to the value of index, there are six different development levels. While the provinces in the first level have the highest index value and thereby the highest level of development, the provinces in the sixth level have both a negative index value and the lowest level of development (Doğan et al., 2025).

In this context, in this part of the study, the general characteristics and transition paths of each club will be evaluated by correlating them with the SEGE indexes of those provinces. Ultimately both analyzes have become more advanced and comprehensive. Thereby, the study will go beyond merely determining a club convergence analysis and will attempt to reveal the background of the growth dynamics of the provinces.

First of all, when divergent units are analyzed, İstanbul, İzmir, Ankara and Antalya are among the first level developed provinces according to the SEGE 2025 index score. Manisa is actually among the second-level provinces according to the SEGE score. As highlighted in the SEGE 2025 report, Manisa ranks 4th in Türkiye in terms of total investment with incentive certificates. Its strong industrial infrastructure, high proportion of skilled labor within total employment, and export-oriented nature have made it a rising star. The transition path graph of the Divergent units in Figure 1 clearly illustrates this divergence process. In this context, despite differences between provinces, their transition paths are above 1 and follow a stable course. Thereby, these provinces are trending upwards and maintaining a per capita income level significantly higher than the Türkiye average. In this context, long-term growth dynamics diverge from the country average. Club 1 includes Kocaeli, Bursa, and Gaziantep and as seen in Figure 1, the transition path curves for the provinces in this club are above the national average. Although Gaziantep's transition path curve is separate from the other two provinces, it is upward trending. The coefficient obtained for this club is quite low (0.038), while the t-statistic is positive (0.695). The convergence coefficient

obtained indicates that these provinces exhibited parallel growth with each other. When evaluated in terms of SEGE 2025 Index values, Kocaeli and Bursa, with their strong industrial infrastructure and export identities, are among the first level developed provinces. Gaziantep is among the third level developed provinces, which can be interpreted as; although Gaziantep resembles Kocaeli and Bursa in terms of its economic growth trajectory, other development components such as social and health do not accompany this trajectory.

Table 5: The Distribution of Provinces according to SEGE 2025 Development Level and Club Membership

Clubs	1. Level	2. Level	3. Level	4. Level	5. Level	6. Level
Divergent Units	İstanbul Ankara İzmir Antalya	Manisa				
Club 1	Kocaeli Bursa		Gaziantep			
Club 2		Tekirdağ Konya	Mersin Adana			
Club 3	Muğla Eskişehir	Sakarya Denizli Balıkesir Aydın	Kayseri Samsun	Hatay Kahramanmaraş		Diyarbakır Şanlıurfa Mardin
Club 4		Yalova Çanakkale Kırklareli	Trabzon Düzce	Kütahya Malatya Elâzığ Aksaray Sivas	Ordu Erzurum	Van Şırnak
Club 5		Bolu Edirne	Isparta Uşak Zonguldak	Çorum Kastamonu	Osmaniye	Batman Adıyaman Hakkâri
Club 6			Bilecik Rize Nevşehir Burdur Kırıkkale	Amasya Kırşehir Erzincan	Giresun Kilis Çankırı Niğde Tokat Yozgat	Iğdır Bitlis Siirt Muş Ağrı
Club 7			Karabük	Artvin	Bartın Sinop	Kars
Club 8					Gümüşhane Tunceli	Bayburt Ardahan

Source: Author's own evaluation

Club 2 constitutes from Tekirdağ, Mersin, Konya, Adana and the coefficient obtained for this club is high (0.337) and the t-statistic is positive (3.708), therefore it can be said that there is strong convergence in the group. Moreover, when Club 2 is analyzed deeply it can be said that Konya and Mersin are the rising stars of the club. Because as it can be seen from the Figure 1 there is a catching up process for Konya. For Mersin, there is a dramatic increase in Mersin's SEGE index level. In 2017's SEGE Index Mersin was in the third level of development, and it rose 12 ranks and takes place in the second level of development in 2025's Index (Doğan et al., 2025). There is an opposite situation for Tekirdağ's convergence process, as it can be seen from Figure 1 Tekirdağ starts higher and then there is a decline, the development level of Tekirdağ in the SEGE 2025 Index also supports this finding. Because according to SEGE 2017 Index Tekirdağ was in the first level of development, but on the other hand, according to SEGE 2025 Index the province is in the second level of development.

