

**CLUB CONVERGENCE IN THE MEMBER COUNTRIES OF
ORGANIZATION OF ISLAMIC COOPERATION**

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ABSTRACT

CLUB CONVERGENCE IN THE MEMBER COUNTRIES OF ORGANIZATION OF ISLAMIC COOPERATION

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This study aims to find the convergence club among the fifty-seven members of the Organization of Islamic organization using the log t-test methodology developed by Phillips and Sul (2007). The GDP Per capita of years between 1990-2017 is used to find convergence clubs. The results show the existence of a two-convergence club and one divergent country. Moreover, the conclusion drawn from this study shows that the number of convergence clubs changes over time. For example, the number of clubs dropped from six clubs in 2007 to four clubs in 2008. And the number of convergence clubs dropped again in 2011 from four clubs to two clubs. Even though having fewer clubs within an organization might be a good sign, but in this case, it shows that the number of countries with high GDP, merged towered club with low GDP, a negative convergence.

Keywords: Convergence, OIC, Club, Beta, t-log test

ÖZ

İSLAM İŞBİRLİĞİ TEŞKİLATI'NA ÜYE ÜLKELERDE İKTİSADİ YAKINSAMA KULÜPLERİ

Hamad Mohammed Alshamsi.

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Bu çalışmanın amacı İslam İşbirliği Teşkilatı'na üye elli yedi ülkenin iktisadi kulüp yansımasını Phillips ve Sul (2007).tarafından geliştirilern log t metodolojisi ile sınıamaktır. Çalışmada 1990-2017 yılları arasındaki kişi başına düşen milli gelir kullanmaktadır. Sonuçlar iki adet yakınyasan kulüp ile bir adet uyuşmayan ülkenin varlığına işaret etmektedir. Ayrıca yakınyasan kulüp sayısının zamanla azaldığı görülmektedir. Örneğin 2008'deki altı kulüp sayısı 2007'de dörde inmekte; 2011'de ise ikiye düşmektedir. Herne kadar bir organizasyondaki kulüp sayısının azalması iyi bir işaret olarak gözükse de üst gelir grubundaki ülkelerin daha aşağıdakilerle birleşiyor olması onların da gelirlerinin düşmesine işaret etmektedir.

Anahtar kelimeler: iktisadi yakınsama, Kulüp yakınsaması, İslam İşbirliği Örgütü, log t test.

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LIST OF ABBREVIATIONS

EU	European Union
GCC	Gulf Cooperation Council
GDP	Gross domestic product
NAFTA	North American Free Trade Agreement
NUTS	Nomenclature of Territorial Units for Statistics
NLS	Nonlinear Least Squares
PS	Phillips and Sul
OIC	Organization of Islamic Cooperation
SESRIC	Statistical, Economic and Social Research and Training Centre for Islamic Countries
OLS	Ordinary least square



1. INTRODUCTION

Economic cooperation at the regional and sub-regional levels has been an essential feature of the economic development policies of developing countries. The Organization of Islamic Cooperation (OIC) was established in 1969 to promote economic cooperation and integration among its members. The Organization of Islamic Cooperation, with its fifty-seven members, has become the second most prominent organization in the world, right after the United Nations. Its territory has spread over four continents, and it shares a massive part of the world's resources.

More than 75% of OIC members are geographically connected, and it has shared many fundamentals in common for example, culture and religion, while 60% of its population speaks the same language (Arabic). The members of OIC realize the importance of economic integration and convergence for its stability. Therefore, it states in its charter that promoting **“cooperation among the Member States to achieve sustained socio-economic development for effective integration in the global economy, in conformity with the principles of partnership and equality”** as a reason for its establishment.

In this study, I examined the convergence pattern across 57 Countries members of OIC by calculating Beta convergence (β) using linearized OLS regression model. Then identify convergence clubs members using beta convergence (Log t-test methodology) developed by Phillips and Sul (2007). This study is the first in its field (club convergence) that cover Countries member of OIC. The result of this study shows the existence of weak obsolete convergence plus across OIC members. Moreover, the study shows the existence of two convergence clubs and one divergent country. Moreover, it shows the changes in club numbers over time, which would help to analyze the reasons behind falling or raising club numbers.

This study can be used for further study in the field of convergence. Such as a study that focuses on analyzing the reasons behind the changes in club numbers, and what makes a country move from one club to another, moreover, comparison with the convergence of developed country will help identify where OIC members stand



2. LITERATURE REVIEW

Empirical studies show that some economies grow faster than others. Economists have conducted many studies and research and came up with theories and models to understand the logic behind this fact. One of those economists is Robert Solow, the Nobel prize winner in 1987 who developed a model named after him, the Solow Neoclassical Growth Model, which states that the “Growth in which there are diminishing returns to each factor of production but constant return in scale” (Todaro, Smith, 2015). Later, the law of diminishing returns in the Solow Model opened the discussion over the equilibrium point which an economy tends to approach, and that is called convergence. A theory of convergence which states that each economy has its unique point of equilibrium is called unconditional equilibrium or (absolute equilibrium).

On the other hand, another theory of convergence states that there is one point of equilibrium every economy tends to approach, and that is called conditional convergence. The notion of club convergence is related somehow to conditional convergence which states that there is more than one point of equilibrium, multi-equilibrium, and economies that share some characters would converge to this point (Nazrul Islam, 2018).

The most recent and obvious examples of converged economies are those of the East Asian tigers (Taiwan, Hong Kong, Singapore, and Taiwan). Those economies with their social capabilities benefited from the diminishing return rule and converged rapidly with the developed countries.

Another example of a converged economy is Japan. As a result of World War II, Japan suffered severely economically. However, its GDP was much higher than the GDP growth rate of the United States of America in the same year, (12.04%, and 2.3%

respectively), the growth rate of Japan remained higher than that of the USA for almost ten years (although it decreased over time; see Chart 1).



Figure 2.2: Japan Growth Rate (Blue) vs. USA Growth Rate (Green)

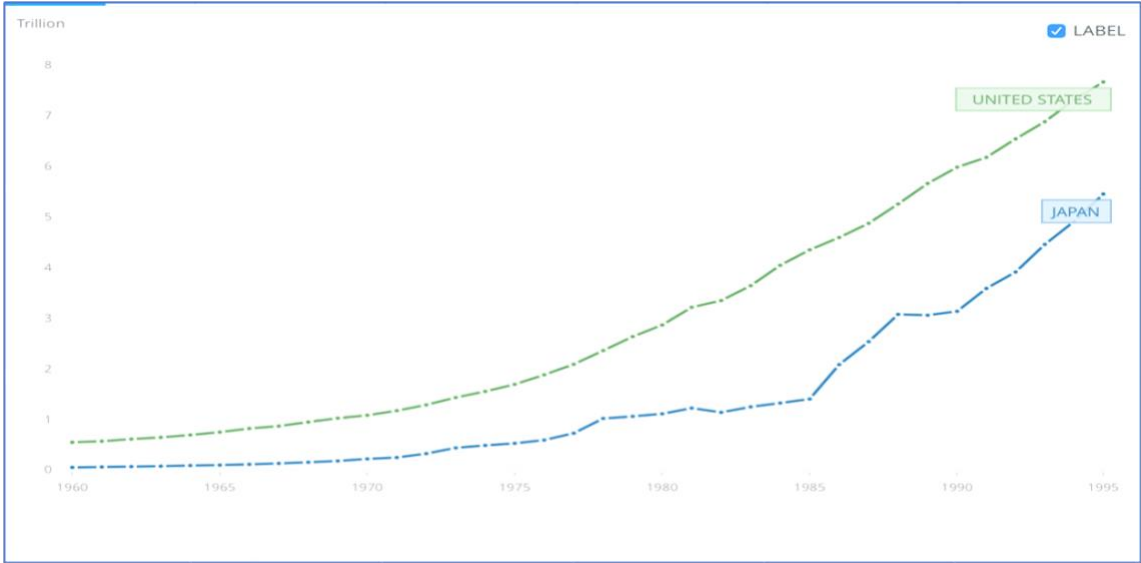


Figure 2.1: Japan GDP Per Capita (Blue) vs. USA GDP Per Capita

This is one of the most obvious examples of the Diminishing Return law that Robert Solow, the 1987 Nobel Prize winner, explained in his model, the Solow Neoclassical Growth Model (Todaro, Smith). The model states that "Growth in which there are diminishing returns to each factor of production but constant return in scale. The model demonstrates the factors of the production function. The effects of capital and labor diminish as they increase until they reach a point where adding either of these factors no longer affects the growth rate. This is called the steady-state point, and this is what happened in the case of Japan and the USA. After World War II, Japan started almost from scratch. Japan's GDP per capita in 1960 was only (478.55 USD), while the USA has already grown, and its GDP per capita in 1960 was much higher (3,007.12 USD). Adding any amount of capital in Japan will induce a high growth rate while adding the same money in the USA will return growth at a lower price. Thus, the gap between the American and Japanese economies kept shrinking and converging (Figure2). This is the basic idea of the Solow Model.

France and Germany also experienced convergence in the early 1950s as a result of the world war II aftermath. Because of the diminishing return law of the Solow Model, poorer countries would develop faster than richer countries and would theoretically lead their economies to converge sometime in the future. However, this is not always the reality due to a lack of social capabilities that affect production functions such as the education level of labor, ideas, and technologies that keep the growth moving (Abramovitez, 1986).

People believe in the importance of convergence for the stability of the world; therefore, they created organizations to help integrate different economies that would eventually foster convergence. The EU, OIC, and GCC are examples of such organizations. The importance of such an organization is that they benefit from the shared resources and lead to a convergence

Economies that share a geographical region such as Latin American countries or are part of one organization such as OIC or EU would create some form of economic sharing principle to integrate the recourses and eventually converge toward a steady-state point, or at least lower the number equilibrium points within the organization. Researchers believe that convergence would facilitate the stability of the region or the organization.



