Comparison between the conditional β and σ convergence in selected MENA countries and Members of OECD

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Abstract
Convergence hypothesis as a result of the neoclassical growth model, suggests that developing countries have a higher growth rate compared with developed countries and are able to reduce the earnings gap between themselves and developed countries. In this article, using real per capita income variable, β and σ convergence process has been tested in selected countries of Middle East and North Africa over the period of 1980-2008 and also in members of Organization for Economic Co-operation and Development over the period of 1970-2009. Based on the results, β and σ convergence have been validated in both groups of countries. This research also showed that human and physical capitals have a positive and significant effect on the speed of income convergence in aforementioned countries. Based on findings, due to their homogeneity, the speed of convergence is higher in the members of Organization for Economic Co-operation and Development in achieving a stable equilibrium level. Since based on obtained results, human and physical capitals in low-income economies are stronger than high-income economies, so the presence of numerous structural factors that act as a growth brake could be the reason for MENA countries' convergence towards low-level equilibrium trap.

Keywords: "Economic Growth, Beta Convergence, Sigma Convergence, Speed of Convergence, Panel Data, MENA Countries and OECD Countries"

Introduction

Achieving a sustainable economic growth is considered as one of the most important goals of development programs in different countries and also in economic theories (Capolupo, 2009). Evaluation campaigns show that there are always some differences in growth rates across regions and countries. In the long run, small differences in growth rates can have a significant effect on the level of welfare in people's life. In recent years, many studies have been carried out on the causes of earning gap between countries. Early studies are related to endogenous growth models which took the difference between fundamental factors of production and technology as the reason for the distinction between the growth rates of different countries and emphasized the accumulation of physical capital (Aghion and Howitt, 1997). In contrast, some new growth theories showed that considering the factors and mechanisms within an economy (e.g. human capital) along with capital and technology, production function has an increasing return compared to the scale and it is possible to explain the reason for the difference in growth rates of countries in the long run.

Convergence has been noted as one of the results of economic growth models (Romer, 2011). Solow (1956) and Swan (1956) proposed the income convergence hypothesis in the form of neoclassical growth models as follows: if the countries have the same economic parameters and similar balanced level of output per capita in the long run, then countries with lower per capita income, grow with a higher rate than the countries with high income thus decreasing the earnings gap between themselves and developed countries. In growth literature this condition is referred as absolute convergence. This theory is not necessarily true if the economic parameters are different. Solow (1956) and Swan (1956) created the main form of neoclassical growth theory. Neoclassical model emphasized the issue that how growth comes from capital accumulation.

Barro and Sala-i-Martin (1990) showed that in this case, there will be several uniform levels of convergence and countries converge towards their steady state with the same speed. In this case, we have conditional convergence. Conditional convergence has a strong descriptive value for economic growth in different countries and regions (Barro and Sala-i-Martin, 2003). So if we can identify the factors that influence economic growth in countries and determine the effectiveness of each factor, we can reduce regional inequalities. Another form of convergence is sigma-convergence (σ). In this definition of convergence, per capita income distribution in different regions is reduced by the passage of time.

In this paper, using panel method, the convergence hypothesis in 13 selected MENA countries during the period of (1980-2008) and 20 selected members of Organization for Economic Co-operation and Development during the period of (1970-2009) are tested and the factors affecting earnings gap and the speed of convergence such as human capital, physical capital, the degree of trade openness, government consumption and inflation are examined in both groups.

This paper is organized in five sections. In the second section, theoretical principles and some empirical evidence are presented. In the third section, research methodology is explained. In the forth one, research findings are presented. The final section is devoted to results and the proposals.

Theoretical Principles

Solow (1956) and Swan (1956) introduced the neoclassical growth model in their articles. The neoclassical growth emphasizes how growth is achieved by the accumulation of capital. In this model, capital accumulation equation is defined as follows:

$$\dot{K} = sf(k) - (n + g + \delta)k \quad (1)$$

In this equation: $\dot{K}$, $sf(k)$, n, g and δ are respectively capital changes, savings per capita, investment per capita, population growth rate, the rate of technological advancement and the rate of capital depreciation. So $\mathrm{K} = \frac{\partial \mathrm{K}}{\partial t}$ equals the differential between break-even Investment amount $(n + g + \delta)k$ and real investment $\mathrm{sf(k)}$. Using this pattern it is possible to show how the per capita income in each

