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Higher education and economic growth nexus

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Abstract
In this paper we try to examine the relationship between higher education and the GDP per capita. Indeed, most theoretical analyzes have confirmed that human capital has positive and significant effect on growth. This article explores time series causality between human capital (particularly higher education) and growth in three different countries, namely Tunisia, Morocco and South Korea during the period 1960-2011. For this, we use cointegration techniques and Granger causality tests. The results show that cointegration between higher education and economic growth exists only in South Korea. This finding is explained by the high level of human capital and the country's economy.

Keywords: human capital, economic growth, Granger causality, cointegration, higher education

1. Introduction
This work is part of the theme of research framework "Human Capital and Economic Growth "especially" higher education and economic growth." However, it is profitable to invest the field of development of human resources in higher education. The interest of this subject is justified by recent developments.
Economic growth as calculated measures only the quantitative variation of an economic aggregate (real GDP per head, it represents the best indicator of well being) it is not synonymous with development in the proper sense.
The development is a rather abstract notion defining the qualitative development of a country and resulting in economic, demographic, cultural or social, development is usually associated with growth, but there can be growth without development.
The issue was to investigate the effect of higher education on economic growth in three main countries of Tunisia, Morocco and South Korea to compare the results obtained in the estimation of time series data. This allows identifying the importance of state intervention in the field of education in a world with a growing privatization push.
It should be noted that the concept of human capital and its formulation are advanced from the sixties. However, the importance of human capital has been studied since the seventeenth century.
Adam Smith (1776) [1], a classical economist, developed the basic concepts of growth theory in his book "The Wealth of Nations" by considering that human beings were a part of the wealth of nations, so improving the level of education leads to increased efficiency of all production factors. This helps explain the disparity of income between developed and developing countries. In the first paragraph, we present the theoretical part which is envisaged to analyze the different transmission mechanisms through which education contributes directly or indirectly to growth.
We will show the effect of human capital as a factor of production, some studies have approved its contribution either by externalities (Lucas (1988)) [2] or by the trade openness (Berthélemy and Varoudakis (1997) [3]) or improving health (David Weil (2005) [4]).
Then we plan to show the role of human capital in imitation and innovation based on the report of Aghion and Cohen (2004) [5]. The theoretical part is a preparation of the empirical part to explain some necessary concepts and mechanisms.
The last section will be dedicated to the empirical part of which we will try to examine whether the results of recent empirical analyzes concerning the effect of education (especially higher education) on economic growth coincide with the theoretical results. It is essential to remember old fundamental empirical work before presenting recent work. Economists still refer to the old basic models. These will be summarized in a summary table.

Finally, we will study the causality between higher education and growth for three countries (Morocco, Tunisia and South Korea) by making estimates on time series data for the period from 1960 to 2011 and that in working on the E-Views econometric software. In other words, we will meet our problem namely the effect of higher education on economic growth. For this, several tests will be performed by following a certain methodology called "The methodology causality tests."

After making various estimates, it will interpret the results and we will try to compare the results to see if they are consistent with literature or not.

2. The transmission mechanisms of the effect of education on growth economic

The transmission mechanisms can be divided into two sections, the first considers human capital as a factor of production and the second emphasizes the role of human capital stock in the imitation and innovation activities.

2.1 human capital is a factor of production

It is from the 1960s that economists began to analyze the effect of human capital on economic growth. Over the years some of them have theoretically studied the impact of education on the growth rate. They agreed on the idea that the accumulation of human capital has a positive effect on growth, but opinions will differ on the mechanism by which human capital affects growth. The introduction of human capital in the production function has contributed to improving the quality of labor input which helped to increase the growth rate of GDP per head.

The first pulse was given by Schultz (1961) [6] and Denison (1962) [7]. They stressed that education contributes directly to growth by improving the qualifications, skills and productive capacities of individuals. The main purpose of Denison studies was to find out the contributions of the various factors of production to economic growth.