3. PREVIOUS WORK ON CLUB CONVERGENCE

Many empirical studies have been conducted to determine convergence clubs' cross regions, as well as convergence club cross districts within a single country or even within multiple countries. One of which is a study that has investigated convergence in income per capita of 329 districts in China from 1990 to 2014 (Zhang, Xu, & Wang, 2019). The research result shows no absolute convergence in the area, but there are four convergence clubs. The highest income club and the lowest income club tended to converge strongly, whereas the two middle-income clubs converged weakly. Another study was conducted to investigate the club convergence in income per capita of 194 European NUTS 2 regions (Lyncker & Thoennesen, 2017). The study results indicated the presence of four convergence clubs in the EU-15 countries. In support of the club convergence hypothesis, the study found that initial conditions matter for the resulting income distribution.

Moreover, Barrios, Flores, and Martinize (2018) conducted an empirical study on 17 Latin American countries to identify whether there is absolute convergence in terms of GDP per capita among the countries or there are multi-equilibrium points. It also set out to determine which countries would form a convergence club. The study showed that there are four convergence clubs cross Latin American countries with two countries being divergent. (Martin and Vazquez 2015) had done another research on the same region (Latin America) to assess the convergence in per capita income of a group of 18 Latin American countries over the period 1950–2008. They used a novel regression-based convergence test proposed by Phillips, P. C. B. and D. Sul (2007).

On the other hand, some studies on Latin America examined deferent decades between 1960–1990 show an absolute convergence for the entire region as a whole (Dobson and Ramlogan, 2002). Convergence is not always the case; a study by Holmes (2005) shows no convergence at all in the Latin American region.

Authors	Region(Unit)	Time Span	Methodology	NO of Clubs
Barrios, Flores, and Martinize (2018)	Latin America (countries)	17 (1990-2014)	Philips and Sul (2007)	4 (2 divergent)
Monfort, Cuestas, and Ordonez(2013)	Europe (countries)	23 (1980-2009) for Western Countries. (1990-2009) for Eastern Countries.	Philips and Sul (2007)	4
Zhang, Xu, & Wang, 2019	China (District)	329 (1990 to 2014)	Philips and Sul (2007)	4
Lyncker & Thoennesen, 2017	Europe (NUTS 2)	194 (1980-2011)	Philips and Sul (2007)	4 (1 divergent)
Siano and D’Uva (2006)	Europe (NUTS 2)	123 (1981-2000)	Breiman (1984)	4

Table 3.1: Convergence Previous Work

Table 3.1 above summarized the results of some studies conducted on convergence clubs cross both countries as we well as districts. The first two studies in the table were conducted based on the District level, the first one on china 329 districts and resulted in 4 clubs, the second one European NUTS2, 4 clubs were produced with one divergent country.

4. ORGANIZATION OF ISLAMIC COOPERATION

The Organization of Islamic Cooperation (OIC) consists of 57 countries, which are 29% of the 195 members of the United Nations members with different governance systems. OIC members vary in wealth including states that are amongst the world's wealthiest countries as measured by their 2017 GDP per capita like Qatar, the UAE, and Saudi Arabia (\$63,505, \$40,609, and \$20,760, respectively); at the same time, however, there are members amongst the poorest countries in the world like Somalia, Yemen, and Afghanistan with GDP per capita of \$104, \$989, and \$618, respectively.

The OIC countries' area size is almost 31.8 million km², which is equal to 21% of the world's size (148.9 million km² total countries' size). As such, environmental and climate diversity is one of its main characteristics due to its enormous size. More than 85% of all OIC members are geographically connected in the middle of the world, as shown in Figure 1, and its members are spread over four continents as follows: 27 of its members are in Asia and are spread in the south, central, north, and east of the continent which include (Malaysia - Indonesia - Brunei - Maldives - Pakistan - Afghanistan - Bangladesh - Iran - Turkey - Saudi Arabia - Bahrain - Kuwait - Iraq - Syria - Lebanon - Jordan - Palestine - Yemen - Uzbekistan - Kazakhstan - Tajikistan - Kyrgyzstan. Qatar – Oman-UAE -Turkmenistan – Azerbaijan)

Twenty-eight of its members in Africa: (Egypt - Sudan - Libya - Tunisia - Algeria - Morocco - Mauritania - Somalia - Djibouti - Comoros - Uganda – COTE D'IVOIRE - Gambia-Guyana-Senegal-Togo - Burkina Faso - Benin - Sierra Leone - Chad - Guinea - Guinea Bissau - Cameroon - Mozambique - Nigeria -Niger-Mali – Gabon). One member of OIC is in Europe (Albania) and another in South America (Suriname).

In terms of population, 24% percent of the world's population lives in OIC territories, (the OIC population is 1.8 billion, and the world population is 7.5 billion) of which the working-age (between 15 and 64 years) includes 712 million people.

Due to its enormous size and its widespread nature, the OIC Union has the advantage of possessing various natural resources, which is the main factor for its economic development. Some of these resources include agricultural resources, as the area of the OIC countries is 31 million square kilometers and 14% of it is cultivated and distributed among the lands of permanent crops (2.95%) with 11.14% for other plants. Moreover, OIC shares 35% of the world's petroleum, 29% of phosphate, 35% of tin 35%, 12% of manganese, and 2.2% of the world's iron.

We can measure the economic performance of OIC by calculating the GDP per capita for the OIC population. The GDP per capita of OIC members combined in 2017 is \$3,670 below the world average GDP per capita (\$17,300).

OIC countries are distinguished from other countries in several points: (a) The vast majority of the peoples of these countries share one religion, one language, customs, and traditions, as well as common destiny. (B) The close geographical location of its member states 85% of its member states are geographically connected, ensures the cooperation and integration of all-natural and human resources in their markets with ease and speed, ideally for the availability of transport. C) Human and natural resources are distributed in varying proportions between their members. The surplus in one is rear in the other and with a form of economic integration such as common market, they would complement each other thus achieving economic convergence.

However, unfortunately, OIC Members failed to establish a common market between its members to reach is economic integration, and that is due to different reasons we will discuss in the upcoming chapters

A. FORMS OF ECONOMIC INTEGRATION

Since the fifties as a result of the division of the world between the capitalist camp and the socialist camp, the debate is about the importance of collective blocs alternative to the bilateral agreements that link international relations. Therefore, thinkers in the field of economics consider the feasibility of applying economic integration between countries. Economic integration is the process that would lead to economic unity, which would result in default economic convergence. According to (Katarzyna Śledziowska), economic integration goes through four stages, as follows:

- A) **Free Trade Area:** This means the abolition of customs duties on goods and services that are transferred between the countries participating in the Free Trade Zone Agreement, with each country maintaining its customs tariff vis-à-vis non-member countries. One of the most popular free trade agreement examples is NAFTA, which is an agreement between North American Countries (Canada, the USA, and Mexico) that was established in 1994.

- B) **Customs Union:** The free exchange of goods shall be agreed upon between the countries of the Customs Union without customs restrictions such as those in the previous phase, and the addition of the application of a unified customs tariff in the transactions with other countries in the world. An example of a Customs Union agreement is the European Union-Turkey Customs Union that came into effect on 31 Dec. 1995, which helped Turkey increase its exports and imports, and, as a result, it had an impact on Turkey's GDP.

- C) **The Common Market:** An increase in the duties of the Customs Union on the free movement of goods and the elimination of customs barriers shall be agreed upon for products, capital, services, and labor – the “four freedoms.” The European Market is an example of Common market within the European Union (EU): “The market

encompasses the EU's 28-member state, and has been extended, with exceptions, to Iceland, Norway, and Liechtenstein through the agreement on the European Economic Area and to Switzerland through bilateral treaties."

- D) **The Economic Union:** In addition to what has been achieved in the Common Market, the treaty shall coordinate economic, financial, and monetary policies and the related procedures and systems among the Member States to eliminate any disparity arising among them. GCC is one example of a market union.

The basic reason behind the need for economic integration is that the world is divided into states and countries that are limited in terms of resources. Hence, economic integration would help share goods, services, and funds for the benefit of all and achieve a shared market and economic development. Before the introduction of economic integration, the world witnessed competition between countries in the form of war and colonization to seize the resources of other countries and to create markets. Examples of colonization for the sake of grabbing resources are the British colonization of East India and Hong Kong and the establishment of the British East India Company in 1600. Other methods of bad competition between countries are tariff restrictions and economic policies that limit the number of goods to be imported or exported. Hence, the economic war between the USA and China to restrict the flow of foreign goods to protect national industries either will cause the two sides to lose eventually or will cause one to benefit at the expense of the other, which would lead to more divergence. As a result, economic integration between groups of countries is essential, and that integration should be based on A) Removing barriers between the groups for the goods and services to flow between them. B) Constructing a relation based on cooperation that would benefit both parties.

For years we have been hearing about the common Islamic market, especially as the world is moving towards establishing small and large economic multinationals in

Europe, America, and Asia. Countries that stand alone in the international community have noticed their weakness in the face of economic problems that are increasing with time. Therefore, economists in OIC began holding conferences and seminars and writing research and articles to discuss the possibility of establishing a common Islamic market among its countries. In Dhaka, the Islamic Research Center organized a conference in cooperation with the Islamic Development Bank, Al Baraka Bank of Bangladesh and opened by the Minister of Finance of Bangladesh, who stressed the importance of establishing a market that achieves cooperation among the countries of the Islamic world.