economy converges towards a steady state and other economies' per capita income. Steady state is defined as follows:

$$k = 0 \rightarrow s.f(k^*) = (n + g + \delta).k^* \quad (2)$$

Since according to the form of production function of Cobb - Douglas in neoclassical growth model with regard to human capital: $f(k) = k^{\alpha}$. So:

$$k^* = [s/(n + g + \delta)]^{1/(1-\alpha)} \quad (3)$$

In Equation 3, steady state level of per capita capital, k*, has a direct relationship with the savings rate, and has an indirect relationship with population growth rate. To study the convergence of per capita income, a cross-sectional regression is used in which per capita income growth rate in a period of time is regressed to the level of initial income.

The convergence pattern which is estimated using cross-sectional and panel data methods is calculated as follows:

$$\frac{1}{\tau}[\ln y(t_2) - \ln y(t_1)] = \frac{(1-e^{-\beta\tau})}{\tau}\frac{\alpha}{1-\alpha-b}\ln s_k + \frac{(1-e^{-\beta\tau})}{\tau}\frac{b}{1-\alpha-b}\ln s_h - \frac{(1-e^{-\beta\tau})}{\tau}\frac{\alpha+b}{1-\alpha-b}\ln(n+g+\delta) + \frac{(1-e^{-\beta\tau})}{\tau}\ln A(0) + g(t_2 - e^{-\beta\tau}t_1) - \frac{(1-e^{-\beta\tau})}{\tau}\ln y(t_1) \quad (4)$$

The previous equation in economic growth literature is known as growth convergence equation or beta conventional convergence equation. In this equation $y(t_2)$ and $y(t_1)$ respectively represent the current level of per capita income and initial level of per capita income, $\tau = t_2 - t_1$ the length of the period, $\ln y(t_2) - \ln y(t_1)$ the average of the per capita income growth rate and $A(0)$ the level of technology. $\frac{(1-e^{-\beta\tau})}{\tau}$ is known as beta convergence coefficient. If the numerical value of this coefficient is between zero and one, convergence is validated. Also $\beta = (1-\alpha-b)*(n+g+\delta)$ is the speed of Convergence (Rassekh et al., 2001).

Another concept for convergence was defined by Easterlin (1960), Borts and Stein (1964), Barro (1991), Baumol (1986), Dowrick and Nguyen (1989) and Barro and Sala-i-Martin (1991 and 1992). In this definition, convergence will occur when the income per capita distribution in different regions decreases over time (or the standard deviation of the logarithm of production per capita decreases over time in some regions.) the convergence process is called sigma-convergence (σ). Accordingly, the dispersion index is defined as follows:

$$D_t = \frac{1}{N}.\sum_{i=1}^{N}[\log(y_{it}) - \mu_t]^2 \quad (5)$$

In which D_t is the sample variance of $\log(y_{it})$, N the number of sample countries and μ_t is the average sample of $\log(y_{it})$. If N is large enough, then the variance of the sample is close to the variance of the community. If D_t decreases over time, it is said that there is a σ convergence and if the variance of increases over time, economies move away from each other. In order to show the dynamics of the variance of the real per capita income log over time and a more accurate study of sigma-convergence theory we will estimate the following equation:

$$D_t = a + b\,D_{t-1} + U_t \quad (6)$$

$$U_t \approx (0, \sigma_u^2)$$

In which D_{t-1} is a constant of D_t. According to equation (6), if b>1, the variance is increasing over time. In other words, there is a divergence in the logarithm of per capita income, and if b<1, the variance is lower than any time before it and thus convergence hypothesis is proven.

2.1 β-Convergences versus σ-Convergence

Following Sala-i-Martin (2002), assume that β-convergence holds for economies $i = 1, ..., N$.
Log-income of the i-th economy can be approximated by (Andrew et al., 2008):

$$\log(y_{it}) = \alpha + (1-\beta)\log(y_{i,t-1}) + u_{it} \quad (7)$$

Where $0 < \beta < 1$ and u_{it} has mean zero, finite variance, σ_u^2 , and is independent over t and i. Manipulating (7) yields

$$log\left(\frac{y_{it}}{y_{i,t-1}}\right) = \alpha - \beta\log(y_{i,t-1}) + u_{it} \quad (8)$$