With reference to studies of Solow (1956) [8] and Schultz (1961), Denison was based on a function Cobb-Douglas, Y = f (K, L, ED) with Y is aggregate output, L is labor, K is physical capital and human capital is the ED. This function shows the growth rate of GDP per capita is the sum of two terms. The first is the share of growth explained by the increase of production factors such as labor and capital. The second term is the unexplained part of the growth by these factors. This share measure called the Solow residual or changes in total factor productivity (TFP). To reduce the share of the unexplained residual, Denison added the level of education and showed that a good proportion of the residue falls under education.

Denison's research (1962) showed that increasing the educational level of the US population during the thirties led to a remarkable growth which is not the case for European countries. The results of empirical work of Denison claim that there is a strong correlation between the level of growth of training and that of productivity.

2.2 The external effects

With the development of endogenous growth theory emerged, according to some economists, other mechanisms by which education has a positive impact on growth. In this theory growth is characterized by the inclusion of human capital and by increasing returns to scale.

Romer (1986) [9] focused in its research, the dissemination of knowledge and innovation which is based on high-level education by ignoring the decrease in yields.

According to work by Lucas (1988) [10] human capital generates externalities. The idea was the main social competence is the result of exchanges of ideas.

Following the theoretical models that have concluded that human capital generates externalities, Romer and Lucas stated that there is a positive correlation between human capital and economic growth. This explains the disparity of income between countries.

Barro (1991) [11] confirmed that there is a positive relationship between the initial level of human capital and the growth rate of GDP per capita and a negative correlation with the initial level of per capita product.

The empirical approach developed by Gemmel Norman (1996) [12], based on the model of Mankiw, Romer and Weil (1992) [13], says that in different countries there was a correlation positive between education and growth of long-term per capita income.

In this context, the results show that human capital has a positive and significant effect on growth through both the level of initial human capital and accumulation for the three levels of education. The level of human capital affects income growth tends to vary according to the group to which the country belongs. Indeed, the results show that primary and secondary education has a greater effect in developing countries, while higher education has a greater effect in advanced countries.

In addition, the externality presented by Lucas (1988), related to the average social level of human capital in the economy has a positive effect and shows that the social return is higher than the individual return. Indeed, the average social level of human capital reflects the collective effects caused by the improvement of individual abilities of the workforce. Lucas's model shows that the aggregate increasing returns, thereby generating a positive endogenous growth rate of long term.

3. The role of human capital through imitation and innovation channels

The bearing theoretical approaches to the relationship between education and growth confirm the positivity of the correlation between human capital accumulation and economic growth.

Higher education is a key element of economic development and the building of the knowledge economy.

Mankiw, Romer and Weil scientists reported that scientific students have more effect on the economic growth of the country than those who study the human and legal sciences "Spending is not all education is intended to yield productive human capital: philosophy, religion, and literature for example... "(1992). Aghion and Cohen (2004) analyzed the impact of education on growth and focused on two mechanisms: The accumulation of human capital and technological progress.

- The accumulation of human capital implies that an individual can become productive as it passes through the education system. The example presented in the report is that of France, one additional year of education increases the productivity at about 8%.
- Regarding the technical progress, the higher the education level, the higher the ability to develop or adapt new technologies will be easy.

According to Aghion and Cohen the impact of education differs depending on the degree of development regional, like the distance to the technological frontier consisting of the United States. This distance is measured by total factor productivity (TFP) of the country compared to that of the United States. This productivity measure the fraction of output (usually GDP) not attributable to growth in the volume of production factors (physical capital and labor) and can explain the differences in development between countries.

Human capital we go step by step in the contribution to growth to a more detailed analysis that is important especially for countries close to the technological frontier that will be important to focus on higher education. Higher education is an important factor that defines the overall productivity of factors as it is able to train researchers, scientists and high levels of technicians. It also facilitates the development of production capacities and access to knowledge worldwide.

