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Testing the Convergence Clubs Hypothesis among MENA Countries

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Abstract

This paper is to study the convergence of per capita income. Convergence clubs hypothesis is one of the forms of convergence hypotheses, implying that countries with the same initial level of economic development, technology, and government policies, tend to be similar in per capita income and thus have a tendency to cluster around a small number of poles. In order to test the hypothesis of the formation of the convergence clubs among 15 Middle East and North African (MENA) countries for the period of 1990–2015, we used a non-parametric analysis (distribution dynamics approach). The distribution dynamics of real per capita GDP showed that "twin peaks" were being formed in the MENA region.

Keywords: Convergence Club, Distribution Dynamics, MENA Countries.
JEL Classification: O_{41}, O_{47}, C_{21}

1. Introduction

The income convergence hypothesis predicts that under the assumptions of substitution possibility and diminishing return for factors of production and also for similar behavioral parameters, countries move toward a common balanced growth path and the distribution of income per capita will consequently be as a unimodal in the long-run. This definition of convergence hypothesis arises from Solow (1956) growth model, and is known as absolute convergence. But this hypothesis has been rejected by endogenous growth theory, and given the inconclusive empirical results therein, its empirical validity remains controversial. In the empirical works on the convergence hypothesis, researchers have tested various

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concepts of convergence e.g. absolute convergence or conditional convergence and catching-up hypothesis, and have used different methodologies such as cross-sectional approach, distribution approach, and time series approach[1]. According to the absolute convergence, economies will converge toward the same per capita income in the long-run steady state, and poverty, in the international level, will be disappeared by itself. The conditional convergence hypothesis implies that the economies will converge to their own steady state. Yet, according to the conditional convergence, the difference between economies in terms of per capita income will not be disappeared even in the long-run steady state.

The cross-sectional and the time series approaches are employed to test the absolute and conditional notions of the convergence hypothesis. In the cross-sectional approach, the per capita income growth rate which is regressed on initial per capita income, and a negative (partial) or reverse correlation between two variables, are interpreted as the evidences of the absolute (conditional) convergence. In the time series framework, the convergence hypothesis is examined by using the unit root or stationary tests.

An alternative hypothesis by Durlauf and Johnson (1995) showed the possibility of multiple-equilibriums model in cross-country growth behavior; therefore, the economies will converge as locally rather than globally. On the other words, countries with similar initial conditions move toward common steady states in the long-run, and thus the difference among economies in terms of per capita income will not be disappeared, which can lead to the convergence clubs' formation. One possible manifestation of the convergence clubs' presence is multiple modes in the cross-country distribution of per capita income, each corresponding to an individual convergence club. Most researches investigating the shape of the cross-country distribution of per capita income, have used kernel estimation methods (e.g. Quah, 1996, 1997; Izraeli and Murphy, 1997; Bianchi, 1997; Jones, 1995; Henderson et al., 2008; Azomahou et al., 2011, etc.). Bianchi (1997) and Henderson et al. (2008) present various tests of the unimodal distribution hypothesis against that of a multimodal distribution.

1. For more details, see Islam (2003) and Rassekh (1998).

In this paper, we are going to test the convergence clubs' hypothesis among MENA countries. We found that some researchers tested the convergence hypothesis among the countries, and most of them applied the time series approach, and thus only tested the convergence toward a benchmark country (e.g. Guetat and Serranito, 2007; Erlat, 2007; Serranito, 2010; Tunali and Yilnaci, 2010). In this study, we go one step ahead and test convergence clubs' hypothesis for MENA. To the end, we use the non-parametric distribution dynamics approach that was popularized by Quah (1996). Results showed that some MENA countries with low real GDP per capita (RGDPPC) stayed poor, and some could catch up. In addition, the middle income countries in MENA are going to disappear.

The remainder of this paper is organized as follows. Section 2 describes the formation of convergence clubs hypothesis. Section 3 presents the data used in this study and its methodology. Section 4 gives the results, and Section 5 concludes the paper.

2. Formation of Convergence Clubs

Convergence clubs hypothesis refers to the countries with similar initial levels of economic development tendency for similarities in preferences, technologies, government policies, locally converging trend, and thus a steady-states distribution tendency to cluster around a small number of poles. One possible manifestation of the convergence clubs presence is the multiple modes in the cross-country distribution of per capita income, and immobility within the distribution. So that the countries in the vicinity of a mode tend not to move to another mode.

