



Testing Club Convergence in Health Outcomes in Pakistan during 2004-2020

Noor Ahmed^{a*}, Asim Khan^b, Israr Ahmed^c, Dr. Khursheed Iqbal^d, Naseebullah^e

^aLecturer, University College of Zhob, BUITEMS, Zhob. ^bLecturer, University College of Zhob, BUITEMS, Zhob. ^cLecturer, University College of Zhob, BUITEMS, Zhob. ^dAssociate Professor, University College of Zhob, BUITEMS, Zhob. ^eLecturer, University College of Zhob, BUITEMS, Zhob.

*Email: Noor.ahmed@buitms.edu.pk

Abstract: Club convergence research has become a prominent focus in economic growth and development research over the past thirty years. When evaluating the degree of national well-being in studies on the convergence of living standards across various locations, gross domestic product (GDP) per capita is frequently used. Utilizing the convergence and clustering technique put out by Phillips and Sul (2007), the analysis yields a better health index. Five health indicators are included in the index. A final health index is obtained by combining the indicators using principal component analysis (PCA). Overall, the results of the study reject the notion that every district in Pakistan reaches a single state of equilibrium for the health index. Four convergence clubs were discovered after testing club convergence. The results show that health outcomes varied throughout districts, emphasizing the necessity for policies designed to lessen these spatial inequities.

Key Words: Club Convergence, Health Index, PCA

1. Introduction

Mental, physical, and social well-being are all included in the concept of health, which is essential to human development. seventeen intricate and interconnected sustainable development goals (SDGs), with 169 targets pertaining to socioeconomic and environmental determination, comprise the United Nations' (UN) 2030 agenda for sustainable development. In addition to being essential indicators of a country's advancement in its social, medical, and technological domains, a country's life expectancy, infant mortality, pre- and postnatal care, child immunization, and overall fertility rate are also significant indicators of its economic state. Improved life expectancy, reduced infant mortality, and a lower overall fertility rate are examples of a nation's noteworthy achievements. Global health conditions have significantly improved within the past 20 years. Population health in poorer nations, however, might still pose a serious threat. Over this time, Pakistan's data on child and newborn mortality have steadily improved. As compared to emerging nations with comparable socioeconomic position, the rates are nonetheless alarming. Not much attention has been paid in the development literature to the question of convergence or divergence in health and other elements of human development. Our tendency to regard growing nations as a single, homogenous political, social, and economic entity is the primary reason for this. It is critical to evaluate the state of people, nations, and areas. For developing nations like Pakistan, figuring out convergence is crucial. Reducing regional imbalances across the country has been the main objective of Pakistan's planning programs. Concerns over this matter have been reflected in the nation's plans and programs, which have placed a strong emphasis on the need to rectify territorial discrepancies in development. The principal aim of Vision 2025 is to attain more rapid and equitable economic growth. This

acknowledges how crucial it is to make sure that groups of people who have been left out of the benefits of affluence as a result of rapid economic progress. Pakistan has achieved remarkable economic growth in the past 20 years, despite several social, economic, and political challenges. This progress may be attributed to the implementation of reforms and the promotion of unrestricted commerce. Pakistan's Gross Domestic Product (GDP) has had a significant growth, surging from \$82.69 billion in 2000 to \$346 billion in 2021, representing a more than fourfold increase over a period of two decades. Furthermore, the country's per capita income has tripled. Pakistan's per capita income experienced a significant rise from around \$570 US in 2000 to approximately \$1,538 US in 2021. Over the last two decades, the country has regularly achieved an average GDP growth rate of around 4.6%, which is seen as praiseworthy.

Pakistan has had significant economic growth over the past two decades. Conversely, Pakistan is currently grappling with the challenging task of addressing its imbalanced regional growth. Pakistan's trajectory of expansion has led to disparate social and economic development, especially in relation to the provision of public services (Easterly, 2003). Hence, to attain a higher level of comprehensive regional development, it is imperative to ensure equitable distribution of the benefits of growth throughout all regions of the nation. The enduring presence of health inequity throughout the nation has been overlooked in studies on health disparities. Hence, enhancing effectiveness in attaining fairness and enhancing regional public health results are crucial factors in Pakistan's health transition process. The remainder of the analysis is presented in the following sections. Following the summary in Section 1, we move on to Sections 2 and 3 that provides an overview of the existing literature and delve into the technique and data, respectively. Section 4 provides an explanation of the findings and facilitates a conversation, while Section 5 specifically addresses the conclusion and its implications for policy.

2. Literature Review

In the second portion, we thoroughly examine the research findings and theoretical works pertinent to the issue of spatial inequality. This sector is further parted into two subsections. The study's components consist of both empirical data and theoretical literature.