The empirical findings of this report confirm that if the distance between the country and the technological frontier is important then that country must invest in primary and secondary education and the main activity is the imitation of technologies discovered by the rich countries. In contrast, if the distance is reduced, the country has more interest to innovate and invest in higher education. However, there is a threshold below which developing countries are called away from the technological frontier and must adopt a strategy of imitation to stimulate growth. Beyond this threshold countries must innovate to increase growth. This threshold is estimated at 24% below the technological frontier, it's ready to be the level where France is currently located. The adoption of the strategy of imitation requires government intervention by limiting competition and public subsidies to provide enterprises with the means to recoup their investments because of capital market failures. In contrast, countries that are closer to the technological frontier, represented by USA, adopt the innovation strategy.

Hence it is desirable that young companies appear since they are characterized by competent personnel. Growth in these countries will be slower than in low- and middle-income as the demand innovation activity more time and more money. However, investment in higher education and research is expensive.

It cites the example of France, which increased spending in higher education for 0.7 points of GDP (from 1.3% to 2% of GDP) can increase growth by 0.2 percentage points in ten years. According to Aghion and Cohen, the main objective of the developed countries is to remain globally competitive. However, the developing countries aim to catch (catching up) the level of development of the rich countries.

Vandenbussche, Aghion and Meghir (2007) [14] discussed human capital contribution to growth by developing a theoretical model and focusing on two strategies namely imitation and innovation. They got almost the same results concluded by Aghion and Cohen (2004). They have adopted two different theories:

- Study the relationship between levels of education and economic growth. This relationship was investigated by Nelson and Phelps (1966) [15] who admitted that in a country far from the technological frontier is through education that there is possibility of adapting technology which positively influences growth. That is more the worker is educated is its ability to acquire technologies will be fast and efficient.
- Study how the impact of human capital composition on growth depends on the distance of the country at the border.

The idea of the model is shared with Benhabib and Spiegel (1994) [16]; the high-level human capital enhances the ability of a country to imitate new technologies. Which accelerates the speed of convergence of the developing countries to the level of total factor productivity (TFP) achieved by developed countries.

The conclusions drawn by Vandenbussche, Aghion and Meghir (2006) are as follows. First, the increased productivity of innovation requires a large number of skilled workers, which explains the reallocation of labor from imitation to innovation that will have a remarkable impact on growth. Then the increase in the rate of growth is due to the increase skilled human capital, not the total human capital.

In this regard, to determine the impact of human capital on the growth it is important to know not only the distance of the country at the technological frontier but also the human capital composition.

4 The effect of education on economic growth

The theoretical contributions have analyzed the economic effects of education on growth by two approaches: the microeconomic approach and the macro approach.

4.1 The micro economic approach

This approach implies that an additional year of education increases productivity the individual and the future income. Human capital is a personal investment that is evaluated by the difference between the benefits (future earnings) and direct costs (costs of education spending) and indirect costs (opportunity cost, ie the individual receiving salary if he had entered the labor market).

Human capital theory was developed in 1964 by Gary Becker [17], whose main idea was to consider that education is an investment for the individual. The value of this investment depends on the monetary cost of education and expected future gains from knowledge. This investment is also important for the company since it provides higher welfare gains for private gains. This is a positive externality which public intervention is explained. The micro-economic approach on the performance of education refers to the "Mincer equation."

The latter explains the logarithm of the salary of a person as a linear function of the number of years of education of that individual. Mincer (1957) [18] and Becker (1964) approved the idea that optimal individual must arbitrate between the increased salary upon entering the workforce and the loss of income they suffer for the extra year of study. The yield of education is underestimated due to the non-consideration of externalities of Mincer equation.

4.1 The macroeconomic approach

Unlike the micro-economic approach, the macroeconomic approach takes into account externalities. This approach began with the neoclassical model of Solow (1956), the production function is composed of two factors namely capital and labor. Its main finding was the decrease in factor returns.

In this approach there are two currents: Endogenous growth : Lucas (1988) and Barro (1990) have questioned the neoclassical theory in terms of diminishing returns for an accumulative factor and focusing on externalities. On the

other hand, Mankiw, Romer and Weil (1992) who introduced the accumulation of human capital in the Solow production function without changing its main logic.