Most researches investigating the shape of the cross-country distribution of per capita income, have used kernel estimation methods, and most of them have contributed to the so-called "twin peaks" literature (e.g. Quah, 1996; Bianchi, 1997; Henderson et al., 2008). Bianchi (1997) and Henderson et al. (2008) presented various tests of the hypothesis of a unimodal distribution against that of a multimodal distribution. Both papers reject the null hypothesis of unimodal distribution, and find little mobility between the modes.

Grazia, Pittau, and Zelli (2010) found that models which generated a cross-country distribution of per capita income, implied a law of

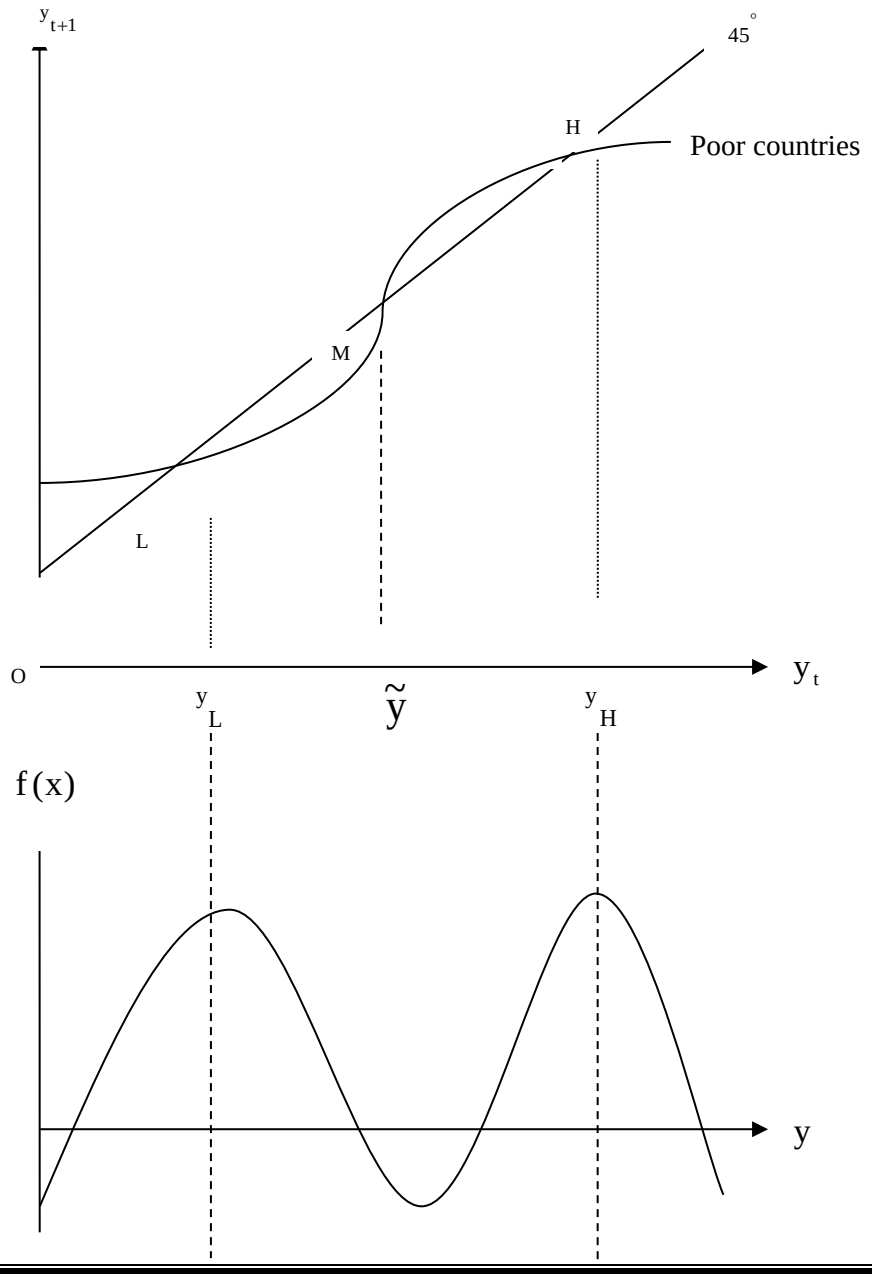


Figure 1: Formation of Convergence Clubs
(According to Figure 2 in Galor, 1996)