The benefits of the Islamic Common Market include: (a) Approaching self-sufficiency and reducing dependence on the outside world in importing the necessary commodities for the local market in, food, medicine, and industrial light and heavy, especially in the field of security and military defense. B) To benefit from the productivity of the participating countries and thus to establish specialized industries among the member countries, which lead to improving the quality and quantity of production, and providing it with the best specifications in the markets. C) Support the positions of OIC members in the face of international competition in the field of international trade to be able to prove their presence in the international arena. D) Expanding the fields of production and multiplying its ways to meet the needs of the market in the member countries and creating job opportunities for Arab and Muslim youth

However, OIC after years of establishment could not reach to a point to enjoy the benefits of the common market because Initiatives of OIC in the field of economic cooperation often come in the form of reaction to events taking place in other parts of the world without considering the differences in economic and social conditions. In this context, the Common Islamic market initiative simulated similar measures that were underway among the European countries. When these countries planned to

establish the European Common Market, the Islamic countries were concerned about it sought to establish a similar arrangement among them, However, the difference between the expected results of the European market and the expected results of the common Islamic market is significant, because the nature of the economies of Islamic countries compared to European countries and the volume of intra-trade



5. CONVERGENCE ACROSS ORGANIZATION OF ISLAMIC COOPERATION'S MEMBERS

GDP per capita data for the 57-member states of the OIC for the period from 1990-2017 were employed. GDP per capita from 1990-2017 is calculated by dividing GDP in USD dollars in constant prices of each country by its respective working-age population. We collect the data from a subsidiary organ of the OIC, namely the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC).

Beta convergence (β) can be calculated either by using linearized OLS regression or nonlinear least squares (NLS) technique. Convergence exists if the value of beta coefficient is negative ($\beta < 0$) when OLS regression or beta Coefficient if value is positive ($\beta > 0$) if NLS model is used then there is beta convergence and it is possible to calculate the speed of convergence, λ , and the so-called Half-Life H, (Allington/McCombie 2007) (Goecke/Huether 2016).

We used R-Studio (**See Appendix C For Codes Used**) to calculate the Beta Coefficient and the beta Speed. Table 5.1 summarized the result.

	Estimate	Std. Error	t value
Beta (β)	-5.007038e-03 (-0.005007038)	0.001924367	-2.601914
Alpha	1.201780e-02	0.003861697	3.112052
R-Squared	0.1095995		
Beta Speed	1.859117e-04		
Convergence(λ)	(0.0001859117)		
Half-Life H	3.728368e+03 (3728.368)		

Table 5.1 Beta Coefficient and Beta Speed Convergence

The result in table 5.1 shows the existence of beta convergence across members of the organization of Islamic cooperation. However, it is weak convergence, beta is negative 0.005, and half-life (h) is 3728.36 which means it takes 3728 years to reduce the productivity gap by one half.

Figure 5.1 below shows this relationship as a scatter plot of the average annual growth rate of real per capita GDP between 1990 and 2017 in the Y-axis against the log of real per capita GDP in 1990 in Y-Axis. The Organization of Islamic cooperation members showed a tendency to converge at a speed of 0.69% per annum. This is a weak convergence as the semi-horizontal slop shows in Figure 5.1. in other words, this suggests that even though poorer economies inclined to grow faster than richer economies as the case of Sudan, Nigeria and Mali, they hardly able to catch up and converged with rich economies like Saudi Arabia, The UAE, and Qatar. this is most likely due to lack of education, transfer of technology, inability to, attract capital and difficulties to participate in the global market that helps poor economy converge with high GDP per capita economies.

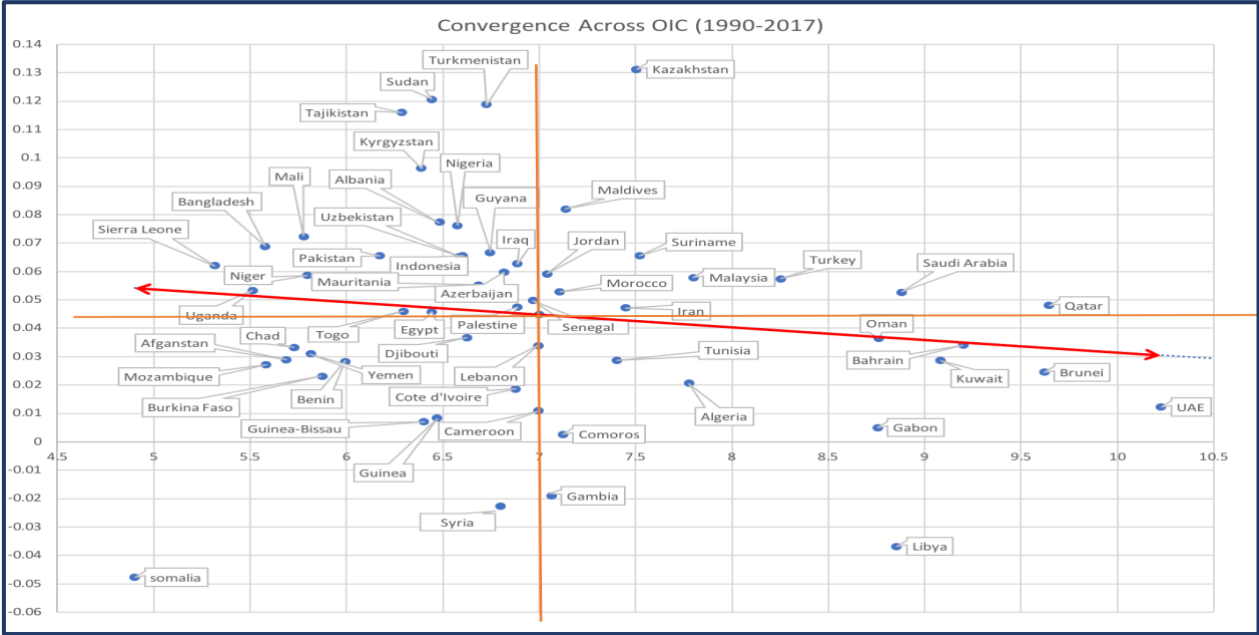


Figure 5.1 Convergence Across OIC Countries. 1990-2017

The right top quadrant (Q1) represents the outperformed economies. The average growth rates of 10 OIC economies in this quadrant were above the average of OIC countries. The top performers in the outperformed economies quadrant were Kazakhstan, Maldives, Suriname, Jordan, Malaysia, Turkey, Morocco, Saudi Arabia, Qatar, and Iran with an average growth rate of over 6.5% from 1990 to 2017.

The left top quadrant (Q2) denotes the catch-up economies. These 22 OIC countries were observed to converge to higher-income OIC countries through higher growth rates during the 1990-2017 period. The top performers in the catch-up economies quadrant were Sudan, Turkmenistan, Kyrgyzstan, and Albania with an average growth rate of over 7.04 % in this period.

The left bottom quadrant (Q3) displays 14 OIC economies whose real per capita GDP diverged from the OIC average. Most of these 14 OIC countries in this quadrant suffer from wars such as Yemen, Syria, and Afghanistan at an average growth rate of 1.55%

The right bottom quadrant(Q4) includes 11 OIC economies (mostly high-income) whose growth rates were lower than the OIC average as expected according to the diminishing law of return.

Quadrant	Countries	Average Growth Rate	AVERAGE LOG (1990)
(Q1) The right top quadrant	KAZ, MDV, SUR, JOR, MYS, TUR, MAR, SAU, QAT, IRN	6.5%	7.83
(Q2) The left top quadrant	SDN, TKM, TJK, KGZ, ALB, NGA, MLI, BGD, GUY, PAK, IDN, UZB, IRQ, SLE, AZE, NER, MRT, UGA, SEN, PSE, TGO, EGY	7.04%	6,36
(Q3) The Left bottom quadrant	DJI, LBN, TCD, YEM, AFG BEN, MOZ BFA CIV, COM, GIN, GNB, SYR, SOM	1.55%	6.2
(Q4) The right bottom quadrant	OMN, BHR, KWT, TUN, BRN, DZA, UAE, GAB, COM, GMB, LBY	1.25%	8.53

Table 5.2: Convergence Cross Member of OIC

6. CLUB CONVERGENCE ACROSS ORGANIZATION OF ISLAMIC COOPERATION

A. DATA AND METHODOLOGY

GDP per capita data for the 57-member states of the OIC were employed. GDP per capita form 1990-2017 is calculated by dividing GDP in USD dollars in constant prices of each country by its respective working-age population. We collect the data from a subsidiary organ of the OIC, namely the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC).

We apply the methodology of Phillips and Sul (2007, 2009) (henceforth PS) to test for convergence and the identification of convergence clubs. Specifically, consider a general framework in which X represents the variable of interest which is per capita GDP, with $i=1, \dots, N$ and $t=1, \dots, T$ representing cross-section and time dimension of the 57 countries over the period 1990-2017 in our study. This variable can be decomposed as $X_{it} = \delta_{it} \mu_t$, where μ_t is a single common component and δ_{it} is the time-varying idiosyncratic element which captures the deviation of city i between the common trend component μ_t and X_{it} . PS suggests testing for convergence by analyzing whether δ_{it} converges toward δ . To do so, they first define the relative transition component as:

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

In the presence of convergence, the h_{it} should converge towards unity, while its cross-sectional variation (H_t) should go to 0 when T moves toward infinity: that is:

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

PS test for convergence by estimating the following equation:

$$\log \frac{H_1}{H_t} - 2 \log[\log(t)] = \alpha + \beta \log(t) + u_t, \quad \text{with } t = [rT] + 1, \dots, T \quad (3)$$

Where r takes values around **1/3** of the sample. Based on the results of their Monte Carlo simulations, PS recommend $r=0.3$. We also used this setting. Eq.(3) is known as

log-t regression. The presence of convergence is tested utilizing a standard t-statistic and, according to PS, the null hypothesis of convergence is rejected at the 5% level if this t-statistic takes values lower than -1.65. The null hypothesis implies convergence for all regions or cities while the alternative hypothesis implies no convergence for some regions.

If convergence is rejected, we apply PS's four-step clustering algorithm to test for the existence of different convergence clubs. The purpose is to search for convergence across all combinations of countries until $N-k=1$, where k is the number of countries in convergence clubs. PS recommends performing club merging tests after running the algorithm. We briefly outline the respective algorithm for club convergence.