Thus, $\beta > 0$ implies a negative correlation between growth and initial log income. The sample variance of log income in t is given by

$$\sigma_t^2 = \left(\frac{1}{N}\right)\Sigma_{i=1}^{N}[\log(y_{it}) - \mu_t]^2 \quad (9)$$

where μ_t is the sample mean of (log) income. The sample variance is close to the population variance when N is large, and (7) can be used to derive the evolution of σ_t^2:

$$\sigma_t^2 \cong (1-\beta)^2\sigma_{t-1}^2 + \sigma_u^2 \quad (10)$$

Only if $0 < \beta < 1$ is the difference equation stable, so β-convergence is necessary for σ- convergence. (If $\beta \leq 0$ the variance increases over time.)[1] Given $0 < \beta < 1$, the steady state variance is,

$$(\sigma^2)^* = \left[\frac{\sigma_u^2}{1-(1-\beta)^2}\right] \quad (11)$$

Thus, the cross-sectional dispersion falls with β but rises with σ_u^2. Combining (10) and (11) yields,

$$\sigma_t^2 = (1-\beta)^2\sigma_{t-1}^2 + [1-(1-\beta)^2](\sigma^2)^* \quad (12)$$

This is a first-order linear difference equation with constant coefficients. Its solution is given by:

$$\sigma_t^2 = (\sigma^2)^* + (1-\beta)^{2t}[\sigma_0^2 - (\sigma^2)^*] \quad (13)$$

Thus, as long as $0 < \beta < 1$, we have $|1 - \beta| < 1$, which implies that:

$$\lim_{t\to\infty}(1-\beta)^{2t} = 0. \quad (14)$$

This ensures the stability of σ_t^2 because it implies that,

$$\lim_{t\to\infty}\sigma_t^2 = (\sigma^2)^*. \quad (15)$$

Moreover, since $(1 - \beta) > 0$, the approach to $(\sigma^2)^*$ is monotonic.

[1] If the $\beta = 1$ the variance is constant, and if $\beta > 1$ then the partial correlation between (log) income and its previous-period value would be -1 and the series would oscillate, potentially from positive to negative values and back (making little economic sense).

It follows, therefore, that the variance will increase or decrease towards its steady state value depending on the initial σ_0^2. Therefore, σ_t^2 can be rising even if β convergence is the rule. Intuitively, economies can be β-converging towards one another while, at the same time, random shocks are pushing them apart.
The above example is stylized. In real economies, σ-convergence would also depend on whether or not disturbances are correlated, and have constant variances, across time and economies. Still, even in the stylized example, β-convergence is necessary but not sufficient for σ-convergence (Andrew et al., 2008).

2.2 The Empirical Evidence

Research conducted by Barro and Sala-i-Martin (1991) is one of the most important pioneer studies. In this research, the economic convergence in different states of America, the European Union and Japan was studied during the period of 1960-1985. Based on obtained results, because of different structural parameters in regions, absolute β convergence was not confirmed in these regions. They studied the convergence between America's states and found that the amount of β was about 2%. The results were almost the same in other regions. In addition to confirming the convergence between each state's regions, they also studied sigma-convergence. The results showed that sigma convergence applies to America's states, the European Union and Japan. This means that the standard deviation of GDP per capita had been decreasing.
Wei (1998) once without accounting for human capital variable, and once again with the presence of this variable in the model, studied the income convergence between Canada's states and compared the results with cross-sectional state. This study showed that the speed of convergence using panel method is more than cross-sectional method, and attraction of production to capital has been reported to be less.
Guetat and Seranito (2007) using Unit root test of panel data, studied β absolute and conditional convergence in 9 countries in the MENA region, during 1960-1990 and 1960-2000. Results show convergence of most of sample countries during both periods.