motion for per capita income (y_t), e.g. $y_{t+1} = f(y_t, \varepsilon_t)$ in which ε_t was a random disturbance term. Putting $\varepsilon_t = 0$ in the equation, we show the law of motion for per capita income in Figure 1. Fixing $\varepsilon_t = 0$ yields a non-stochastic dynamic system with two locally-stable steady states at y_L and y_H, and an unstable steady state at $\tilde{y}$. If a country starts with $y_t < \tilde{y}$ and/or $y_t < y_L$, then it will converge to y_L, and if it starts with $y_t > \tilde{y}$ and/or $y_t > y_H$, then it will converge to y_H. If we put $\varepsilon_t \neq 0$, the law of motion for per capita income can produce a cross-country distribution of per capita income with density $f(y)$ as shown in the Figure 1. As can be seen, the distribution is bimodal with each mode corresponding to one of the stable steady states in the non-stochastic case.

3. Data and Methodology

3.1 Data

In this paper, we collected the datasets for RGDPPC of 15 MENA countries, including Algeria, Bahrain, Djibouti, Egypt, Iran, Israel, Jordan, Lebanon, Malta, Morocco, Oman, Saudi Arabia, Tunisia, United Arab Emirates, and Yemen from the World Bank's World Development Indicators (WDI) dataset (2018) online. Considering the scarcity of access to long-period datasets for RGDPPC of MENA countries, we have to consider the period 1990–2015 in order to put more countries into analysis.

Table 1 provides average RGDPPC and average annual RGDPPC growth rate for two decades 1990s, 2000s, and first half of 2010s, and Figure 1 presents the RGDPPC dynamics over the period 1990–2015. The dynamics of RGDPPC datasets over the period indicates that United Arab Emirates, Saudi Arabia, and Oman have the highest RGDPPC, and Djibouti, Morocco, and Yemen have the lowest RGDPPC.

In panel B, we prepared the average annual growth rate of RGDPPC for three decades. Results showed that the RGDPPC series of Lebanon, Malta, and Tunisia over the 1990s, Jordan, Morocco, and Tunisia over the 2000s, and Djibouti, Malta, and Morocco over the first half of 2010s had the highest growth rate, and the RGDPPC

series of Algeria, Djibouti, Saudi Arabia, and United Arab Emirates over the 1990s, Bahrain and United Arab Emirates over the 2000s, and Iran, Jordan, Lebanon, Oman, and Yemen over the first half of 2010s experienced negative growth rates.

Table 1: Real GDP per capita Dynamics in MENA Countries over the Period 1990-2015

Countries	Panel A: Average RGDPPC			Panel B: Average yearly growth rate of RGDPPC		
	1990s	**2000s**	**2010s**	**1990s**	**2000s**	**2010s**
Algeria	9643	11687	13244	-0.029	0.229	0.113
Bahrain	**41622**	42996	41995	0.225	-0.093	0.124
Djibouti	2534	2286	2852	-0.450	0.251	**0.367**
Egypt	6320	8165	9882	0.216	0.286	0.043
Iran	12033	15244	17080	0.121	0.302	-0.143
Israel	23109	27111	30967	0.215	0.069	0.119
Jordan	6722	8528	8914	0.133	**0.331**	-0.200
Lebanon	11503	12961	14760	**0.521**	0.242	-0.362
Malta	19249	26160	30406	**0.367**	0.110	**0.307**
Morocco	4138	5339	6874	0.156	**0.395**	**0.232**
Oman	38378	**43438**	**42103**	0.171	0.035	-0.190
Saudi Arabia	**44575**	**43729**	**48940**	-0.016	0.030	0.171
Tunisia	6285	8733	10505	**0.301**	**0.328**	0.053
United Arab Emirates	**102653**	**87812**	**61330**	-0.105	-0.464	0.206
Yemen	3528	4084	3682	0.154	0.112	-1.076

Notes: Figures in bold are countries with highest RGDPPC (yearly growth rate) and underlined figures are countries with lowest RGDPPC (yearly growth rate).