Step 1 (ordering): Order the members of the panel (countries in our case) according to the last observation.

Step 2 (core group formation): Calculate the convergence t-statistic, t_k , for sequential *log-t* regressions based on the k highest members (Step 1) with $2 \leq k \leq N$. The core group size is chosen based on the maximum of t_k with $t_k > 1.65$.

Step 3 (club membership): Select countries for membership in the core group (Step 2) by adding one at a time. Include the new country (member) if the associated t-statistic is greater than zero (conservative choice). Make sure that the club satisfies the criterion for convergence.

Step 4 (recursion and stopping): The countries not selected in the club formed in Step 3 form a complementary group. Run the *log t* regression for this set of provinces. If it converges, then these cities form a second club. If not, Steps 1–3 are repeated, to reveal some sub-convergent clusters. If no core group is found (Step 2), then these countries display divergent behavior.

We extract the trend components of the series by using the Hodrick and Prescott (1997) filter. Convergence club identification is realized through both R and Stata algorithms. **(See Appendix D for Codes Used to find the club members)**. The panel logarithmic GDP per capita of 57 counties was input data to identify the economic growth of convergence clubs.



B. EMPIRICAL RESULTS AND DISCUSSION

We present our empirical analysis by reporting the results when the log t-test is applied to real per capita GDP of the 57 countries and for real GDP per capita from the years 1990 to 2017. For the econometric analysis, all of these per capita GDP series are considered in logarithms. After removing their cyclical components using Hodrick's and Prescott's (1997) (HP) filter, as suggested by Philips and Sul Besidesn, we also discard the first third of the sample period. Qualitatively similar results are obtained when this trimming parameter is varied by taking on the values of 30%, 20%, and 15%.

Ordinary least squares' estimation of the log (t) regression yields an estimate of the slope coefficient equal to -4.62, with an associated HAC standard error of 2.77, and a t-statistic of (-1.67) (p-value =0.027). This statistic indicates that the slope coefficient is statistically different from zero and supports the view of real per capita GDP divergence across the 57 countries.

Further developing this initial result, we examine the possibility of conforming smaller clubs of convergence through the application of the clustering algorithm as outlined above. Table 6.1 presents both initial classification and merging analysis of convergence clubs.

	Countries	Beta coefficient	T value	Beta Speed Convergence (λ)	Half-Life H
Panel A: Club convergence tests		-4.617	-1.661*		
Club 1	UAE, KWT, BRN, BHR, SAU, TUR, KAZ, MYS, MDV, SUR, TKM, AZE, IRQ, ALB, UZB,	0.354	4.713	NA	NA
Club 2	GAB, LBN, IRN, DZA, TUN, OMN, IDN, GUY, MAR, JOR, EGY, NGA, BGD, MLI, TJK,	0.015	0.338	NA	NA
Club 3	PSE, DJI, LBY, COM, CIV, CMR, SDN, SYR, SEN, MRT, PAK, KGZ, TCD, BEN, GMB, GIN, BFA, AFG, TGO, UGA, GNB, YEM, MOZ, SLE, NER	0.332	3.486	NA	NA
divergent units	QAT, SOM				

Table 6.1: Club Convergence of GDP Per Capita in OIC Member Countries (2017)

	Countries	Beta coefficient	T value	Beta Speed Convergence (λ)	Half-Life H
Panel B: Club merging analysis					
Merging Club 1 and Club 2	UAE, KWT, BRN, BHR, SAU, TUR, KAZ, MYS, MDV, SUR, TKM, AZE, IRQ, ALB, UZB, GAB, LBN, IRN, DZA, TUN, OMN, IDN, GUY, MAR, JOR, EGY, NGA, BGD, MLI, TJK	-0.037	-0.785	1.396365e-03 (0.00139)	4.963938e+02 (496.3938)
Club 3	PSE, DJI, LBY, COM, CIV, CMR, SDN, SYR, SEN, MRTR, PAK, KGZ, TCD, BEN, GMB, GIN, BFA, AFG, TGO, UGA, GNB, YEM, MOZ, SLE, NER, SOM	-0.068	-1.005	2.608239e-03 (0.002608239)	2.657529e+02 (265.7529)
Divergent Units	QAT				

Table 6.2: Merged Club Convergence of GDP Per Capita in OIC Member Countries (2017)

Club 1 is formed by UAE, KWT, BRN, BHR, SAU, TUR, KAZ, MYS, MDV, SUR, TKM, AZE, IRQ, ALB, UZB, GAB, LBN, IRN, DZA, TUN, OMN, IDN, GUY, MAR, JOR, EGY, NGA, BGD, MLI, TJK. Club 1 Beta coefficient is -0.037 which results in Beta Speed Convergence (λ) of $1.396365e-03$ and Half-Life (h) of 496.4. The degree of convergence of this club is higher than that of club 2 ($t=-0.785$). Within club 1 MLI, TJK, BGD, and UZB show a clear growing trend toward the average of the club.

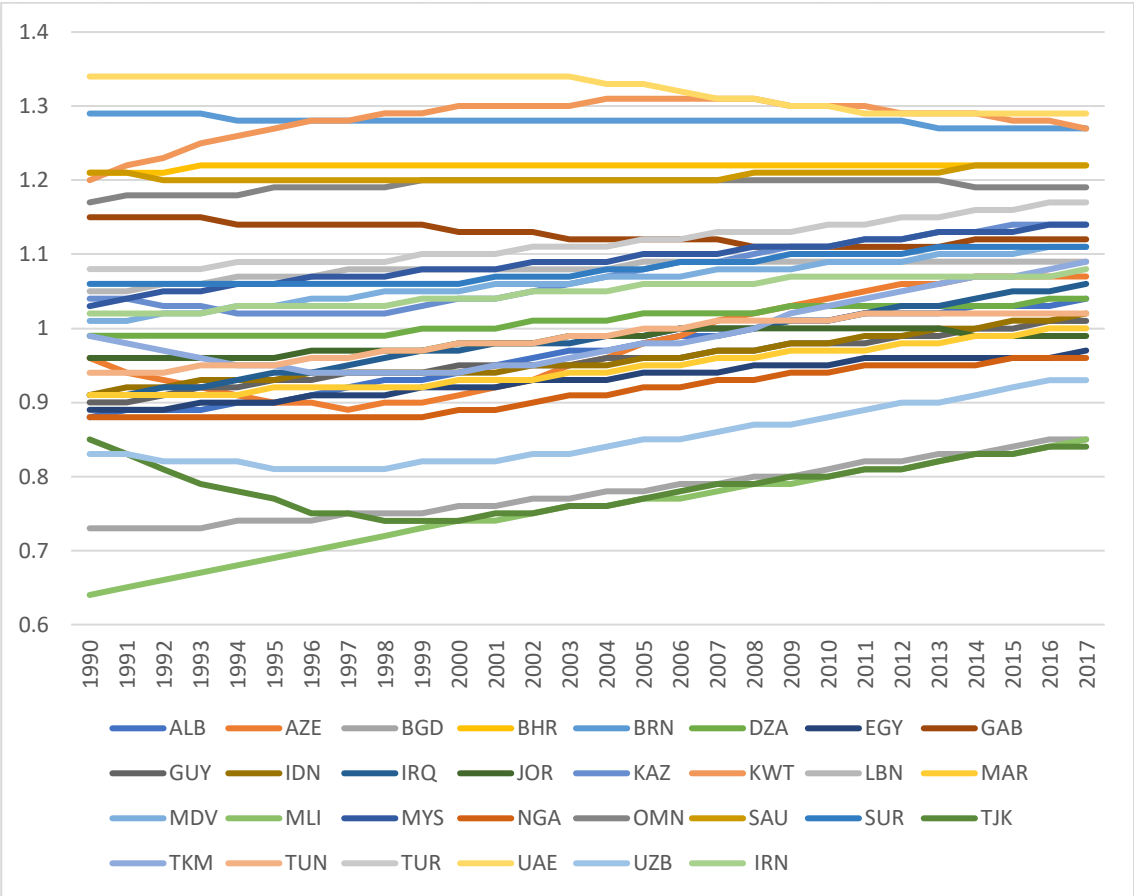


Figure 6.1: Relative Transition Paths for Club One

Club 2 is formed by PSE, DJI, LBY, COM, CIV, CMR, SDN, SYR, SEN, MRTR, PAK, KGZ, TCD, BEN, GMB, GIN, BFA, AFG, TGO, UGA, GNB, YEM, MOZ, SLE, NER, SOM. Club 2 Beta coefficient is -0.068 which results in Beta Speed Convergence (λ) of $2.608239e-03$ and Half-Life (h) of 265.7. This group presents a slower degree of convergence ($t=1.005$) comparing to group one. within club 2 MOZ and UGA, show a clear growing trend toward the average of the club while LBY remains constant until 2008 then starts to decline.