In club 3 there are thirteen provinces; Kayseri, Muğla, Balıkesir, Sakarya, Eskişehir, Mardin, Samsun, Hatay, Denizli, Aydın, Diyarbakır, Şanlıurfa, Kahramanmaraş and according to the coefficient obtained for this club is quite low (-0.001) and the t-statistic is negative (-0.03), therefore it can be said that there is a weak convergence in this club. In other words, the income per capita gap between developed and less developed provinces has not been closed. While 2025 SEGE ranks Eskişehir (7th) and Şanlıurfa (79th) at opposite ends of the development spectrum, the club convergence analysis places them on the same long-run transition path. This situation may be due to a three-legged dynamic within the club. The first one is the stable economies among western provinces (Eskişehir, Muğla, Denizli) whose relative growth has stabilized, and the second dynamic is the catch-up effect among southeastern provinces (Mardin, Diyarbakır), which are leveraging demographic advantages and public investment to grow at a velocity sufficient to converge with higher-income peers. As seen in Figure 1 (Club 3), the relative transition path of Mardin begins significantly below 1.0 but exhibits a strong positive slope, visually confirming the catch-up hypothesis against the flatter trajectories of established provinces. Third and the last dynamic is about the inclusion of Hatay and Kahramanmaraş in this club may indicate their recent SEGE rank regression due to the 2023 earthquakes effect convergence process of the club.

Club 4 is a merged club, and there are 15 provinces: Trabzon, Çanakkale, Afyonkarahisar, Malatya, Ordu, Van, Aksaray, Yalova, Şırnak, Erzurum, Sivas, Kütahya, Kırklareli, Elazığ, and Düzce. According to the coefficient obtained for this club, it is quite strong (0.596), and the t-statistic is positive (5.657), which means this club has shown strong internal convergence. Furthermore, looking at club 4, it appears to be quite heterogeneous. This club includes not only developed provinces like Yalova and Çanakkale but also low-income provinces such as Van and Şırnak, along with provinces that are better off compared to their regions, like Trabzon, Malatya, Elazığ, and Kütahya. This club would likely diverge rather than converge if it consisted solely of developed and underdeveloped provinces. However, cities like Trabzon, Malatya, Elazığ, and Kütahya served as hubs, making the club a strong convergence point. Because, as emphasized in the SEGE 2025 report, Trabzon is the most developed province in the Eastern Black Sea region and has a strong infrastructure in the health and education sectors. Malatya has an infrastructure above the regional average in both healthcare and transportation, and a low unemployment rate. Kütahya, on the other hand, has a competitive and innovative capacity, which is significantly indicated by the high share of high and medium-high-technology employment within the total employment. Elazığ, as highlighted in the SEGE 2025 report, also boasts a strong healthcare infrastructure and low unemployment rates (Doğan et al., 2025). In other words, the existence of these provinces has stabilized the club and made it the strongest region in terms of convergence within itself.

Club 5 which constitutes from, Zonguldak, Edirne, Isparta, Bolu, Çorum, Uşak, Adıyaman, Kastamonu, Osmaniye, Batman, Hakkari, exhibits structural heterogeneity, which is also reflected in the beta coefficient. Club 5's coefficient is (0.172) is an indicator of a weak but statistically significant convergence because the t-statistic is positive (2.321). When the provinces in Club 5 are analyzed in more detail, it is seen the SEGE index is high for Bolu, Edirne, and Isparta. Moreover, in this club there are provinces like Zonguldak that have not sufficiently transformed their industrial structure and provinces that show a catching-up trend, such as Hakkari and Batman. It is also possible to identify Çorum as the rising star of this club because, despite having a low value in the SEGE index, it is the second province in Türkiye with the highest per capita exports.