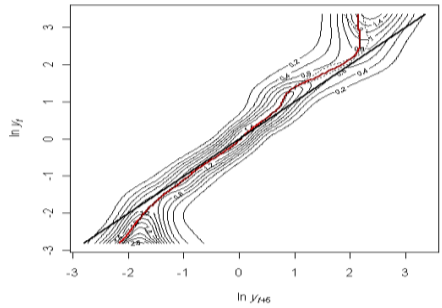
3.2 Methodology

As mentioned in Section 1, we tested the convergence clubs hypothesis among MENA countries employing distribution dynamics approach by Quah (1996). It models intra-distribution dynamics of RGDPPC as a first-order Markov process. In fact, density distribution ψ_t is assumed to evolve as time-invariant and Markovian in accordance with the following equation:

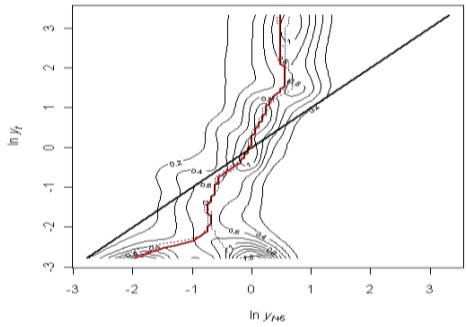
$$\psi_{t+\tau} = M\psi_t \qquad (1)$$

Where M is the operator that maps the transition of RGDPPC distribution between period t and t+h. If we model the density distribution ψ_t as discrete, the operator M is called Markov's transition matrices, and if we model it as continuous, the operator M is called stochastic kernel[1].

Panel A: The probability mass runs along the 45° line



Panel B: The probability mass moves counterclockwise around the 45° line



Panel C: The probability mass moves clockwise around the 45° line

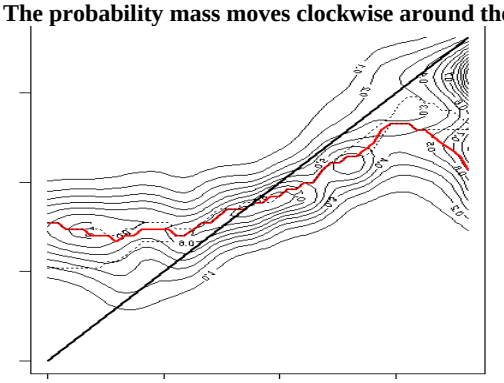


Figure 2: Benchmark Stochastic Kernel Contour Plots

Note: Red line is the estimated median value of y at t + h conditional on its value at time t.

1. For more details on distribution dynamics and its application in convergence debate, see Epstein et al. (2003).

In order to describe our methodology, we have presented three benchmark stochastic kernel contours in Figure 2. The vertical axis measures the time t income distribution, and the horizontal axis measures the time t+h income distribution. Suppose that the stochastic kernel contours of RGDPPC for our sample be as panel A of Figure 2. It shows that there had not been any movement across countries for equalization in RGDPPC. If the stochastic kernel contours of RGDPPC is as Panel B of Figure 2, in other words, the stochastic kernel contours of RGDPPC has counterclockwise movement, it will show that over time, the RGDPPC of countries move toward equalization. But, if the stochastic kernel contours of RGDPPC has clockwise movement around the 45° line (as panel C of Figure 2), it will show that the countries diverge.

4. Empirical Results

As a preliminary step, we test the β - convergence among the MENA. To the end, we identify the well-known absolute β - convergence equation as it follows:

$$GY_{i,t} = \alpha + \beta \ln(Y_{i,0}) + \varepsilon_i \qquad (2)$$

Where GY is the growth of GDP. The equation 1 is estimated for the three periods including 1990–1999, 2000–2009, 2010–2015, and for 1990–2015. The estimation results are illustrated in Figure 3. As can be seen, over the 1990s, we cannot find evidence in favor of convergence. But over the period 2000–2009, we find strong evidence in favor of RGDPPC convergence among MENA countries. The process has altered during the first half of 2010s. So, we find evidence for divergence among the countries that may be signal for formation of convergence clubs.