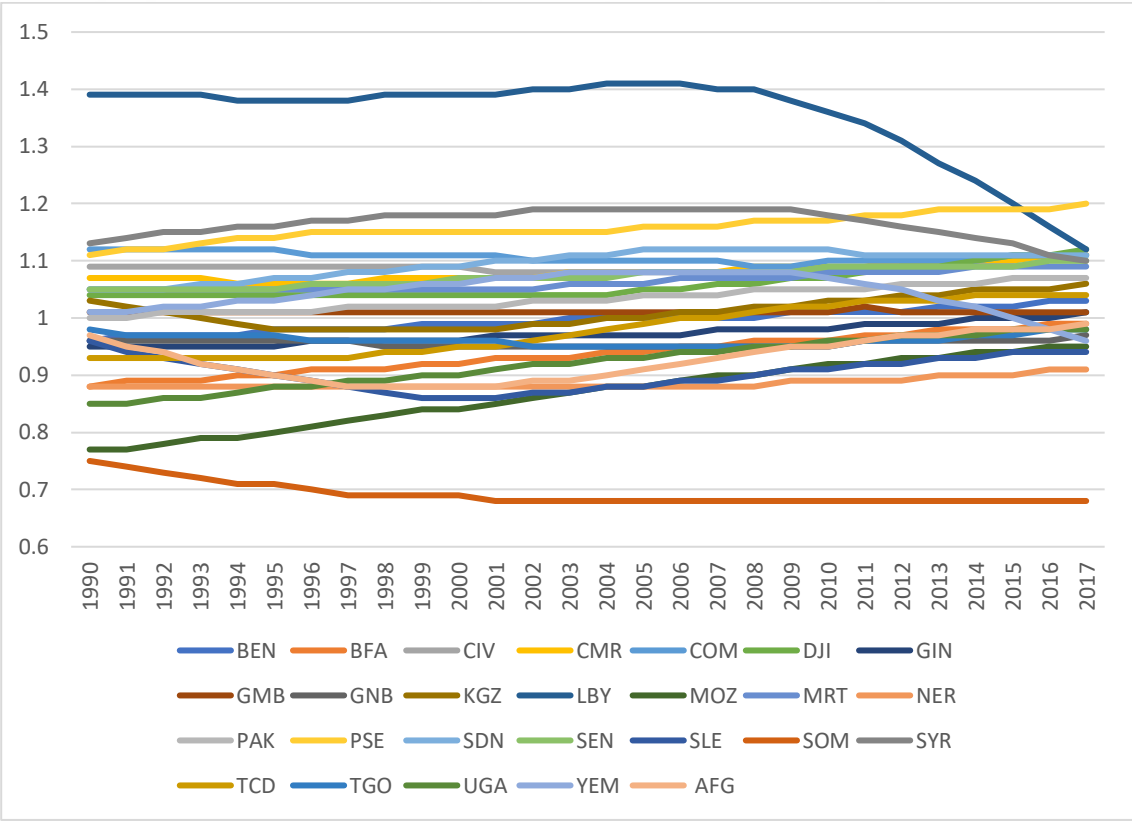


Figure 6.2: Relative Transition Path for Club Two

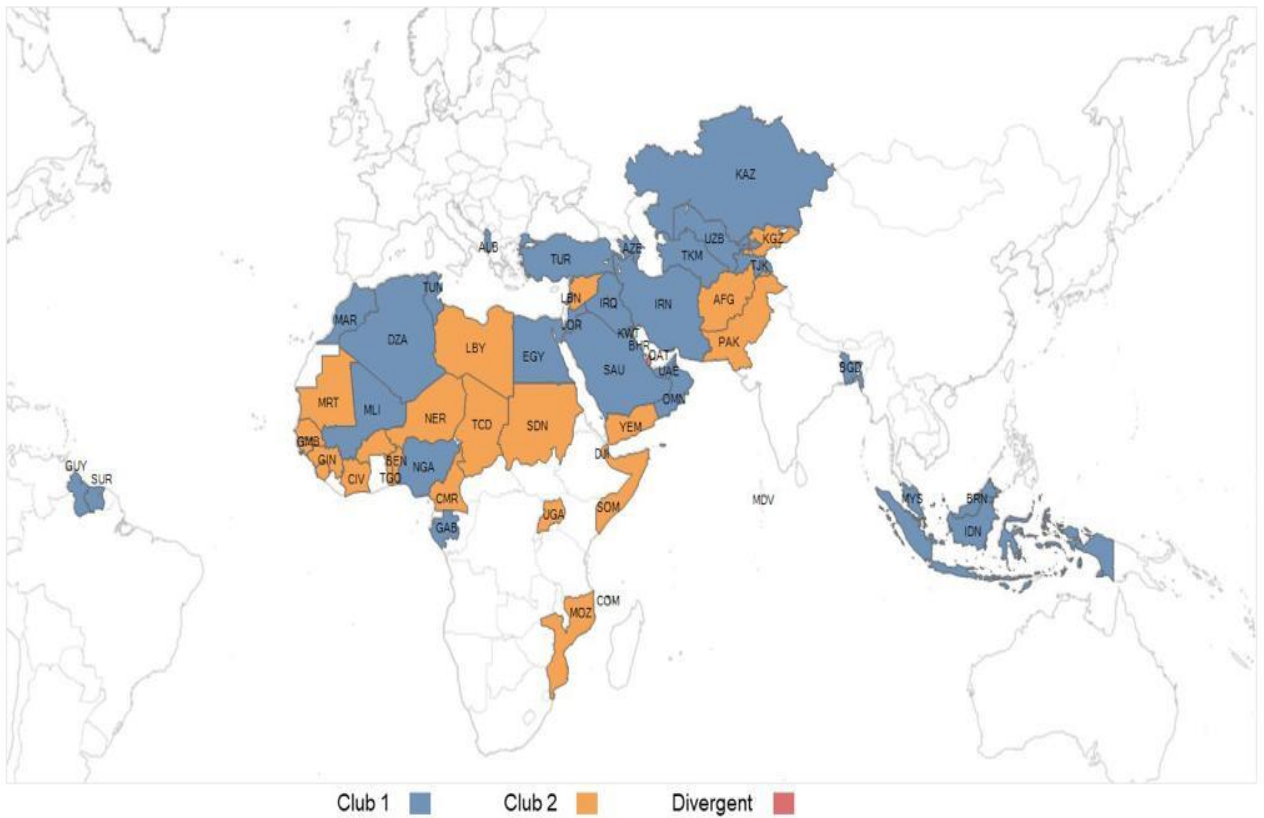


Figure 6.3 Map Shows the location of the club members

Figure 6.3 shows how the club members are spread over the map world. It is clear from the map that geographical location affects the club members. Almost 70% of club 1 (Blue) are connected. They spread from gulf countries (west of Asia) to Uzbekistan and Kazakhstan in the east of Asia. While club two members are concentrated in the middle of Africa.

C. RECURSIVE CLUB CONVERGENCE

Convergence tests would result in different convergence clubs and different numbers of divergent countries if the period sample is changed. E.g. if the sample ends in the year 2005, the number of clubs would be 8 and would result in 3 divergent countries. The number of clubs decreases dramatically from 6 clubs in 2008 to 4 clubs in 2009 which seems to be the result of the aftermath of Global Economic crises. This means that clubs from countries with a high GDP decrease to allow the middle-class club to merge with the high-class club. The number of clubs decreases again from 4 clubs in 2011 to 2 clubs in 2013 which might be the result of the aftermath of the Arab Spring that spread over Arabic Countries such as Syria, Tunis, Egypt, Libya, and Yemen. Having a low number of clubs is usually a good sign, however, in our case, the decreasing of the number of clubs was due to crises as mentioned earlier clubs with high GDP going toward middle-low GDP clubs. (see Figure 6.4)

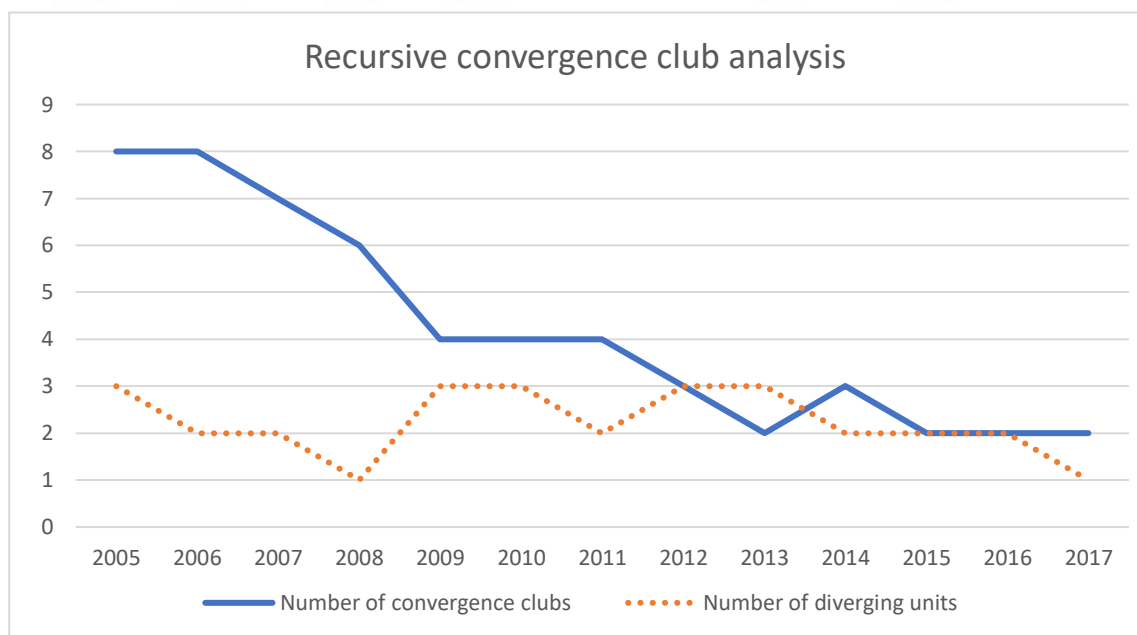


Figure 6.4: Recursive Club Convergence Analysis.

To better analyze the factors behind falling the number of the clubs, the club members as of 2008 and 2009 are identified and listed in Table 6.2 and Table 6.3

	Countries	Beta coefficient	T value
Club 1	UAE, KWT, BRN, AZE, BHR, SAU, OMN, KAZ, QAT	0.033	0.27
Club 2	TUR, LBY, GAB, MYS, SUR, LBN, MDV, IRN, ALB, DZA, TUN, TKM, IRQ, JOR	-0.083	-1.292
Club 3	IDN, GUY, MAR, SYR, NGA	0.469	2.314
Club 4	EGY, PSE, SDN	0.01	0.081
Club 5	COM, CMR, SEN, YEM, CIV, UZB, MRT, DJI, PAK, KGZ, TCD, BGD, TJK, MLI, UGA, MOZ, GMB, BEN, BFA	0.064	0.976
Club 6	GNB, TGO, AFG, GIN, SLE,	-0.013	-0.044
Divergent Units	NER, SOM		

Table 6.3 Club Convergence of GDP Per Capita in OIC Member Countries (2008)

Table 6.2 above shows the existence of 6 convergence clubs across the member of the Organization of Islamic cooperation as of 2008 with two divergent units. (The initial result was eight convergence clubs and three divergent units.).