2.1 Theoretical Literature

Economists studying economic growth and development have taken a keen interest in Solow's 1956 publication of his neoclassical growth model. In 1956, Solow improved the Harrod-Domar model by adding labor as a requirement for manufacturing, thereby completing a comprehensive growth equation. He argues that as each economy reaches its equilibrium growth trajectory, technological advancements will lessen the real per capita income inequality among developed nations. In other words, this statement implies that, regardless of initial income levels, nations' income levels will eventually reach a comparable and stable situation if their fundamental qualities remain constant (Barro & Sala-I-Martin, 1992). This scenario is commonly known as absolute convergence. Due to its belief in exogenous growth, the Solow model failed to provide an explanation for how these economies might sustain a stable equilibrium. The absence of the neoclassical model in understanding steady state growth demands the creation of several alternative models. Against the neoclassical model, Myrdal's (1957) claim that growth is a spatial phenomenon that causes disparities to increase is generally supported by endogenous growth theories (Romer, 1986; Lucas, 1988 & Howit, 1998), institutional theory (Lundvall, 1992; Nelson, 1993), and new economic geography (Krugman, 1991; Venables, 1999). A few theories on growth Economies with similar structural features (production technology, preferences, governmental regulations, etc.) can nevertheless converge to distinct steady state equilibria even though their initial conditions differ, as demonstrated by numerous studies (Chatterji, 1992; Barro & Sala-I-Martin, 1992; Durlauf & Johnson, 1995; Quah, 1996; Azariadis, 1996; Galor, 1996).

A set of comparable economies must have the same starting points in order to forecast a shared, balanced development trajectory for them. According to Galor (1996), nations are considered to be members of the same convergence club if their economies are in a comparable steady state equilibrium. The idea of club convergence was first presented by Baumol and Wolff in the late 1980s. According to Chatterji (1992), some regions have achieved a per capita income that is steady and sustained, which he claims is indicative of a convergence club. The concept of national club convergence was first forth by Quah in 1996. He developed an empirical method that was designed to replicate the oscillations of cross-sectional distributions of economies without the need for a theoretical model. Quah argues there is a lack of data to support the idea that economies are converging economically, since per capita income has instead established a bimodal distribution globally.

2.2 Empirical Literature

The number and features of groups have been the subject of varied conclusions from empirical study on the convergence club hypothesis, which has had a discernible impact on the methodology employed. In 1988, Wolff and Baumol used a simple non-linear model to identify a group of people with high income convergence and low-income divergence. In 1992, Chatterji discovered two unique convergence clubs that were mutually exclusive, with one comprising of wealthier countries and the other of less affluent ones. For 105 nations spanning 1960–1990, Quah (1993) investigated the club convergence hypothesis using regression tree analysis, using per capita income as a measure of development. He observed a pair of mountains that were becoming larger and were causing the country to split into two separate social groups.

Durlauf and Johnson (1995) applied regression tree analysis to test the occurrence of club convergence across 121 nations. Based on their research, the growth and diversity of the existing human resources have a significant influence on the formation of clubs. Galor (1996) expands on the idea that there could be multiple stable equilibria by developing models for club convergence. He acknowledged that while different sets of equilibria do not converge, countries with similar characteristics eventually tend to converge on a single stable equilibrium.

Studies examining the phenomenon of club convergence were unsuccessful to address the issues of convergence path, individual heterogeneity, economic transition, and economic structure. Phillips and Sul (2007) investigated how variances between nations and changes over time affect the process of economic growth. Additionally, they provided an innovative way to categorise panels into club convergence groupings. Since Phillips and Sul (2007), numerous studies on economic convergence have been carried out; a few of these studies will be covered in the section that follows.

According to Aksoy and colleagues' research in Turkey, convergence clubs existed in all NUTS-III districts between 1987 and 2017. They discovered five clubs during the first period, which lasted from 1987 to 2001. They discovered six new clubs between 2004 and 2017. Tian et al. (2016) analyzed the regional income convergence of 31 Chinese provinces between 1978 and 2013. The authors made a trait concerning the two convergence groups and said investment, openness, and human capital affect a region's high-income status.

Similar research by Li et al. (2018) used data from 2286 Chinese localities from 1992 to 2010. Six convergence societies were found and their establishment was established by the inquiry. The factors influencing the result were per capita fixed assets, industrialization, and population density. Velázquez et al. (2015) examined the patterns of convergence in income per capita among Mexican states from 1940 to 2015 using a time-series approach that accounts for both temporal and transitional variability. The results contradict the theory of Mexican state convergence. Unlike general convergence, club convergence showed both income per capita and geographical disparity.

Bartkowska and Riedl (2009) conducted a study between 1990 and 2005 to analyze the per capita income output in 206 European cities that were experiencing convergence. It was determined that these clubs exist, implying that European areas may be divided into five distinct groupings, each with its own stable circumstances. Hao (2008) examined the convergence club using Chinese province data from 1985 to 2000. Based on his results, The Chinese areas are categorized into two distinct divisions, each exhibiting convergence clubs that demonstrate unique patterns of growth. Previous empirical research has demonstrated that per capita GDP is the sole statistic typically employed in studies examining convergence clubs. The concept of "club convergence" has been widened to encompass the analysis of convergence amongst economies according to their sub-indices of development. The studies that are presented here have been carefully chosen.