5 Empirical analyses: Time Series Estimation

In this part we will study the causality between indicators of higher education and economic growth. Recall some empirical work on which was conducted this analysis. Magali Jaoul (2009) [19] developed the hypothesis of Aghion and Cohen said that the role of education on growth varies according to the degree of development of the country. Jaoul extended previous work to test econometrically causality between higher education and growth. He made an international comparison between France, Japan and the USA. The variables used are the number of higher education and GDP. The results affirm the existence of bidirectional causality for Japan, while for the US it is rather the reverse, there is only causality from GDP to the staff of the superior. In contrast, in France, there is no relationship between these two variables were entered.

Aghion and Cohen (2004) distinguished between different sectors "They (universities) have often chosen to develop new channels, more professionalized or even immediate professional purpose and as often shorter than those of the faculties...This movement was later extended to other countries, the most recent examples being those of countries which, alongside traditional faculties had until then that high-level engineering programs such as Switzerland. "According to these economists, we must distinguish between the humanities and arts graduates and graduates in sciences and engineering since there are specific pathways involved in the development of the country.

Boulila and Haddar (2006) [20] studied the causality between higher education and economic growth in Tunisia. They used as indicators of higher education the number of years of study and education spending, and real GDP per capita as an indicator of economic growth. The authors found that causation was absent between education and growth and that the Tunisian education system is far from a long-term growth factor as a short term.

From those econometric analysis, we will test the cointegration and the error correction model to study the causal relationship between higher education and growth for three countries; Morocco, Tunisia and South Korea. The work is divided into three principal stages, the first order of integration must be checked using a series of tests Unit root Augmented Dickey-Fuller. Then we will use the b-var Johanson [21] approach for non-stationary variables to study the cointegration. Finally, as part of an error correction model, we will do the Granger [22] causality test on cointegrated variables to determine the causal direction.

The indicators of higher education that we chose are: spending per student as a percentage of per capita GDP (expenditure), the number of graduates in science and engineering (dip) and the gross enrollment ratio in education higher (txsco). The indicator of economic growth is real GDP per capita (y).

The data used are obtained from the Statistical Institute of UNESCO and the World Bank data (CD-ROM World Development Indicators 2011). These data are annual and cover the period 1960-2011.

5.1 Tests of unit root

In a preliminary step, it is essential to check the degree of integration (stationarity) series. The time series are stationary if the variables have no trend that is to say the first moments (hopes and variances) are constant. These variables are called zero-order integrated I (0). However, if the series are non-stationary variables are integrated of order 1; I (1). To test the unit root test is used Augmented Dickey - Fuller (ADF). This test is applicable to residues of the balance equation.

We begin by performing the tests of the unit root on variables expressed in logarithm and first level difference to ensure that the order of integration does not exceed "1". The results obtained are shown in Table (1).

Table 1: Tests the unit roots: Augmented Dickey-Fuller test

Variables in level	GDP per capita	expenditure	dip	txsco
Morocco	-0,3249*	-1,4398*	-1,6592*	-2,5417*
Tunisia	-0,7421*	1,3281*	-0,2375*	-2,5951*
South Korea	-0,7655*	-0,5733*	-0,3490*	-0,8642*

Variables with first difference	GDP per capita	expenditure	dip	Txsco
Morocco	-8,4628	-6,5207	-4,5423	-8,4312
Tunisia	-5,8743	-7,4317	-6,9435	-6,4338
South Korea	-6,7277	-4,8423	-2,8434*	-5,8345

(*) the variable is non stationary

These results obtained with the ADF are significant to a level of 95%... In each case, the null hypothesis assumes that the variable has a unit root so the series studied is integrated "I (1)", and it is said to be non-stationary that is to say it is cleaned its trends.

If the value of the ADF statistic is greater than the critical value, H0 is accepted and the variable is said to be non-stationary. According to the results we note that the variables in level are non-stationary.

ADF tests performed in first differences have made non-stationary variables in stationary variables. The next step is to perform cointegration tests on the variables we accepted the null hypothesis [(I (1)].