Methodology

In this study required statistical information and data are collected using library method. This study's proximity range, which is an international study, is limited to 13 MENA countries in the region including Jordan, Algeria, UAE, Iran**,** Bahrain, Tunisia, Sudan, Syria, Saudi Arabia, Malta, Mauritania, Morocco, Egypt and the members of Organization for Economic Co-operation and Development, including Austria, Spain, Australia, Germany, UK, USA, Italy, Ireland, Belgium, Portugal, Denmark, Japan, Sweden, France, Finland, Canada, South Korea, Norway, the Netherlands and Greece. The period of statistical data related to MENA countries is form 1980 to 2008 and the data (WDI, 2010) related to members of Organization for Economic Co-operation and Development are over the period of (1970-2009) and are based on the most available information.
According to the above description, the model is used in this way for studying convergence is the present research:

$$\frac{1}{\tau}\left[\mathrm{Log}(y_{i,t}) - \mathrm{Log}(y_{i,t-\tau})\right] = \beta_0 + \beta_1 \mathrm{Log}y_{i,t-\tau} + \beta_2 Z_{i,t} + \varepsilon_i \qquad (16)$$

In the above equation τ, $\mathrm{Log}(y_{i,t})$, $\mathrm{Log}(y_{i,t-\tau})$, β_1, $Z_{i,t}$ and ε_i are respectively length of the period, end of period log of per capita income, beginning of period log of per capita income , the speed of convergence, a combination of control variables influencing the per capita income growth rate and residual. Islam's (2003) findings showed that In order to eliminate the effect of short-term fluctuations on the estimation of convergence coefficient, it's necessary to use the average of non-overlapping data in estimating the model. In the way that the entire period is divided to 5 year sub-periods (τ=4 times the number of periods). Within this framework, control variables are calculated in the form of 5 year averages in each period. In the above equation, dependent variable is the average per capita income growth rate during the studied period. If the equation (16) is estimated without the control variables and β_1

coefficient is estimated between zero and minus one (0>β_1>-1), absolute convergence is confirmed and If while the control variables are entered in the model, β_1 coefficient is estimated between zero and minus one (0>β_1>-1), in this case the hypothesis of conditional convergence of β will be confirmed. In order to estimate the conditional convergence model the following control variables are used and their impact is studied on the income growth and speed of convergence in MENA countries and OECD:

Since human capital is a good predictor for showing the income differences in countries, educational acquisition variable entered growth model as an alternative for human capital. In this study, the percentage criteria of the people 25 years and older who have a college education was used. The data was collected by Barro and Lee (2010). This variable is expected to have a positive effect on the rate of economic growth (DiCaprio, 2013).

Fixed capital formation is a key component of final demand for goods and services and is essential for production in the future and is a platform to transfer technology to the structure of domestic production. The data on gross private fixed capital formation to GDP is used as a representative for investment. The estimated coefficient depending on the type of efficiency to scale can be positive or negative.

An effective way for a country to accelerate its production of knowledge is importing the technology used in goods from the more developed countries. Accordingly, to determine the external effects of knowledge economic openness scale has been used. This scale is calculated by dividing the 5-year average of the sum of exports and imports to GDP. The sign of the estimated coefficient is not predictable.

The effects of the government's intervention are determined by average levels of government's share of total consumption to GDP for each period. According to Barro and Sala-i-Martin (2003), if the government expenditures are used in productive sections such as education and infrastructures there can be a positive effect on the economic growth otherwise there will be negative effects on the economic growth.

In this research, the average levels of inflation are used for each period. Since inflation, causes disturbance in resource allocation in economy and technological changes are slow under these circumstances, the estimated coefficient is expected to be negative.

According to convergence hypothesis, factors such as physical and human capital which are effective on economic growth are more effective in low-income economies compared with high-income economies. Therefore the coefficients of physical capital and human capital in MENA countries are expected to be more powerful according to estimations.

To calculate the speed of β convergence, after calculating convergence coefficient the equation below is used:

$$b = \frac{1-e^{-4\beta}}{4} \tag{17}$$

Accordingly, the time required for the adjustment of half the gap between current income and stable equilibrium is obtained as follows:

$$e^{-\beta t} = 0.5 \tag{18}$$

Results

4.1 The Results of proposed model estimation for selected MENA countries

In order to study the sigma-convergence, at first the variance of log of per capita income for the years (1980-2008) are calculated using equation (5) and the trend is plotted in Figure 1:

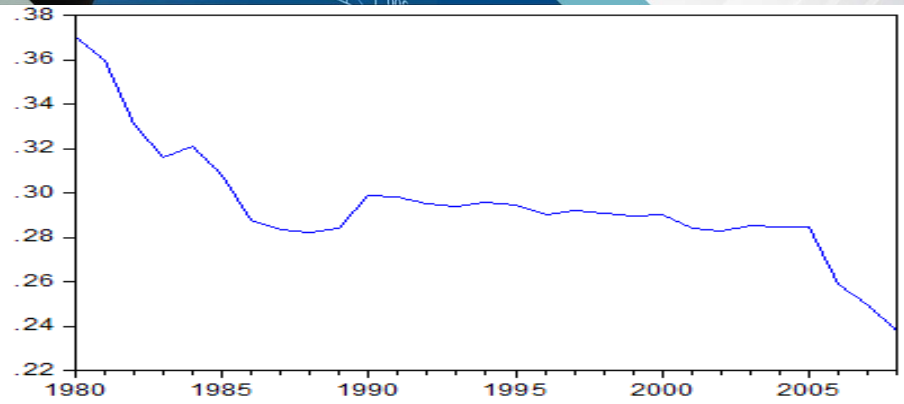

Figure 1. Sigma-convergence in MENA Countries (Source: the calculations of authors)

According to the diagram above, the variance of the log of per capita income, despite the fluctuations, has a downtrend. As it can be seen in Figure 1, the variance of the log of per capita income has decreased from 0.37 in 1980 to 0.23 in 2008. Therefore sigma-convergence is confirmed in selected MENA countries. Results from estimating equation (6) which is done to study sigma-convergence, are given in the following equation:

$$D_t = 0.039 + 0.85\ D_{t-1}$$
$$R^2 = 0.86, t = 12.63$$

As the above equation shows, according to the significant coefficient the variance is declining with a descending rate. So sigma-convergence is observed in selected MENA countries' per capita income. To test the absolute convergence hypothesis, equation (16) is used without entering the control variables.
At first the reliability of the variables is studied using Levin, Lin and Chu tests. Based on this test's null hypothesis, the existence of unit root is not verified, and the data is in static level. To choose between least-squares consolidated model (pool) and fixed effects model F-Limer test is used (Choi, 2001; Novak, 2007; De Blander, 2012). In table 1, the results of the pool test for combined data are given:

Table 1. Estimation results of the pool test for combined data (The dependent variable is the per capita income growth rate)

Variable	Coefficient	t-statistics	Levels of Possibility
Intercept	0.03	4	0.00
Log of Initial per capita income	-0.01	-2.5	0.01
R^2	0.085		
F state	7		
Unit root test	-10.43(0.00)		
Restrict F state	1.54		
Speed of convergence	1%		
The half-life of per capita income	69 years		

Source: the calculations of authors

In the table above, the number in parenthesis shows the probability of rejecting the H_0 hypothesis. Since the coefficient of the log of initial per capita income is a number between minus one and zero, and with regard to the significant estimated coefficient, there is an inverse relationship between the initial state of the log of per capita income and per capita income growth rate over time. So the absolute convergence hypothesis is confirmed. The estimated convergence rate indicates that every year 1% of the gap between

per capita income and the level of stable equilibrium of the countries present in the sample is reduced. Accordingly, the time needed to adjust half the gap between current income level and the level of stable equilibrium will be 69 years.

It is necessary to consider the specific characteristic of each country in the estimates. Before estimation, the reliability of the variables is studied at first, and then the effects of a series of control variables on the economic growth and the speed of convergence are analyzed. In Table 2 the results of panel estimation with fixed effects are provided:

Table 2. Shows the results of panel estimation with fixed effects (The dependent variable is the per capita income growth rate)

Variable	Coefficients	t-statistics	Levels of possibility
Intercept	0.13	4.04	0.00
Logarithm of initial per capita income	-0.043	-4.57	0.00
Human Capital	0.004	6.14	0.00
Investment	0.0004	1.68	0.09
Government consumption	-0.001	-2.99	0.00
Inflation	-0.0002	-1.7	0.09
Degree of trade openness	0.0001	1.65	0.10
R^2	0.84		
F state	18.42(0.00)		
Unit root test	-8.53(0.00)		
Restrict F state	10.18		
Hausman state	44.56(0.00)		
Speed of convergence	4.3%		
The per capita income's half-life	About 16 years		