From 1990 to 2018, Nag et al. (2023) looked at the progressive changes in the convergence and divergence patterns in the health status across India's major states. The study's conclusions show that the life expectancy at birth is falling into club one and converging in the same way for all states. In contrast, there are notable cross-state differences and indications of clubs' convergence and divergence in the areas of total fertility rate, neonatal death rate, and infant mortality rate. Using an updated indicator, Basel et al. (2020) analyzed the convergence club to evaluate the state of development in 102 countries. The energy use, life quality, access to water and sanitation, environmental conditions, health and education, and good governance are among the seven major development indicators that make up the index. Four clubs were found to reflect actual convergence in the study, which looked at how clubs expanded over 102 countries between 1996 and 2015.

Montan et al. (2018) used data on income and the human development index to examine the convergence hypothesis in Spain for the years 1980-2007 and 1980-2014. The analysis came to the conclusion that fewer clubs existed between 1980 and 2014, suggesting that regional inequities were lessened by the Great Recession. Szendi (2014) examined the Human Development Index (HDI) in all countries from 1990 to 2010. The objective was to evaluate

social and economic growth by applying club convergence and the HDI beta convergence idea. The findings point to a limited degree of social and economic convergence. The global center-periphery dynamics hypothesis and global patterns of regional disparities are supported by the convergence clubs.

Health outcomes at the district level are becoming more comparable in Pakistan, but economists and development experts have not paid much attention to this despite the abundance of available material. This study experimentally investigates the phenomenon of several Pakistani regions coming together to create distinct stable conditions and the establishment of convergence clubs, as proposed by experts in the field of economic development (Baumol, 1986; Durlauf, 1995; & Galor, 1996).

3. Data and Methodology

3.1 Data and Variables Description

Six PSLM surveys provide district-level data on health indicators. The exact indicators used to generate the health index are listed in Appendix 1. 19 districts were excluded from the analysis as a result of lacking observations, despite the fact that these questionnaires gathered information from 116 districts spread across four Pakistani provinces. Appendix 2 contains a list of the districts that were eliminated. Gross Domestic Product (GDP) per capita has commonly used as the primary indicator for assessing living standards in most of the literature. Economists are becoming more cognizant of the fact that income growth rates are an inadequate measure of welfare, as they fail to encompass the entirety of human well-being. This includes aspects that go beyond what can be captured by income growth rates, as highlighted by Sen (1983), Goossens (2007), Fleurbaey (2013), and Stiglitz et al. (2019). Within this setting, a multitude of options have been proposed by economists and non-economists alike (Cordoba & Verdier 2008; Fleurbaey & Gaulier 2009). Economist Xavier Sala-I-Martin, a well-known figure in growth literature, has suggested that convergence can be utilised when examining human development indicators (Roy & Bhattacharjee, 2009). As an outcome, by conducting research on the convergence club and employing the enhanced health index, our objective is to calculate the health index for 97 districts in Pakistan from 2004 to 2020. The health index has five indicators. Multiple indices are aggregated using weights generated from Principal Component Analysis (PCA) (Basel et al., 2020).

3.2 Econometric Methodology

This phase investigates Phillips and Sul (2007) technique for identifying convergence groups and measuring convergence over a sample of districts. This study employs PS's proposed log t test to investigate the convergence of the health index among Pakistani districts. The strategy is empirically sound because it creates exclusive clubs out of places with comparable traits. The log t test is significant because it makes no assumptions regarding the relevant variable's trend or stochastic non-stationarity, as well as the panel's shared components across people (Aksoy et al. 2019).

The strategy is predicated on a special breakdown of the variable of interest. Panel data is often divided into the following groups.

$$\log y_{it} = \phi_i u_t + \varepsilon_{it} \tag{1}$$

The symbol " u_t " indicates the mutual factor, " ϕ_i " represents the component of the unit characteristic, and " ε_{it} " denotes the error term. However, in this pattern, the logarithm of income per capita, $\log y_{it}$, is shown with a factor that changes with time. This variation may be attributed to the depiction of typical panel data.

$$\log y_{it} = (\phi_i + \frac{\varepsilon_{it}}{u_t}) u_t = \delta_{it} u_t \tag{2}$$

Where δ_{it} absorbs the error term, the unit-specific component represents the unique proportion that varies with time. The first model used y_{it} and two-unit characteristic components, ϕ_i and ε_{it} , to show individual $\log y_{it}$ patterns. The second approach uses the variable δ_{it} to elucidate income per capita by calculating a country's proportion of the shared growth trajectory (μ_t). To represent the transition coefficients (δ_{it}), a relative transition coefficient (hit) is created:

$$hit = \frac{\log y_{it}}{N^{-1} \sum_i^N} = \log y_{it} = \frac{\sigma_{it}}{N^{-1} \sum_i^N} = \sigma_{it} \tag{3}$$

" hit " refers to the relative to the cross-sectional average, the transition route of an economy i . It serves two purposes: first, it determines the behaviour of an individual area in comparison to other regions, and second, it depicts the region's relative departure from the common growth path μ_t . Convergence occurs when all regions follow the same transition route, resulting in $hit \rightarrow 1$ for all i as $t \rightarrow \infty$ as $t \rightarrow \infty$. for all i as t approaches infinity.