	Countries	Beta coefficient	T value
Club 1	KWT, UAE, BRN, KAZ, AZE, BHR, SAU, OMN, TUR, ALB, LBY, GAB, MYS, SUR, LBN, MDV, IRN, DZA, TKM, TUN, IRQ	-0.088	-1.258
Club 2	IDN, GUY, MAR, SYR, NGA, JOR	0.207	1.733
Club 3	EGY, PSE, SDN, UZB, MLI, COM, CMR, SEN, CIV, YEM, MRT, DJI, PAK, KGZ, TCD, BGD, TJK, UGA, AFG, MOZ, GMB, BEN, BFA	-0.095	-1.453
Club 4	GNB, TGO, SLE, NER	0.138	0.822
Divergent Units	QAT, GIN, SOM		

Table 6.4 Club Convergence of GDP Per Capita in OIC Member Countries (2009)

Table 6.4 above shows the existence of 4 convergence clubs across members of the Organization of Islamic cooperation as of 2009 with two divergent units. (The initial result was six convergence clubs and three divergent units.)

From the tables above, we noticed that members of club one as of the year 2008 disappeared, eight of the nine members of the club merged with club two and one member (Qatar) diverged. To understand the reasons behind the disappearing of club one, we look into the GDP per capita of club one and two as of the year 2008 and 2009 and we found that GDP per capita of the member of club one declined dramatically. The members that merged with member of club two are Azerbaijan, Bahrain, Brunei, Kazakhstan, Kuwait, Oman Saudi Arabia, and the United Arab Emirates (their growth rate between 2008 and 2009 are -12.6%, -19.1%, -35.7%, -47.8%, -31.5%, -24.5%, and -38.3%, respectively) (See Appendix C).

While members of club two barely got affected, except in the case of turkey, Malaysia and Libya but these countries managed to remain in the same club. The nine members of club one mainly oil producers country and were affected directly and indirectly by 2008 economic crises which explain the reason behind the merge of club one club two. Even though convergence and merging of the club are usually a good sign and healthy for the stability and the equality of the people of the nation, but the incident in our hand is negative (high-income countries merged with Low-income countries, where we seek the other way around).

Figure 6.4 shows the average transition path for all clubs from 1990 to 2008, and figure6.5 shows the average transition path for all clubs from 1990 to 2009. Where the number of clubs declines from six clubs to four clubs.

We already know from previous findings that club one, which consists of high GDP per capita countries like Saudi Arabia, Bahrain, UAE, and Kuwait merged with club two in 2009. The path of club one in Figure 6.4 and 6.5 confirm the finding. Figure 6.4 shows the path of club one is going down towered club two. Figure 6.5 shows that both clubs(one and two) merged.

Moreover, the path of club four in 2008 is getting close to club three. Figure 6.5 shows that three and four merged in 2009.

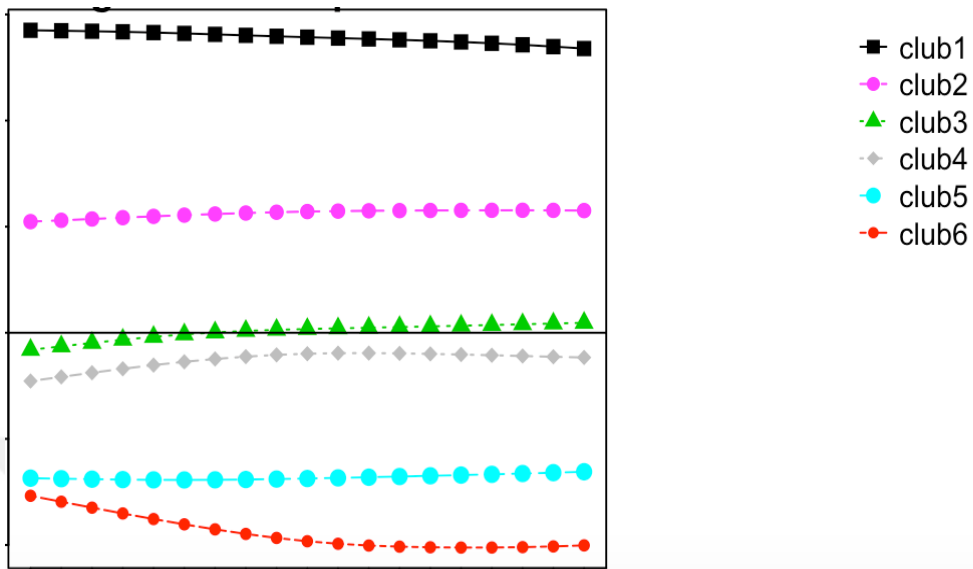


Figure 6.5 Average Transition Path for All clubs as of 2008

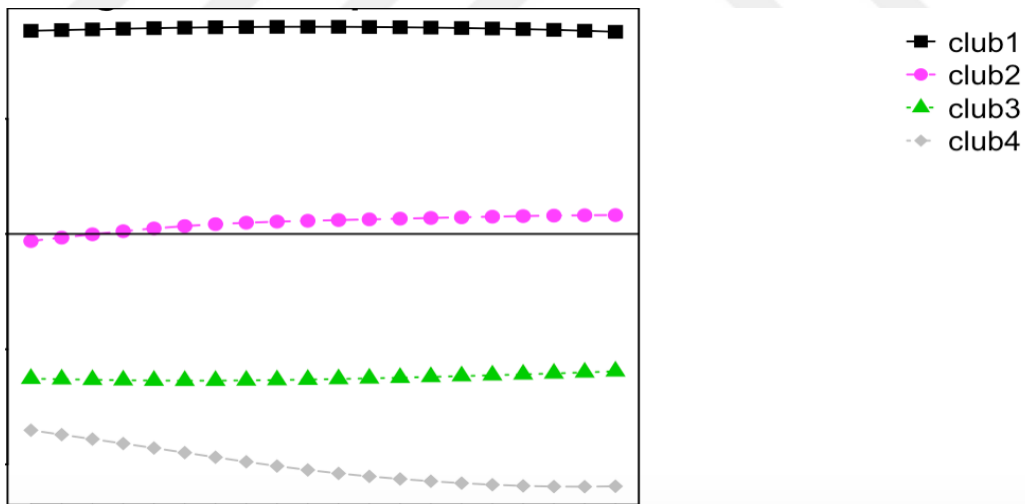


Figure 6.6: Average Transition Path for All clubs as of 2009

7. CONCLUSION

Club convergence is not a new study, there have been many different studies conducted on European and South American countries. On the other hand, this is the first study that ever been done on the Organization of Islamic Cooperation using the methodology of Phillips and Sul for the aim to identify the club convergence within the organization. The following conclusions were drawn:

- 1) Absolute Beta convergence exists across member Country of Organization of Islamic Cooperation, however, it is weak convergence.
- 2) As of 2017, the findings show the existence of two convergence club across the Organization of Islamic Cooperation's countries with a deferent degree and speed of convergence and one divergence country.
- 3) The number of clubs changes over time, in 2005, the number of clubs was 8 and there were 3 divergent countries. In 2008, the number of clubs was 6 with one divergent country and in 2010, the number of clubs was 4 with 3 divergent countries.
- 4) Even though, moving towered lower number of clubs is a good sign for the stability of the region. In the OIC case, however, having a low number of clubs was due to reasons related to crises such as economic crises in 2008. The findings showed how the high-income countries merged with lower countries, negative merged.
- 5) The fact that drawn from beta convergence which states that poorer country tends to catch-up growth is not always guaranteed. The result of beta convergence shows that there is a weak convergence due to "social capabilities which is a must to benefit from the catch-up growth. These, include an ability to absorb new technology, attract capital, and participate in the global market" (Abramovitez, 1986).

This study covers the fifty-seven members of the Organization of Islamic Countries and tests the Per Capita GDP convergence patterns across the OIC members during 1990-2017 using the log t-test methodology developed by Phillips and Sul (2007)

This study of Club Convergence cross member of OIC can be used for further research on the drivers of convergence club cross OIC members by examining the similarities and differences between countries within a club.