Panel A: RGDPPC series of MENA countries (in logs)

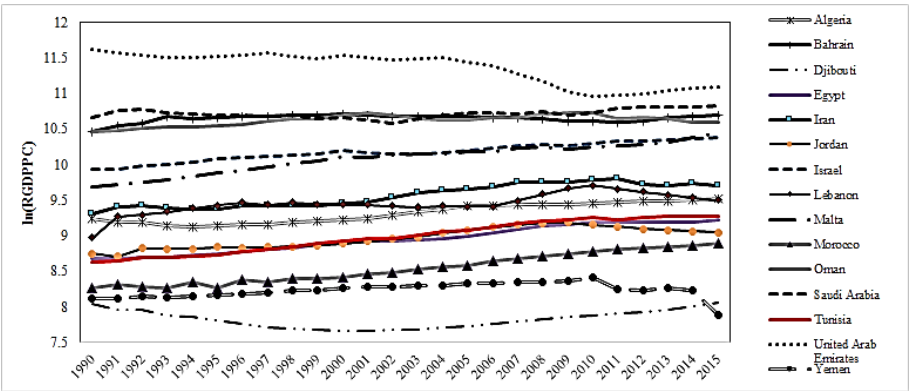


Figure 3: Real per capita GDP Dynamics of MENA Countries

The sigma convergence is a good condition to confirm the results of β - convergence. The sigma convergence is related to the distribution of RGDPPC series over time. The main indicator that is used to test the sigma convergence is standard deviation of RGDPPC over time. Results have been demonstrated in Figure 4. As can be seen, over the two period 1990–1999 and 2010–2015, the standard deviation of RGDPPC has upward pattern which confirms the divergence over the two periods. In contrast, over the period 2000–2009, the standard deviation of RGDPPC shows downward pattern that indicates the RGDPPC inequality decrease among MENA countries.