The cross-sectional variance of hits, represented as $V^2_t = N^{-1} \sum_i (hit - 1)^2$, will eventually converge to zero. In the

scenario of no convergence, there exist multiple potential conclusions. An example of this is when V_i converges to a positive integer, which is a characteristic of the convergence club. Alternatively, V_i may remain above zero without converging or diverging.

The null hypothesis is determined by modelling δ_{it} in a semi-parametric form, as done by Sul and Phillips (2007).

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{L(t)t^\alpha} \tag{4}$$

Where δ_i is fixed, σ_i is an idiosyncratic scale parameter, ξ_{it} is iid(0,1), $L(t)$ is a function varying slowly (such that $L(t) \rightarrow \infty$ as $t \rightarrow \infty$) and α is the decay rate.

The variable δ_i is assumed to be fixed, while σ_i represents an idiosyncratic scale parameter. The term ξ_{it} follows an independent and identically distributed (iid) distribution with mean 0 and standard deviation 1. The function $L(t)$ is characterised as varying slowly, meaning that it approaches infinity as t approaches infinity. Lastly, α denotes the decay rate.

Explaining the convergence null hypothesis:

$$H_0 : \delta_i = \delta \text{ and } \alpha \geq 0 \tag{5}$$

It compares to the alternative $H_A : \delta_i \neq \delta$ for all i , or $\alpha < 0$. The null hypothesis of convergence allows different transitional models of regions i and j , such as momentary divergence, to be seen.

Because stationarity tests (Franses and Hobijn, 2000) fail in the presence of temporary divergence, Sul and Phillips' (2007) method reveals convergence even in this case. The convergence argument is incorrectly rejected because stationary time series algorithms cannot identify asymptotic movement between two time series. Stationary time series methods cannot detect the asymptotic movement of two time series.

The cross-sectional variance of hit has a limiting form under convergence, according to Sul and Phillips (2007), who use Eq. (4).

$$Vt^2 \sim \frac{A}{L(t)^2 t^{2\alpha}} \text{ as } t \rightarrow \infty \text{ for some } A > 0 \tag{6}$$

From regression, we can figure out the following convergence test:

$$\log\left(\frac{v1^2}{vt^2}\right) - 2 \log L(t) = \alpha + \text{blogt} + u_t$$

$$\text{For } t = [rT], [rT] + 1, \dots, T \tag{7}$$

In general, $r \in (0, 1)$ and $L(t)$ is a slowly changing function. Based on Monte Carlo simulations, Sul and Phillips (2007) advise using $L(t) = \log t$ and $r = 0$ for sample sizes less than $T = 50$. Finally, using $\hat{b} = 2\alpha$, a one-sided t test that is resistant to autocorrelation and heteroskedasticity is used to evaluate the difference between the null hypothesis $\alpha \geq 0$.

If $t_{\hat{b}} < -1.65$ (1% significance level)

This would indicate that the null hypothesis is false. The test can be summarised in four steps. The units are initially arranged in descending order depending on the most current period of the group's time series dimension. Convergence among the groups is then ascertained using the log t test. Furthermore, this is accomplished by adding each district first gradually to the set having the two highest income regions initially, then completing the t log test until the t value for this group exceeds -1.65. One then runs a log t test. on each remaining unit in the sample to determine convergence. If not, the remaining units are subjected to the first three phases. Should no clubs arise, one may argue that those economic entities are unique from one another.

4. Empirical Findings

Here, we give the results on the club convergence of the health index throughout different districts of Pakistan.

4.1 Log t Convergence Test

We begin by looking at the health index's whole convergence. Initially, we perform a log-t regression analysis to determine the health index for 97 districts between 2004 and 2020. The findings demonstrate that, because the t-statistic value is less than -1.65, the null hypothesis is rejected for the entire sample at the 1% significance level. Moreover, it implies that there is a rejection of convergence throughout all districts. As a result, we must continue with the clubs identification.

Table 1: Phillips Sul log t Regression Results for Health Index

Variable	β Coefficient	SE	T-stat
log(t),	-1.539	0.026	-57.709

Note: convergence test reject the null hypothesis at the 1% level

4.2 Club Convergence Identification

If the entire sample does not exhibit convergence, we move on to identify the creation of convergence clubs. To identify clubs, we employ the "Phillips-Sul algorithms of club clustering." The output for club identification is displayed in Table 2.