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9. APPENDIX

A. APPENDIX A: COUNTRY CODES

Country	Code	Country	Code	Country	Code
Afghanistan	AFG	Indonesia	IDN	Qatar	QAT
Albania	ALB	Iran	IRN	Saudi Arabia	SAU
Algeria	DZA	Iraq	IRQ	Senegal	SEN
Azerbaijan	AZE	Jordan	JOR	Sierra Leone	SLE
Bahrain	BHR	Kazakhstan	KAZ	Somalia	SOM
Bangladesh	BGD	Kuwait	KWT	Sudan	SDN
Benin	BEN	Kyrgyzstan	KGZ	Suriname	SUR
Brunei	BRN	Lebanon	LBN	Syria	SYR
Burkina Faso	BFA	Libya	LYB	Tajikistan	TJK
Cameroon	CMR	Malaysia	MYS	Togo	TGO
Chad	TCD	Maldives	MDV	Tunisia	TUN
Comoros	COM	Mali	MLI	Turkey	TUR
Cote d'Ivoire	CIV	Mauritania	MRT	Turkmenistan	TKM
Djibouti	DJI	Morocco	MAR	Uganda	UGA
Egypt	EGY	Mozambique	MOZ	United Arab Emirates	UAE
Gabon	GAB	Niger	NER	Uzbekistan	UZB
Gambia	GMB	Nigeria	NGA	Yemen	YEM
Guinea	GIN	Oman	OMN		
Guinea-Bissau	GNB	Pakistan	PAK		
Guyana	GUY	Palestine	PSE		

Table 9.1: Organization of Islamic Cooperation's Country Codes

B. APPENDIX B: GDP PER CAPITA GROWTH (1990-2017)

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
ALB	7.23	7.25	7.28	7.32	7.36	7.41	7.46	7.52	7.58	7.64	7.7	7.77	7.84	7.9	7.97	8.03	8.09	8.14	8.19	8.24	8.28	8.32	8.35	8.39	8.42	8.44	8.47	8.5
AZE	7.84	7.73	7.62	7.52	7.44	7.37	7.33	7.32	7.34	7.38	7.45	7.53	7.63	7.75	7.88	8.01	8.14	8.26	8.37	8.47	8.54	8.61	8.65	8.69	8.72	8.74	8.76	8.78
BEN	6.36	6.37	6.39	6.41	6.42	6.44	6.46	6.48	6.5	6.51	6.53	6.55	6.56	6.57	6.58	6.59	6.6	6.62	6.63	6.64	6.65	6.67	6.68	6.7	6.72	6.74	6.76	6.78
BFA	5.83	5.86	5.88	5.9	5.92	5.95	5.97	6	6.03	6.06	6.08	6.11	6.14	6.17	6.2	6.22	6.25	6.28	6.3	6.33	6.36	6.38	6.41	6.43	6.46	6.48	6.51	6.53
BGD	5.94	5.97	5.99	6.01	6.04	6.06	6.09	6.12	6.14	6.18	6.21	6.24	6.28	6.31	6.35	6.4	6.44	6.49	6.53	6.58	6.63	6.67	6.72	6.77	6.82	6.88	6.93	6.98
BHR	9.91	9.92	9.94	9.95	9.97	9.98	9.99	10	10	10.01	10.01	10.01	10.01	10	10	9.99	9.99	9.98	9.98	9.97	9.97	9.97	9.98	9.98	9.99	9.99	10	10.01
BRN	10.53	10.53	10.52	10.52	10.52	10.52	10.51	10.51	10.51	10.51	10.51	10.51	10.51	10.51	10.51	10.51	10.5	10.5	10.49	10.49	10.48	10.46	10.45	10.44	10.42	10.4	10.38	10.37
CIV	7.21	7.21	7.2	7.2	7.2	7.19	7.19	7.19	7.18	7.18	7.17	7.16	7.14	7.13	7.12	7.11	7.11	7.1	7.1	7.11	7.12	7.14	7.16	7.19	7.23	7.26	7.3	7.34
CMR	7.06	7.05	7.04	7.03	7.02	7.02	7.02	7.02	7.03	7.04	7.05	7.07	7.08	7.1	7.11	7.13	7.14	7.16	7.17	7.18	7.2	7.21	7.23	7.24	7.26	7.28	7.3	7.32
COM	7.41	7.4	7.39	7.38	7.37	7.36	7.35	7.34	7.33	7.32	7.31	7.3	7.28	7.27	7.26	7.25	7.24	7.23	7.22	7.22	7.23	7.24	7.25	7.27	7.29	7.31	7.33	7.35
DJI	6.87	6.86	6.86	6.86	6.85	6.85	6.84	6.84	6.83	6.83	6.83	6.84	6.85	6.86	6.88	6.91	6.94	6.97	7	7.04	7.08	7.12	7.16	7.21	7.25	7.3	7.35	7.4
DZA	8.12	8.11	8.11	8.11	8.11	8.11	8.12	8.13	8.15	8.16	8.19	8.21	8.24	8.26	8.29	8.32	8.34	8.36	8.38	8.39	8.41	8.42	8.43	8.44	8.46	8.47	8.48	8.49
EGY	7.27	7.29	7.32	7.34	7.37	7.4	7.42	7.45	7.48	7.5	7.53	7.56	7.59	7.61	7.64	7.67	7.7	7.73	7.75	7.78	7.8	7.82	7.84	7.85	7.87	7.88	7.9	7.91
GAB	9.39	9.38	9.38	9.38	9.37	9.36	9.36	9.34	9.33	9.31	9.28	9.26	9.23	9.21	9.19	9.16	9.15	9.13	9.12	9.11	9.11	9.11	9.12	9.13	9.13	9.14	9.15	9.16
GIN	6.29	6.29	6.29	6.29	6.29	6.3	6.31	6.32	6.33	6.34	6.35	6.37	6.38	6.39	6.4	6.41	6.42	6.44	6.45	6.46	6.48	6.5	6.52	6.54	6.57	6.59	6.62	6.65
GMB	6.65	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.65	6.65	6.66	6.67	6.67	6.68	6.68	6.68	6.69	6.69	6.69	6.69	6.7	6.7	6.69	6.69	6.69	6.69	6.69
GNB	6.32	6.32	6.32	6.32	6.32	6.31	6.31	6.3	6.29	6.29	6.28	6.27	6.27	6.26	6.26	6.26	6.26	6.27	6.28	6.28	6.29	6.3	6.31	6.32	6.34	6.35	6.36	6.37
GUY	7.34	7.39	7.44	7.5	7.55	7.59	7.64	7.67	7.71	7.73	7.76	7.78	7.8	7.82	7.84	7.86	7.89	7.92	7.95	7.98	8.02	8.05	8.09	8.13	8.16	8.2	8.23	8.27
IDN	7.47	7.51	7.54	7.58	7.61	7.63	7.66	7.67	7.69	7.7	7.72	7.74	7.76	7.78	7.81	7.84	7.88	7.91	7.95	8	8.04	8.08	8.12	8.16	8.21	8.25	8.29	8.33
IRQ	7.45	7.47	7.51	7.55	7.6	7.66	7.72	7.79	7.86	7.92	7.97	8.01	8.04	8.06	8.09	8.12	8.15	8.18	8.22	8.26	8.31	8.36	8.41	8.46	8.51	8.56	8.61	8.66
JOR	7.83	7.84	7.85	7.87	7.88	7.89	7.91	7.92	7.94	7.96	7.99	8.01	8.04	8.07	8.1	8.13	8.15	8.17	8.18	8.18	8.18	8.18	8.17	8.16	8.14	8.13	8.11	8.09
KAZ	8.52	8.47	8.43	8.4	8.37	8.35	8.35	8.36	8.38	8.42	8.47	8.54	8.61	8.68	8.76	8.83	8.9	8.96	9.02	9.07	9.12	9.17	9.2	9.24	9.27	9.3	9.32	9.35