5.2 Cointegration tests

We will study the causality between measures of higher education and economic growth. The unit root has allowed us to identify the variables of integration order. The concept of co-integration was introduced by Engle and Granger (1981). Then the cointegration tests appeared with the approach VAR established by Johanson (1988). The disadvantage of this methodology is that it suffers from many shortcomings in the sense that, for example, it cannot be applied in the case of a single cointegration relationship.

Table 2: Cointegration tests

countries	Variables	Hypothesis H0 H1	1960-2010 Trace	Critic value 5%
Tunisia	Y and expenditure	r= 0 r ≥1 r ≤1 r ≥ 2	5,5611 2,5642	15,41 3,76
	Y and dip	r= 0 r ≥1 r ≤1 r ≥ 2	8,5413 1,3287	15,41 3,76
	Y and txsco	r= 0 r ≥1 r ≤1 r ≥ 2	6,6389 1,5318	15,41 3,76
Morocco	Y and expenditure	r= 0 r ≥1 r ≤1 r ≥ 2	5,5243 0,7692	15,41 3,76
	Yand dip	r= 0 r ≥1 r ≤1 r ≥ 2	7,6573 1,9833	15,41 3,76
	Y and txsco	r= 0 r ≥1 r ≤1 r ≥ 2	8,1845 1,7534	15,41 3,76
South Korea	Y and expenditure *	r= 0 r ≥1 r ≤1 r ≥ 2	18,5632 2,8645	15,41 3,76
	Y and dip	r= 0 r ≥1 r ≤1 r ≥ 2	7,8734 2,9475	15,41 3,76
	Y and txsco	r= 0 r ≥1 r ≤1 r ≥ 2	9,8446 1,1328	15,41 3,76

(*) Detection of a threshold cointegration 5%
r: is the number of cointegrating vectors is that the rank of the cointegration

The principle is that if the value calculated from statistics of the trace is greater than the critical value associated with it, then we reject H_0 (r = 0) and (r≤ 1) in favor of H_1 (r ≤1) and (r ≥2) which means the existence of at most two cointegrating relationships.

- In the case of South Korea, the value of statistical track of the variable(y and expenditure) is greater than the critical value, so the null hypotheses are rejected and we only accept the alternative hypothesis H_1 where (r ≥1). It concludes that there is one cointegration at 5%. For other variables cointegration is not detected.
- In the case of Tunisia, we note that for the variables (y and expenditure), (y and txsco) and (y and dip) null hypothesis (r = 0) and (r ≤1) are accepted at the 5 %: while cointegration is absent.
- Similarly in Morocco, we accept the null hypothesis and it is noted that there is no cointegration between variables. When cointegration is detected it can be said that there is a steady state in the same sense coevolution between higher education and economic growth indicators giving the long run co-integrating vector or a state of the long-term equilibrium.

5.3 Granger causality tests

It is essential to recall the definition of causality Granger: It is said that because Xt Granger Yt if current and past information, Xt helps to improve forecasting Yt variable. This definition is based on the dynamic relationship between the variables. In our case, we make use of a bivariate VAR (BVAR) with variables expressed in first differences to solve the causal direction problem detection cointegration allows to introduce the error correction model (ECM) that prevents sets too far from their long-term equilibrium.

Short term causality tests

In the case where the variables are not cointegrated (from Table (2)) Granger causality tests are carried out in the short term with a bivariate VAR in first differences since the error correction model is not appropriate.

Table 3: Granger causality tests

	F (k, n)	F (k, n)
Morocco		
(y and dip)	2,7623	0,6345
(y and expenditure)	1,5139	1,5398
(y and txsco)	1,5487	0,6342
Tunisia		
(yand txsco)	0,3487	1,5437
(y and dip)	1,4287	1,7639
(y and expenditure)	0,5693	0,0864
Corée du Sud		
(y and dip)	4,7349*	1,5701
(y and txsco)	0,3178	0,5630

(*)SIGNIFICANCE OF 5%

In the table (3) and for the case of Tunisia and Morocco Fisher statistic is less than the critical value then we accept the null hypothesis. Therefore the test is not statistically significant. There is no short-term causal relationship between higher education and growth. By cons, in South Korea the variable (y and dip) is statistically significant in the short term so we conclude that higher education cause economic growth.