Table 2: Club Convergence Results for Health Index

Clubs	Districts in Club	N	β Coefficient
1st Club	Chakwal, Khushab, Qilla Saifullah	3	1.486 (3.080)
2nd Club	Islamabad, Rawalpindi, Jehlum, Sargodha, Bhakhar, Faisalabad, T.T.Singh, Sialkot, Mandi Bahuddin, Narowal, Okara, Sheikhpura, Lahore, Kasur, Vehari, Sahiwal, Pakpattan, Lodhran, Multan, D.G.khan, Rajanpur, Bahawalpur, Layyah, Shaheed Benazirabad, Larkana, Dadu, Hyderabad, Karachi, Lower Dir, Chitral, Malakand, Peshawar, Charsada, Kohat, Bonair, Nowshera, Tank, Mansehra, Abbottabad, Haripur, Mardan, Swabi, Pashin, Zhob	44	0.227 (4.518)
3rd Club	Attock, Mianwali, Jhang, Gujranwala, Gujrat, Hafizabad, Khanewal, Muzaffar Garh, Bahawalnager, Rahim Yar Khan, Nowshero Feroze, Sukkur, Badin, Sanghar, Mir Pur Khas, Tharparkar, Ghotki, Shikarpur, Khairpur, Swat, Upper Dir, Hangu, Shangla, Karak, D.I.Khan, Batagram, Kohistan, Lakki Marwat, Quetta, Qilla Abdullah, Sibbi, Kalat, Awaran, Kharan, Lasbilla, Gwadar, Loralai, Barkhan	38	0.101 (0.556)
4th Club	Thatta, Bannu, Ziarat, Mastung, Jafarabad	5	0.162 (0.801)
5th Club	Jacobabad, Khuzdar, Nasirabad	3	0.583 (1.109)
6th Club	Chaghi, Musa Khel, Jhal Magsi, Bolan	4	-0.049 (-0.229)

Note: Results display 5 clubs from row 1 to row 6. The t-statistics are in parenthesis. N is the number of districts in each club

Results from Table 2 clearly show that the health index across 97 districts converged initially to six clubs

4.3 Club Merging Tests (Convergence between the Clubs)

The As Phillips and Sul (2009) argue, the convergence technique may result in an overestimation of the actual number of clubs. We evaluate the merging of nearby clubs utilizing club merger tests to combine smaller clubs into larger ones in order to address this grave issue. We test for convergence amongst clubs as we move the investigation along. The log t-test was proposed by Phillips and Sul (2009) as a means of testing the merger of two or more clubs into a new club. Every pair of clubs is subjected to a log t-test, and if the convergence hypothesis is jointly satisfied, the clubs may combine to establish a new one. Table 3 presents the outcomes of the club merging experiments.

Table 3: Club Merging Test Results (Health Index)

S	N	Clubs Merging Test	β Coefficient	Final Clubs	N
1st Club	3	Club 1 + Club 2	0.027 (0.233)	1st Club	47
2 nd Club	44	Club 2 + Club 3	-0.819 (-41.95)	2 nd Club	43
3 rd Club	38	Club 3 + Club 4	-0.049 (-0.376)	3 rd Club	3
4 th Club	5	Club 4 + Club 5	-1.730 (-27.300)	4 th Club	4
5 th Club	3	Club 5+ Club 6	-0.840 (-8.495)		
6 th Club	4				

Note: The t-statistics are in parenthesis. N is the number of districts in each club.

4.4 Final Clubs Classification

There is evidence of convergence between the two groups, as indicated by the club merging results mentioned above. A club consisting of 47 districts is formed when the first and second clubs combine, while a club consisting of 43 districts is created when the third and fourth clubs combine. After four groupings converge, four clubs for convergence are shown in the final club categorization presentation (Table 4).

Table 4: Final Clubs Classification (Health Index)

Club	Final Club	N	β Coefficient
Club 1	Islamabad, Rawalpindi, Jehlum, Chakwal, Sargodha, Bhakhar, Khushab, Faisalabad, T.T.Singh, Sialkot, Kasur, Okara, Sheikhpura Lahore, , Vehari, Mandi Bahuddin, Sahiwal, Multan, Pakpatten, Lodhran, D.G.khan, Rajanpur, Layyah, Bahawalpur, Narowal, Shaheed Benazirabad, Larkana, Dadu, Karachi, Hyderabad, Chitral, Lower Dir, Bonair, Malakand, Nowshera, Charsada, Peshawar, Kohat, Tank, Mansehra, Abbottabad, Haripur, Mardan, Swabi, Pashin, Zhob, Qilla Saifullah	47	0.028 (0.234)
Club 2	Attock, Mianwali, Jhang, Gujranwala, Gujrat, Hafizabad, Khanewal, Muzaffar Garh, Bahawalnager, Rahim Yar Khan, Khairpur, Sukkur, Nowshero Feroze, Ghotki, Thatta, Shikarpur, Badin, Mir Pur Khas, Tharparkar, Sanghar, Swat, D.I.Khan, Shangla, Karak, Upper Dir, Hangu, Kohistan, Bannu, Lakki Marwat, Batagram, Quetta, Qilla Abdullah, Sibbi, Mastung, Awaran, Ziarat, Kharan, Barkhan, Lasbilla, Kalat, Gwadar, Loralai , Jafarabad	43	-0.049 (-0.377)
Club 3	Jacobabad, Khuzdar, Nasirabad	3	0.583 (1.109)
Club 4	Chaghi, Musa Khel, Jhal Magsi, Bolan	4	-0.049 (-0.229)