Club 6 is a group formed by the merger of clubs 8 and 9, and it consists of 21 provinces: Tokat, Giresun, Niğde, Karaman, Erzincan, Kırşehir, Çankırı, Bingöl, Kilis, Bilecik, Rize, Yozgat, Amasya, Burdur, Kırıkkale, Nevşehir, Muş, Ağrı, Siirt, Bitlis, Iğdır. The coefficient is (0.109) and the t-statistic is positive (1.6669), this situation indicates a weak convergence with a marginal significance level, meaning it is close to the critical value of 5%. The club's transition path curves are below one, indicating that they are below the national average and are balancing toward a low-

income level within themselves. Although this group has a quite heterogeneous structure according to SEGE-2025 data, it is predominantly composed of 4th-, 5th-, and 6th-level developed provinces. Bilecik, however, is considered an outlier province for this club because its membership is attributed to its stagnant economy rather than the province's backwardness. The fact that it was a second-level developed province according to the 2017 SEGE index, but it is ranked among the third-level developed provinces in 2025 can be considered an indicator of this situation. When the SEGE indicators of other provinces in the club are evaluated, it is seen that in provinces at this level of development, human capital is generally insufficient, competitiveness is low, high value-added production is inadequate, and R&D expenditures are low.

Club 7 is constituted of Artvin, Karabük, Kars, Sinop, and Bartın, and the coefficient (0.517) and t-statistic is positive (4.568); however, the downward trend of club 7's transition path indicates a divergence from the national average. The SEGE 2025 report states that the only region to drop from Level 2 to Level 3 based on 2017 index values is the TR 81 Level 2 (Zonguldak, Karabük, and Bartın) region. Two members of this region are in club 7. Additionally, according to the SEGE 2025 report, Bartın, Karabük, and Kars fall below the national average in terms of competitive and innovative capacity.

Club 8 is made up of Gümüşhane, Tunceli, Ardahan, and Bayburt, and the coefficient (0.017) indicates that these provinces aren't catching up to each other; they're staying put where they are. Additionally, the t-statistic (0.292) is also insignificant. According to data from the Turkish Statistical Institute (TUIK), the club shows the smallest provinces in terms of population per square kilometre (www.tuik.gov.tr). The small population leads to an inadequate domestic market and prevents the achievement of economies of scale in many sectors. In this case, the provinces that make up this club are exhibiting structural stagnation rather than converging. The fact that the transition path curve of club 8 in Figure 1 is below 1 and is moving toward a stable equilibrium can be considered an indicator of this finding.

7. Conclusion

Regional disparity is a phenomenon that no country desires, whether developed or developing, and it has been attempted to be eliminated for years by comprehensive policies. One of the theories that inspired these policies, neoclassical growth theory, predicts that poor regions will grow faster than rich regions and the gap between them will close. However, country and regional experiences show that the convergence process did not occur, and instead, club convergences emerged. Based on this idea, this study first investigated whether there is income convergence among provinces in Türkiye. For this purpose, the real GDP per capita data (in 2009 prices), frequently used to measure economic development, are used in the study. The provincial-level real GDP per capita dataset published by TurkStat covers the period from 2004 to 2023; due to this data limitation, the study is restricted to this time frame. For the convergence analysis, the method developed by Phillips and Sul (2007, 2009) is used, and this nonlinear model enables the capture of different convergence possibilities, such as absolute, conditional, and club convergence and divergence. According to estimates by using the method of Phillips and Sul (2007, 2009), there is neither absolute nor conditional convergence among provinces in Türkiye throughout this period; on the other hand, there is club convergence. In the first step of analysis, it is found that there are 11 clubs and 5 divergent units, and to abstain from overestimating the number of clubs, following the related literature, several clubs are merged, and according to the results, there are 8 convergence clubs and 5 divergent provinces. In this context results show that some of Türkiye's most developed provinces form divergent units. Furthermore, clubs 2 and 4 show strong internal convergence; on the other hand, clubs 1, 3, 5, and 6 show weak convergence. Among the clubs showing strong convergence, it appears that some provinces act as a driving force. This finding constitutes an important cornerstone for clubs showing weak convergence or divergence.