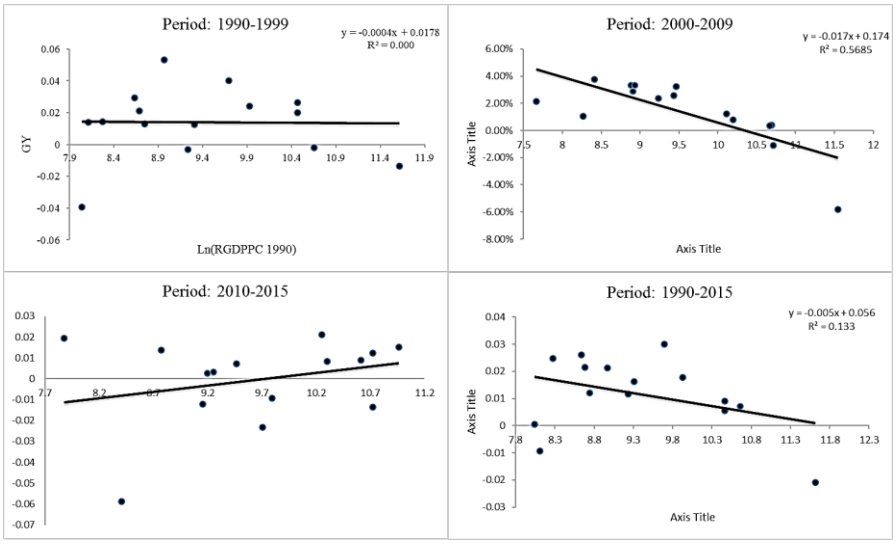


Figure 4: β - Convergence among the MENA Countries

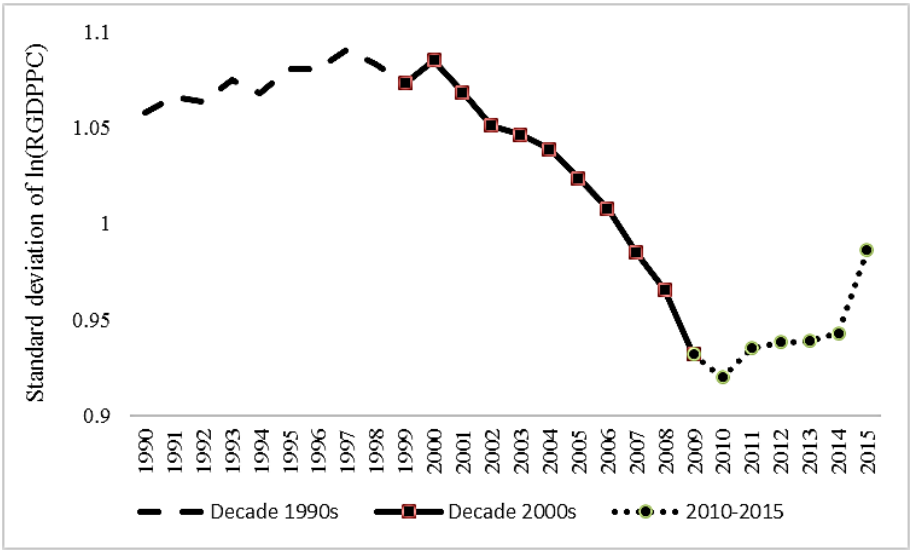


Figure 5: Sigma Convergence

The main part of our study is related to testing the convergence clubs' hypothesis. To the end, we use the stochastic kernel by Quah (1996) that analyzes the distribution dynamics of RGDPPC. In this approach, the evaluation of RGDPPC as a Markov process measures the transitions in the cross country from one RGDPPC class to another over h-year transitions[1].

We estimated dynamic stochastic kernel for 5-year transition (h=5), and plotted it in panel A of Figure 6. Moreover, we plotted its contour and the estimated median value of RGDPPC (red line) at time t+5 conditional on the value at time t in panel B. As can be seen in panel B, there are two peaks in the stochastic kernel among which one captures the clubs of poor countries, and the other captures the convergence among rich countries in MENA region.

The contour plot has a counter-clockwise movement around the 45° line, especially in two end tiles. Furthermore, the estimated median value of RGDPPC (red line) crossed the 45° line in two points which were named A and B. The point B is always stable equilibrium, but the point A is stable equilibrium only from behind. Based on the counter-clockwise movement of contour plot, we expect that the low

1. For more details on distribution dynamics and its application in convergence debate, see Epstein et al. (2003).

income countries, with RGDPPC less than Y_L, will experience upward convergence and move toward Y_L. The countries with RGDPPC about Y_L are in the low income trap. But the countries with RGDPPC between Y_L and Y_H experience upward convergence and move toward Y_H. The MENA rich countries have downward convergence, and move toward $Y_{H.}$ As can be seen, middle income countries disappear. Results show that the two convergence clubs are being formed in MENA region, one in A and another in B. So, the point A is low income trap and the countries in this state should escape from the steady state level by applying various economic, social, and political plans.

Panel A: Stochastic Kernel **Panel B: Contour plot of Stochastic Kernel**

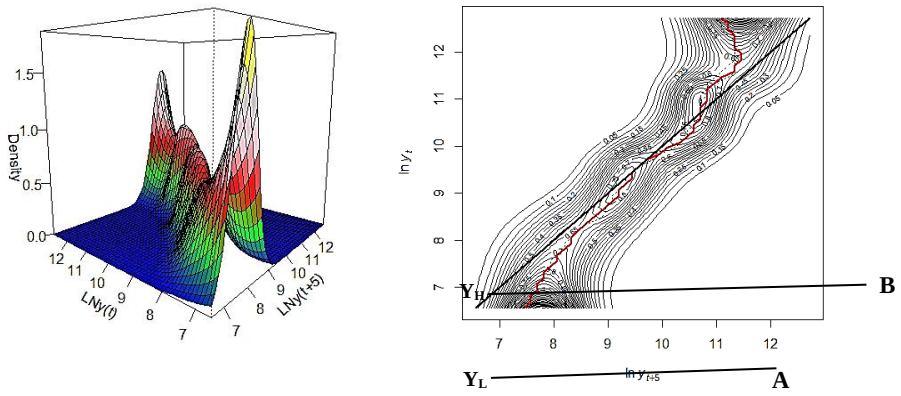


Figure 6: Real per capita GDP Dynamics of MENA Countries

5. Conclusion

The real per capita GDP dynamics in MENA region show that a separation is being formed among countries in the region. In this paper, we tested the convergence clubs' hypothesis by employing the distribution dynamics approach. The distribution dynamics of RGDPPC in the form of "*twin peaks*" are being formed in the MENA region. As a result, 6 countries including United Arab Emirates, Israel, Bahrain, Saudi Arabia, Malta, and Oman have formed the high income club, and 9 countries including Yemen, Djibouti, Morocco, Egypt, Iran, Algeria, Jordan, Tunisia, and Lebanon have formed the low income club.

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