Note: Results display 4 clubs from row 1 to row 4. The t-statistics are in parenthesis. N is the number of districts in each club

As seen from the table 4, the results of final club classification revealed four convergence clubs. The first club is represented Islamabad, Faisalabad, Rawalpindi, Khushab, Multan, Chakwal, Lahore, Sargodha, Bahawalpur, Okara, Bhakhar, Sialkot, T.T.Singh, Sheikhpura, Mandi Bahuddin, Narowal, Vehari, Kasur, Sahiwal, Pakpatten, Jehlum, Lodhran, D.G.khan, Rajanpur, Layyah, Shaheed Benazirabad, Larkana, Dadu, Hyderabad, Karachi, Malakand, Peshawar, Chitral, Charsada, Nowshera, Bonair, Kohat, Tank, Lower Dir, Mansehra, Abbottabad, Haripur, Mardan, Swabi, Pashin, Zhob and Qilla Saifullah. The second is the integration of Attock, Mianwali, Jhang, Gujranwala,

Gujrat, Hafizabad, Khanewal, Muzaffar Garh , Bahawalnager , Rahim Yar Khan, Sukkur, Nowshero Feroze, Khairpur, Shikarpur, Ghotki, Badin, Thatta, Mir Pur Khas, Sanghar, Tharparkar, Bannu, Swat, Hangu, Upper Dir, Lakki Marwat, Batagram, Shangla, Karak, D.I.Khan, Kohistan, Quetta, Sibbi, Loralai, Lasbilla, Ziarat, Kalat, Awaran, Qilla Abdullah, Mastung, Kharan, Gwadar, Barkhan and Jafarabad. The third club comprises Jaccobabad, Khuzdar and Nasirabad. The fourth club encompasses Chaghi, Musa Khel, Jhal Magsi and Bolan.

4.5 Transitional Behavior of Clubs for Health Index

To find the transition path of the health index clubs, we map the internal transition path of each club district. For this, we employ the concept of a transition path curve, which was introduced by Phillips and Sul (2009). Figures 1-4 display the internal relative transition trajectories for each of the four convergence clubs in each district.

Figure 1: Relative convergence within Club 1 (Health Index)

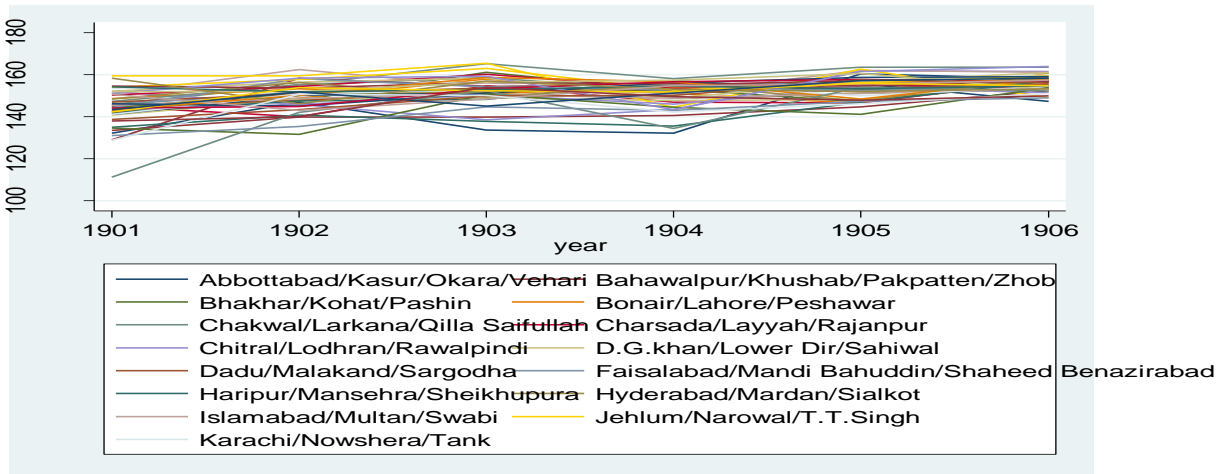


Figure 2: Relative convergence within Club 2 (Health Index)