Subsequently, to incorporate a development perspective into the analysis, this study associate's convergence club memberships with the 2025 SEGE index. The fact that no other study combining club convergence with the SEGE index was found in the literature review makes this study unique. In this context, this study contributes to the literature by analyzing the question of why a province is in that club from a multi-dimensional perspective. Thus, it has been possible to identify some clubs' rising star provinces, some clubs' blood-losing provinces, and some clubs' catch-up provinces. In addition, the analysis shows that even if some provinces have high growth potential (e.g., Gaziantep, Tekirdağ), their growth quality will be poor if their social and health indicators are poor, despite the provincial growth.

Additionally, the results obtained with club 4 show that the provinces with their strong health and transportation infrastructure are actually acting as a hub between the developed provinces in the west and the less developed provinces in the east, preventing regional imbalances from increasing further. Because there is mobility of labor and capital within the country, these regions serve as a kind of bridge. Therefore, when designing policies to address regional imbalances, policymakers should consider not only the problems of developed and undeveloped provinces but also how moderately developed provinces can further develop. Most of the provinces in Clubs 7 and 8 have negative SEGE index values. This finding actually shows that it is not possible for the provinces in these clubs to move to the upper clubs without improving their human capital and social indicators, gaining competitiveness, and changing their production patterns. Last but not least, based on the study's findings, provinces in Türkiye formed heterogeneous convergence clubs in terms of real GDP per capita during the 2004-2023 period. Additionally, when the club convergence results obtained are combined with the SEGE index, it indicates that the analyzes should be conducted from a multi-dimensional and holistic perspective. Therefore, policies aimed at achieving convergence and reducing the development disparities between provinces must take this fact into account. Consequently, policies designed and implemented in this area should not consist of a single element, but rather a combination of several policies suitable for each province. Moreover, these policies should be aimed at divergent provinces, provinces experiencing stagnation, and less developed provinces; that is, they should be province specific. For this, they should consider the economic sectoral composition of the provinces, the state of the labor market, the knowledge and skill set of the labor force, and the state of the infrastructure. In conclusion, convergence can only be achieved with policies that are customized for that province and consider the growth and development dynamics of that province.

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Appendix (1)

Table 1: The Merged Club Results according to Phillips and Sul (2007) Method

Club	Merged Club	N and Names	Beta coefficient	Std. Err	t-value
1	clubs: 1	3 Bursa, Kocaeli, Gaziantep	0.016	0.054	0.301
2	clubs: 2	4 Adana, Mersin, Tekirdağ, Konya	0.337	0.091	3.708
3	clubs: 3, 4	13 Kayseri, Muğla, Balıkesir, Sakarya, Eskişehir, Mardin, Samsun, Hatay, Denizli, Aydın, Diyarbakır, Şanlıurfa, Kahramanmaraş	-0.001	0.043	-0.03
4	clubs: 5, 6, 7	26 Trabzon, Çanakkale, Afyonkarahisar, Malatya, Ordu, Van, Aksaray, Yalova, Şırnak, Erzurum, Sivas, Kütahya, Kırklareli, Elazığ, Düzce, Zonguldak, Edirne, Isparta, Bolu, Çorum, Uşak, Adıyaman, Kastamonu, Osmaniye, Batman, Hakkâri	-0.06	0.053	-1.127
5	clubs: 8, 9	21 Tokat, Giresun, Niğde, Karaman, Erzincan, Kırşehir, Çankırı, Bingöl, Kilis, Bilecik, Rize, Yozgat, Amasya, Burdur, Kırıkkale, Nevşehir, Muş, Ağrı, Siirt, Bitlis, Iğdır	0.109	0.065	1.669
6	clubs:10	5 Artvin, Karabük, Kars, Sinop, Bartın	0.517	0.113	4.568
7	clubs:11	4 Gümüşhane, Tunceli, Ardahan, Bayburt	0.017	0.057	0.292
Divergent Units: 5	İstanbul, Ankara, İzmir, Antalya, Manisa				