Source: the calculations of authors

In this table, Levin et al. (2002) test is used for unit root hypothesis test. According to the null hypothesis of this test, the unit root cannot be validated. So panel data are static. Conditional F-test was used to choose between least-squares consolidated model and panel model, and Hausman (1978) test was used to choose between fixed and random effects which showed the acceptance of fixed panel effects for estimating the conditional convergence model (Bücker et al., 2012). The assessments of the results show a negative relationship between initial per capita income and per capita income growth rate in the studied countries over the period of 1980 to 2008. That is the less the initial per capita income, the rate of economic growth will be more during the period. Therefore based on the results, the neoclassical growth model for conditional convergence is confirmed. The sign of all descriptive variables is consistent with theoretical expectations. Human capital and government consumption variables have 5% error level and investment, inflation and the degree of trade openness variables are significant at 10% error level. According to forecasts of Islam (2003), the obtained convergence speed is higher than the speed of convergence in a situation where countries are converging toward a stable equilibrium level of income. In other words, the specific conditions of each country can be a driving factor for converging the country's per capita income to its stable equilibrium level. Based on the information given in the Table 2, it is expected that one percentage increase in the number of people with a university degree, investment, trade openness, government consumption and inflation respectively increases MENA countries' growth rate of per capita income by 0.004, 0.0004, and 0.001 percent and decreases it by 0.0002 percent, 0.0001 percent. Comparing coefficients indicate that human capital has the most effect on the economic growth in selected MENA countries compared to fixed gross private capital formation assuming that other

circumstances are fixed. This variable has been able to increase production with development and attraction of technology and thus result in economic growth.

4.2 The Results of the assessment of the proposed model for selected OECD countries

Figure 2 shows the result of the calculating the variance of the log of per capita income according to equation (5) for 20 selected OECD countries during (1970-2009):

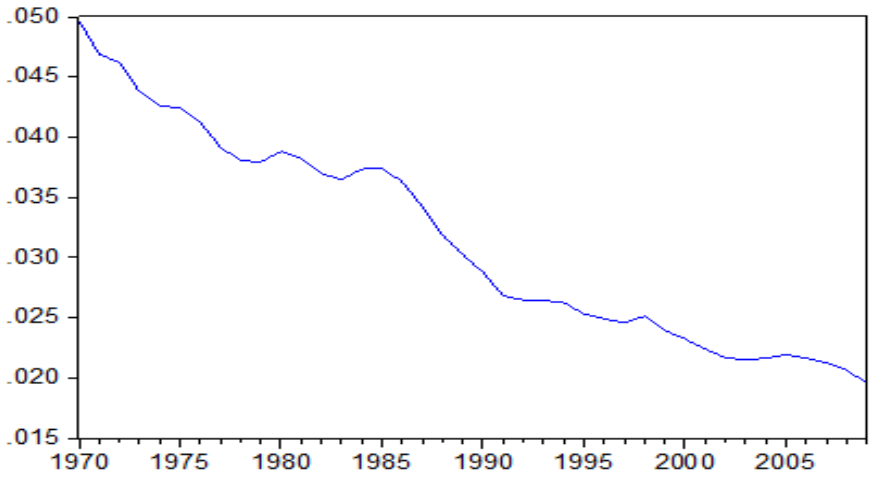

Figure 2. Sigma-convergence in OECD countries

Source: the calculations of the authors

As it can be seen in Figure 2, the variance of the log of per capita income has decreased from 0.05 in 1970 to 0.019 in 2009. According to the above chart, low dispersion is observed over time. The slope of the trend line is relatively high so it can be concluded that the rate of convergence is high too. The results of estimating equation (6) for determining the sigma convergence are given in the equation below:

$$D_t = 0.00045 + 0.96\ D_{t-1}$$

$$R^2 = 0.99, t = 62.7$$

Since decrease in real per capita GDP dispersion over time indicates the approval of sigma convergence between countries, so according to the diagram and the determined equation, sigma convergence is confirmed in OECD countries. In this step the absolute convergence model is determined for this group of countries using equation 16. With Levin et al. (2002) unit root tests, conditional F-test and Hausman (1978) tests the hypothesis of Unit root, least-squares consolidated model and Random effects model of panel are denied (Bücker et al., 2012). The results of panel test are given in table 3 to determine the absolute convergence model.