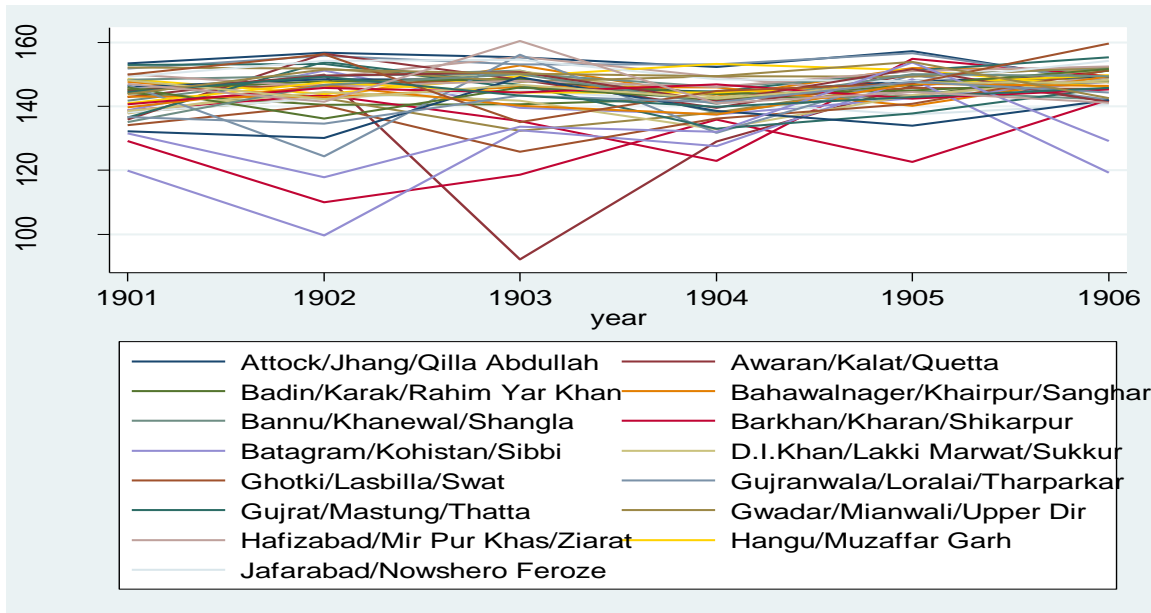


Figure 3: Relative convergence within Club 3 (Health Index)

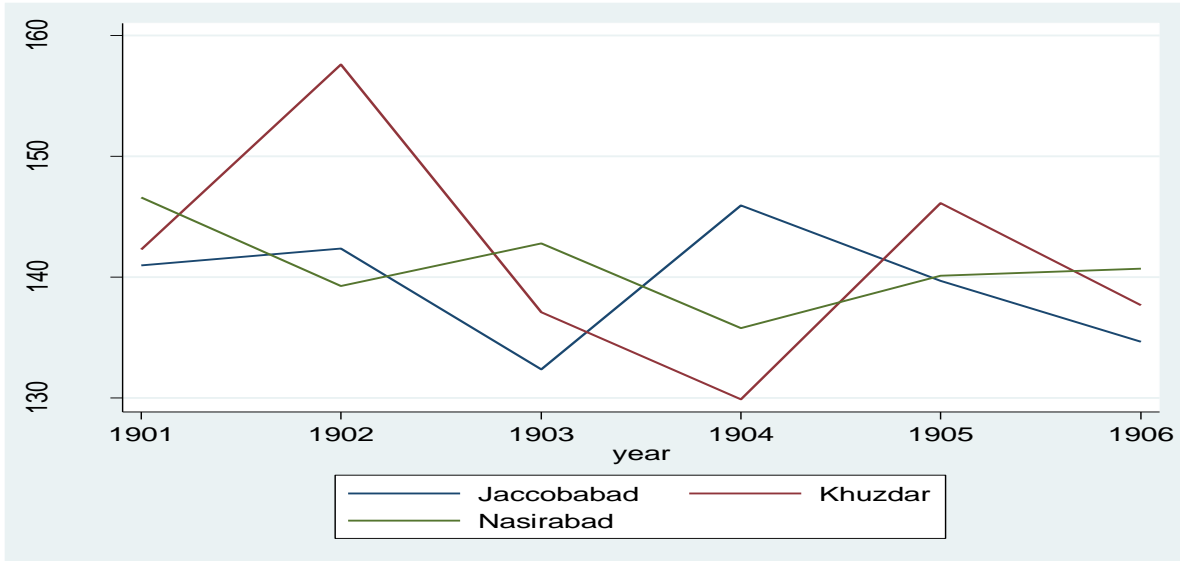
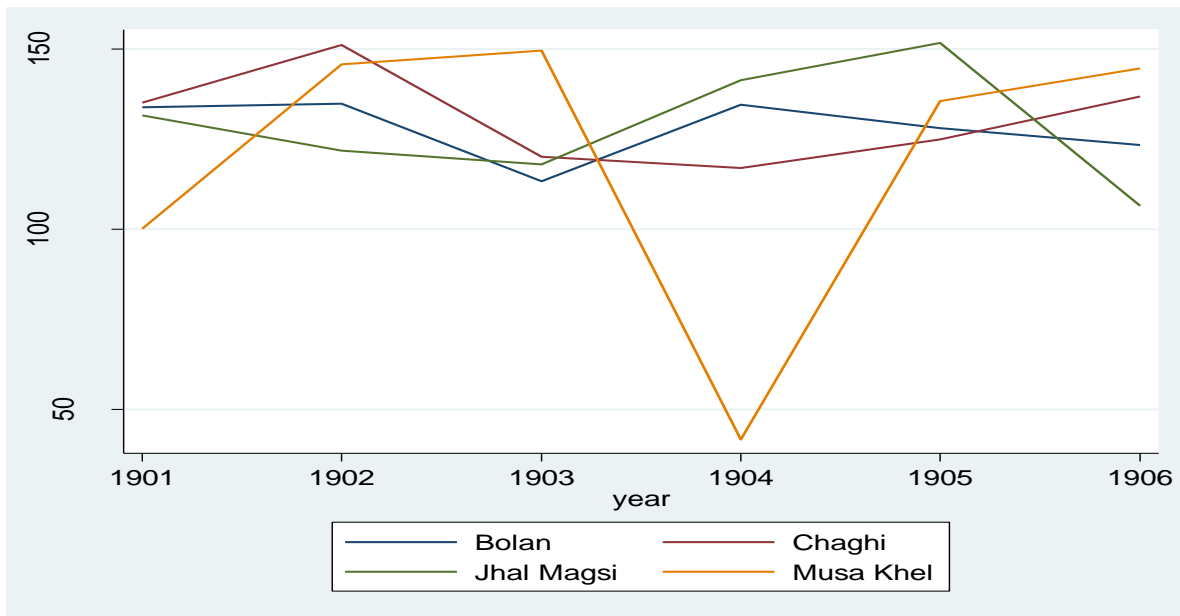