Long term causality tests: The error correction model

Countries adjustment coefficient term of error correction

β Xt-1αXt-1=y t-1-α1(expenditure) t-1- α2

Table 4: The adjustment and the term of error correction coefficients

	α1	α2	
South Korea	0,4279	-0,2731	y t-1 + 8,0315 (expenditure) t-1 – 1
(expenditure)	(4,6183)*	(-0,6234)	(-3,5428)*

The figures in parentheses are the Student t
(*) Significant at 1%

The series presented in the table (4) are cointegrated, α1 is the adjustment coefficient variable indicating higher education and α2 is the coefficient of growth indicator:

- It shows that in South Korea, α1 coefficient is positive and significant, since the term of error correction is positive then the effect of higher education on growth is positive. Similarly, α2 coefficient is negative and not significant when growth has no effect on higher education. In conclusion, the term error correction is statistically significant. This means that there is a long-term causality of higher education to the GDP.

Table 5: Results of Granger causality tests of long-term

education doesn't cause Y		Y doesn't cause education	
t 1: α1 = 0	F1: α1 = 0	t 2: α2 = 0	F2: α2 = 0
Granger causality			
South Korea (4,6183)*	4,8329*	(-0,6234)	1,1925

Significant at 10% at least

The null hypothesis of F1 statistic demonstrates that higher education does not cause GDP. Similarly, according F2 economic growth does not cause higher education.

In South Korea, we note that F1 is statistically significant. So we reject H_0 and found that higher education because Granger economic growth. In other words, long-term, causality is unidirectional from higher education to economic growth.

6. Conclusion

The missions of the universities are multiple, among these missions we note: the development of culture of students in the various areas (letters, science, economics, management, etc.), the training of executives, organizing the scientific and technological research and the development of exchange and cooperation with foreign universities in the field of teaching and research.

Higher education is the highest educational level, it allows to adopt two strategies; imitation is the strategy (for developing countries) by adapting technologies already discovered or the innovation strategy (for developed countries) by creating and developing new technologies. Economically, higher education represents a solution to the problem of unemployment. It also encourages innovation and research and development in all areas (health, industry, export, computer, etc.) which contributes to economic growth. Developing countries ensure diversification of sectors and university courses and training to enhance the openness of educational institutions on the economic environment. In this regard, the national authorities have set the goal of encouraging the university to contribute, through research and training carried out there, to boost the economic process.

The majority of empirical analyzes approved by different estimation methods, the positive impact of education on economic growth. In general, education has a direct and indirect impact on real GDP per capita. Following this model, we studied the effect of higher education on growth in three emerging countries (South Korea, Tunisia and Morocco) to see the change in the magnitude of its effect through these countries. According to estimates, it is noted that the cointegration tests are inconclusive for the cases of Tunisia and Morocco. In contrast, South Korea, specifically for the variable (y and expenditure), cointegration is detected. That is to say that in this country higher education positively affects real GDP per head. This conclusion is logical for the economic gap between countries.

To compare the economic level of a country and have a sustained long-term growth, we must use the human capital indicators (human resources and skills) and not only physical capital.

The proof is the existence of two groups of countries (developed and developing) and disparities in income between them. To solve this problem, several models have emerged to explain this disparity. Developing countries are still trying to improve their economic situation by facilitating access to education (this is the main indicator of human capital).

Higher education has a direct effect on growth by creating jobs (teachers and administrative staff). There is also a public and private good composed of different sectors to meet the needs of the economy. It also has indirect effects by improving the quality of labor. In conclusion, the results obtained in the empirical analysis are consistent with the literature; essentially the work of Aghion and Cohen (2004). These authors claim that for high-income countries it is important to invest in higher education. This goes against the low and middle income countries in their interest it is desirable to invest in primary and secondary education. Empirical studies have shown that education plays an essential role in the process of economic growth.

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