Table 3. The results of determining the panel with fixed effects (The dependent variable is the per capita income growth rate)

Variable	Coefficients	t-statistics	Levels of possibility
Intercept	0.156	11.3351	0.00
Logarithm of initial per capita income	-0.034	10.64	0.00
R^2	0.53		
F state	6.95		
Unit root test	-4.62626(0.00)		
Restrict F state	4.84		

Hausman state	7.9538(0.00)
Speed of convergence	3.7%
The per capita income's half-life	About 19 years

Source: the calculations of the authors

According to the above table, the estimated coefficient on the log of initial per capita income Shows that there is an inverse relationship between growth rate and the initial state of the log of initial per capita income. Therefore there is an absolute convergence between sample countries. It should be noted that many of factors are effective in explaining the growth rate and in absolute convergence only the beginning of period per capita income has been taken into account. Human capital, investment, government consumption, inflation and trade variables are entered into the model to find the variable with the most effect on the per capita income growth during the desired period. Table 4 shows the results of the panel estimation with fixed effects:

Table 4. The results of panel estimates with fixed effects (The dependent variable is the per capita income growth rate)

Variable	Coefficients	t-statistics	Levels of possibility
Intercept	0.34	10.245	0.00
The logarithm of initial per capita income	-0.074	9.144	0.00
Human Capital	0.0003	1.6	0.10
Investment	0.0002	1.16	0.24
Government consumption	-0.001	-4.36	0.00
Inflation	-0.0011	-7.6	0.00
Degree of trade openness	0.00007	1.58	0.11
R^2	0.65		
F state	8.53(0.00)		
Unit root test	-8.12(0.00)		
Restrict F state	6.92		
Hausman state	63.38(0.00)		
Speed of convergence	8.7%		
The half-life of per capita income	About 8 years		

Source: the calculations of the authors

In the above table, based on Levin, Lin and Chu tests, panel data are static. Conditional F-test and Houseman test show the acceptance of panel's fixed effects to estimate the conditional convergence pattern. The obtained coefficients, except investment, have a relatively good level of significance. It is expected that one percent of increase in those with a university degree, investment, trade openness, government consumption and inflation increase the growth rate of per capita income in OECD countries respectively by 0.0002, 0.0003, 0.00007 percent and decrease it by 0.001 and 0.001 percent. The half-life of per capita income shows that selected countries are close to their sustainable level. Increase in the speed of convergence compared to the previous case shows that increase in investment, human capital and trading has a positive impact on income and growth allowing a faster achievement of equilibrium in each of the countries. In other words, it reduces the time needed to read sustainable state in each of the countries.

Conclusions

In this study, the process of economic convergence in selected MENA countries and the members of Organization for Economic Co-operation and Development were studied. Also the impact of human and physical capital on the speed of convergence and sigma convergence was tested. The results of this study, validates the absolute convergence hypothesis for both aforementioned groups of countries. Based on the findings, the convergence rate in OECD countries is more than MENA countries. One explanation for this finding can be higher per capita income in OECD countries. In fact, since the MENA countries don't have the same per capita income and there is a significant difference between them, they will have a smaller speed of convergence to reach a shared equilibrium level so that Each year, only 1% of the gap between the per capita income and the level of stable equilibrium state is reduced in the countries present in the sample.

For estimating the conditional convergence model human capital investment, economy's degree of openness, government consumption levels, and Inflation Indicators were used as control variable. The results showed that considering control and regional variables, the speed of convergence increases. According to results with the addition of the mentioned variables, the speed of convergence in MENA countries increased from 1% to 4.3%. In OECD countries this number increased from 3.7% to 8.7%.

The fact that human and physical capital contributes more in MENA countries' economic growth and yet they have a lower per capita income than OECD countries indicates that there are many structural factors in these countries which act as growth brake and cause these countries to converge towards a low-level equilibrium trap. Due to the importance of the economy's degree of openness, lower-income countries should benefit from trade more than high-income countries because trade facilitates technology transfer between countries, changes the price of factors and converges the per capita income. But it was not observed in the estimated results and the coefficient of the degree of openness was equal in both groups of countries. Evaluation and examination of sigma-convergence in both groups of countries, showed a decreasing trend in the countries' standard deviation of GDP per capita in the studied period.

According to the research findings, a strategic proposal is that MENA countries expand their endogenous trade utilizing their domestic potential capacities and intergroup large markets. Since foreign trade along with the strengthening the infrastructures have a high degree of importance for the economic development of the countries, so it is essential that in order to the transfer wealth from rich countries to the poor ones, foreign countries' direct investment be directed to poor countries' import sections. Because this study shows the influential role of human capital on the speed of convergence especially in the countries with low per capita income, paying more attention to human capital formation is this study's other proposed policy.

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