Figure 4: Relative convergence within Club 4 (Health Index)



The relative transition pathways for each of the four convergence clubs are depicted in the four figures above. Districts in Club 1 have better overall health than districts in other clubs. On the other hand, convergence is proceeding faster among the members of Club 3 compared to the other clubs, this is indicated by the larger coefficient estimate and demonstrated by the curve. The data unequivocally demonstrate that there is a lack of convergence across districts in Pakistan in terms of the health index, as the districts are categorized into four distinct convergence groups. The districts with same level of health indicators are classified within the same group.

5. Conclusions

The concept of the convergence club has played a pivotal role in fostering economic growth and development during the past thirty years. A new category of models, which encompass theories of endogenous growth (Romer, 1986; Lucas, 1988 & Howit, 1998), institutional theory (Lundvall, 1992; Nelson, 1993), and the new economic geography, emerged due to the inadequacy of Solow's (1955) model in explaining consistent growth (Krugman, 1991; Venables, 1999). These notions align with Myrdal's core assertion that expansion is a progressive spatial process that exacerbates inequalities. One category of growth theories (Azariadis & Drazen, 1990; Barro & Sala-I- Martin ,1992; Chatterji,1992; Durlauf & Johnson,1995; Quah,1996; Azariadis, 1996; Galor,1996) explains how varying starting

conditions can result in distinct stable states in economies that have similar structural features (such as preferences, production technology, government policies, etc.). When the initial conditions of a group of similar economies are also similar, a shared balanced growth trajectory is projected. Therefore, it is claimed that countries with economies that are approaching a similar stable state equilibrium are considered members of the convergence club (Galor, 1996). The research specifically looked at the health index as it studied the formation of a convergence club among Pakistan's districts between 2004 and 2020. The study uses more thorough health indicators to analyze the convergence club theory rather than more conventional metrics like per capita GDP. By utilizing five indicators, the augmented health index is produced. Combining the indicators is done using weights that come from Principal Component Analysis (PCA). Using the techniques developed by Phillips and Sul, convergence clubs are analyzed. The results showed indications of club convergence in the health sector across Pakistani districts, notwithstanding the absence of general convergence. Four convergence clubs were identified as a result of the research. The existence of four convergence clubs suggests that Pakistani districts' health outcomes are not dispersed equally. As a result, initiatives that can reduce regional differences in the level of living among Pakistani households in different districts must be developed.

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Appendices

Appendix 1: List of indicators of Health index

S.No	Indicators of Health index
1	Children affected by diarrhea in last 30 days (Aged under 5)
2	Treatment of diarrhea in children (Aged under (Aged under 5)
3	Children who have received vaccinations (Treatment of childhood diarrhea (aged 12-23)
4	Health Consultation (Total number of patients treated as a percentage of all patients sickened over the past two weeks)
5	Pre-natal consultations

Data Limitations

Data from four Pakistani provinces and 116 districts are included in PSLM surveys. Due to missing observations, 20 districts are dropped from the data for this study. The detail of the dropped districts is given in Table 2.

Appendix 2: List of districts dropped from data due to missing observation

	Provinces			
	Punjab	Sindh	KP	Balochistan
Districts	Nankana Sahib, Chiniot	Sujawal, Umerkot, Allah Yar, Muhammad Khan, Jamshoro, Matiari	Shahdadkot, Tando, Kashmore,	Tor-Ghar, Washuk, Nushki, Sheerani, Ketch, Panjgur, harnai, Kohlu, Dera-Bugti