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
KGZ	6.82	6.74	6.67	6.6	6.54	6.49	6.46	6.44	6.44	6.45	6.46	6.49	6.51	6.55	6.58	6.62	6.65	6.69	6.72	6.76	6.79	6.82	6.85	6.88	6.9	6.93	6.96	6.99	
KWT	9.86	9.98	10.09	10.21	10.31	10.39	10.46	10.51	10.55	10.58	10.61	10.63	10.65	10.67	10.69	10.7	10.7	10.7	10.69	10.67	10.64	10.62	10.59	10.55	10.52	10.49	10.46	10.42	
LBN	8.56	8.61	8.65	8.7	8.73	8.76	8.79	8.81	8.82	8.83	8.84	8.84	8.85	8.86	8.87	8.88	8.9	8.92	8.94	8.95	8.96	8.96	8.96	8.95	8.94	8.92	8.91	8.89	
LBY	9.16	9.15	9.15	9.14	9.13	9.13	9.12	9.13	9.14	9.15	9.17	9.19	9.22	9.25	9.27	9.29	9.28	9.26	9.21	9.12	8.99	8.82	8.63	8.4	8.15	7.89	7.63	7.37	
MAR	7.45	7.46	7.46	7.47	7.48	7.49	7.51	7.52	7.54	7.56	7.59	7.62	7.65	7.68	7.72	7.75	7.79	7.83	7.87	7.91	7.95	7.98	8.02	8.05	8.08	8.11	8.15	8.18	
MDV	8.24	8.28	8.32	8.37	8.41	8.45	8.49	8.53	8.56	8.59	8.63	8.65	8.68	8.71	8.74	8.76	8.79	8.82	8.84	8.87	8.89	8.92	8.94	8.97	9	9.02	9.05	9.08	
MLI	5.2	5.29	5.37	5.46	5.55	5.64	5.72	5.81	5.89	5.96	6.02	6.08	6.14	6.19	6.24	6.29	6.34	6.39	6.44	6.49	6.55	6.6	6.66	6.71	6.76	6.81	6.87	6.92	
MOZ	5.06	5.1	5.14	5.18	5.23	5.28	5.34	5.39	5.45	5.51	5.57	5.62	5.68	5.73	5.78	5.83	5.88	5.92	5.96	6	6.04	6.08	6.12	6.15	6.19	6.22	6.25	6.29	
MRT	6.9	6.9	6.91	6.91	6.91	6.92	6.92	6.92	6.92	6.92	6.93	6.94	6.95	6.96	6.98	7.01	7.03	7.05	7.07	7.09	7.11	7.12	7.13	7.15	7.16	7.17	7.18	7.19	
MYS	8.47	8.52	8.56	8.61	8.66	8.7	8.73	8.77	8.8	8.82	8.85	8.88	8.9	8.93	8.96	8.98	9.01	9.04	9.07	9.09	9.12	9.15	9.18	9.21	9.25	9.28	9.31	9.34	
NER	5.83	5.82	5.81	5.8	5.8	5.79	5.79	5.78	5.78	5.78	5.78	5.78	5.78	5.79	5.79	5.8	5.81	5.82	5.83	5.84	5.86	5.87	5.89	5.91	5.93	5.95	5.97	5.99	
NGA	7.17	7.17	7.17	7.17	7.17	7.17	7.18	7.2	7.22	7.24	7.28	7.32	7.37	7.42	7.47	7.52	7.56	7.61	7.65	7.69	7.72	7.75	7.78	7.8	7.82	7.83	7.85	7.86	
OMN	9.61	9.64	9.66	9.68	9.7	9.72	9.73	9.75	9.77	9.78	9.8	9.81	9.81	9.82	9.82	9.83	9.83	9.83	9.83	9.82	9.82	9.81	9.8	9.78	9.77	9.75	9.73	9.72	
PAK	6.61	6.62	6.63	6.65	6.66	6.67	6.68	6.7	6.71	6.72	6.74	6.76	6.77	6.8	6.82	6.84	6.86	6.88	6.9	6.92	6.94	6.96	6.97	6.99	7.01	7.03	7.05	7.07	
PSE	7.31	7.36	7.4	7.45	7.49	7.53	7.56	7.58	7.6	7.6	7.61	7.61	7.61	7.61	7.62	7.63	7.64	7.66	7.69	7.71	7.74	7.77	7.79	7.82	7.84	7.86	7.88	7.89	
QAT	10.55	10.59	10.63	10.67	10.71	10.76	10.81	10.85	10.9	10.94	10.98	11.02	11.04	11.07	11.09	11.11	11.12	11.13	11.14	11.14	11.15	11.15	11.14	11.14	11.13	11.13	11.12	11.11	
SAU	9.87	9.87	9.86	9.85	9.85	9.84	9.83	9.82	9.82	9.81	9.81	9.81	9.81	9.82	9.82	9.83	9.85	9.86	9.87	9.88	9.9	9.91	9.92	9.94	9.95	9.96	9.97	9.98	
SDN	6.91	6.93	6.95	6.98	7	7.03	7.06	7.1	7.13	7.17	7.21	7.25	7.28	7.31	7.34	7.36	7.37	7.37	7.37	7.36	7.36	7.35	7.34	7.33	7.32	7.32	7.31	7.3	
SEN	6.94	6.94	6.94	6.95	6.95	6.96	6.97	6.98	6.99	7.01	7.03	7.04	7.06	7.07	7.09	7.1	7.12	7.13	7.14	7.15	7.16	7.17	7.18	7.19	7.21	7.22	7.24	7.25	
SLE	6.31	6.23	6.15	6.07	5.99	5.91	5.84	5.78	5.73	5.7	5.69	5.7	5.72	5.75	5.78	5.82	5.86	5.9	5.94	5.98	6.03	6.06	6.1	6.13	6.16	6.18	6.2	6.21	
SOM	4.94	4.88	4.82	4.76	4.71	4.66	4.62	4.58	4.56	4.54	4.52	4.51	4.51	4.51	4.5	4.5	4.51	4.51	4.51	4.51	4.51	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
SUR	8.69	8.68	8.67	8.66	8.66	8.65	8.65	8.66	8.67	8.68	8.7	8.72	8.75	8.78	8.81	8.85	8.88	8.92	8.95	8.98	9	9.03	9.04	9.05	9.06	9.06	9.06	9.06	
SYR	7.48	7.52	7.56	7.6	7.63	7.67	7.7	7.73	7.75	7.78	7.8	7.82	7.83	7.85	7.87	7.88	7.88	7.88	7.86	7.84	7.79	7.74	7.67	7.59	7.51	7.42	7.34	7.25	
TCO	6.17	6.16	6.15	6.15	6.15	6.15	6.15	6.16	6.18	6.2	6.23	6.28	6.33	6.39	6.45	6.51	6.57	6.62	6.67	6.72	6.76	6.79	6.81	6.82	6.83	6.84	6.84	6.84	

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TGO	6.44	6.42	6.41	6.39	6.38	6.37	6.36	6.35	6.34	6.33	6.32	6.31	6.29	6.28	6.27	6.26	6.26	6.26	6.26	6.27	6.29	6.31	6.33	6.36	6.38	6.41	6.44	6.47
TJK	6.94	6.79	6.64	6.5	6.37	6.26	6.18	6.12	6.08	6.07	6.08	6.11	6.15	6.21	6.26	6.32	6.38	6.43	6.49	6.54	6.58	6.63	6.67	6.71	6.75	6.8	6.84	6.88
TKM	8.08	8.01	7.94	7.87	7.81	7.76	7.72	7.7	7.7	7.71	7.73	7.76	7.8	7.86	7.92	7.99	8.06	8.14	8.23	8.31	8.4	8.48	8.56	8.64	8.72	8.8	8.87	8.95
TUN	7.68	7.7	7.73	7.76	7.79	7.82	7.85	7.88	7.91	7.95	7.99	8.02	8.06	8.1	8.13	8.17	8.2	8.23	8.25	8.28	8.3	8.31	8.33	8.34	8.35	8.36	8.37	8.37
TUR	8.81	8.83	8.85	8.87	8.89	8.91	8.93	8.94	8.96	8.98	9	9.02	9.05	9.08	9.11	9.14	9.18	9.21	9.25	9.28	9.32	9.36	9.4	9.44	9.48	9.52	9.57	9.61
UAE	11	11	11	11	11	11	11.01	11.01	11.01	11	10.99	10.98	10.96	10.93	10.9	10.86	10.81	10.76	10.71	10.67	10.63	10.6	10.58	10.57	10.56	10.56	10.56	10.56
UGA	5.58	5.62	5.66	5.7	5.74	5.78	5.82	5.85	5.89	5.93	5.97	6.01	6.04	6.08	6.12	6.16	6.19	6.23	6.26	6.3	6.32	6.35	6.37	6.4	6.41	6.43	6.45	6.46
UZB	6.81	6.77	6.74	6.71	6.68	6.67	6.66	6.66	6.66	6.68	6.7	6.74	6.77	6.82	6.87	6.92	6.98	7.03	7.09	7.16	7.22	7.28	7.34	7.4	7.46	7.52	7.57	7.63
YEM	6.64	6.67	6.7	6.74	6.77	6.81	6.85	6.89	6.93	6.97	7.01	7.05	7.08	7.1	7.13	7.14	7.14	7.14	7.12	7.09	7.05	6.98	6.91	6.81	6.71	6.59	6.47	6.35
AFG	6.4	6.29	6.19	6.1	6.01	5.94	5.87	5.83	5.8	5.78	5.78	5.8	5.84	5.89	5.94	6.01	6.07	6.13	6.19	6.25	6.3	6.34	6.38	6.42	6.44	6.47	6.49	6.51
IRN	8.34	8.35	8.37	8.38	8.39	8.41	8.42	8.44	8.46	8.48	8.51	8.53	8.56	8.59	8.62	8.65	8.67	8.7	8.72	8.73	8.74	8.75	8.76	8.77	8.78	8.78	8.79	8.8

Table 9.2: GDP Per Capita Growth (1990-2017)

**C. APPENDIX C: GDP PER CAPITA OF MEMBERS OF CLUB 1&2 AS OF
2008**

Country	2007	2008	2009	Growth (2008 - 2009)
Member of Club One as of 2008				
Azerbaijan	3,851.33	5,574.47	4,950.40	-12.61%
Bahrain	20,977.12	23,067.56	19,356.67	-19.17%
Brunei	36,201.54	42,053.05	30,987.95	-35.71%
Kazakhstan	6,771.42	8,513.57	7,165.22	-18.82%
Kuwait	45,791.73	55,566.13	37,591.39	-47.82%
Oman	15,805.16	22,075.08	16,784.37	-31.52%
Qatar	67,005.51	82,967.34	61,478.32	-34.95%
Saudi Arabia	16,472.17	20,037.83	16,094.29	-24.50%
United Arab Emirates	43,230.27	46,356.90	33,504.77	-38.36%
Member of Club Two as of 2008				
Albania	3,595.04	4,370.54	4,114.14	-6%
Iran	4,857.37	5,660.42	5,650.85	0%
Iraq	2,638.62	3,532.99	3,667.92	4%
Jordan	2,791.65	3,421.09	3,510.21	3%
Lebanon	6,086.80	7,109.51	8,480.99	16%
Libya	10,496.53	15,748.44	11,246.13	-40%
Malaysia	7,269.24	8,513.56	7,326.74	-16%
Maldives	5,559.51	6,583.45	6,615.76	0%
Tunisia	3,778.36	4,309.95	4,130.05	-4%
Turkey	9,709.49	10,850.69	9,036.50	-20%
Turkmenistan	3,795.83	4,382.00	4,036.46	-9%

Table 9.3: GDP Per Capita of Members of Club 1&2 as of 2008

D. APPENDIX D: FUNCTIONS USED IN R TO FIND THE CONVERGENCE CLUBS

1) "FindClubs" function is used to identify the clubs

```
OICclubs2017 <- findClubs(OICClub20017, dataCols=2:29, unit_names = 1,
refCol=29,time_trim = 0.33, HACmethod = 'AQSB', cstar = 0, cstar_method =
'incremental', cstar_increment = 0.1)
```

Note: #OICClubs2017 is the name of dataset

2) "MergeClubs" function is used to merge the possible clubs

```
mclubs2017 <- mergeClubs(OICClub20017, mergeDivergent=TRUE)
```

3) "MergeDivergent" Function is used to Merge Divergent Units

```
mDiv2017<- mergeDivergent(OICClub20017, time_trim=1/3, estar = -1.65)
```

4) "betaconv.ols" Function is used to calculate the Beta Coefficient, Beta Convergence speed, and Half-time

```
betaconv.ols(OIC2017$`1990`, 1990, OIC2017$`2017`, 2017, conditions = NULL,
beta.plot = TRUE, beta.plotPSize = 1, beta.plotPCol = "black", beta.plotLine = FALSE,
beta.plotLineCol = "red", beta.plotX = "Ln (initial)", beta.plotY = "Ln (growth)",
beta.plotTitle = "Beta convergence", beta.bgCol = "gray95", beta.bgrid = TRUE,
beta.bgridCol = "white", beta.bgridSize = 2, beta.bgridType = "solid", print.results =
TRUE)
```

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