Quality of Higher Education and Knowledge Economy (Comparative Study Using PANEL Data)

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Abstract:

Our study aims to project knowledge economy indicators on the higher education system in order to conduct a comparative study of a sample of 10 countries over a 15-years period using PANEL data. Out founding are that both the percentage of students registered abroad and the framing rate have a negative impact on KEI, while patents, number of registered students and the gross registration rate in higher education have a positive effect on KEI. We also found that the best sample for the study is the random impact sample, where the characteristics of each country are preserved and time is neglected.

Keywords: Knowledge economy, Quality of higher education, Scientific research, Comparative study, PANEL model.

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I- Introduction:

Knowledge has become an important and a pivotal role in wealth creation. The main objective of societies have become generating, disseminating, investing and benefiting from new knowledge by paying attention to education and modern technology in all areas of life, which increased the use of internet, computers and the latest technologies.

This transformation requires interest in developing the educational institutions, especially higher education as it is the center for generating knowledge and modern technology and their use in the community through the improvement of curriculum, teaching staff, quality of students, library, etc. That was addressed in the study of (Peters, M. A. 2007) because it is considered as a fundamental pillar of progress and development and its contribution to the development is effective through two main aspects: the first is the human capital formation according to the requirements of the labor market, and the second is the preparation of scientific articles, patents and projects of creativity and innovation. All these are considered as inputs for the economic development, and to promote them, human capital must be created. Laroche, M., Mérette, & Ruggeri, GC 1999)

Transformation of the university in the world puts it in the middle of competition, as a result the student faces the choice of university where he wants to study in terms of specialization, its relation with labor market, efficiency of the teaching staff, means used in the educational process, i.e. technological means and the way management deals with the student. Hence, we started seeking satisfaction of the student with the institution, and a new culture emerged in education which is the quality of higher education. This led us to formulate the following question: To what extent do knowledge economy indicators affect the quality of higher education?

1. THE THEORETICAL APPROACH OF QUALITY TEACHING:

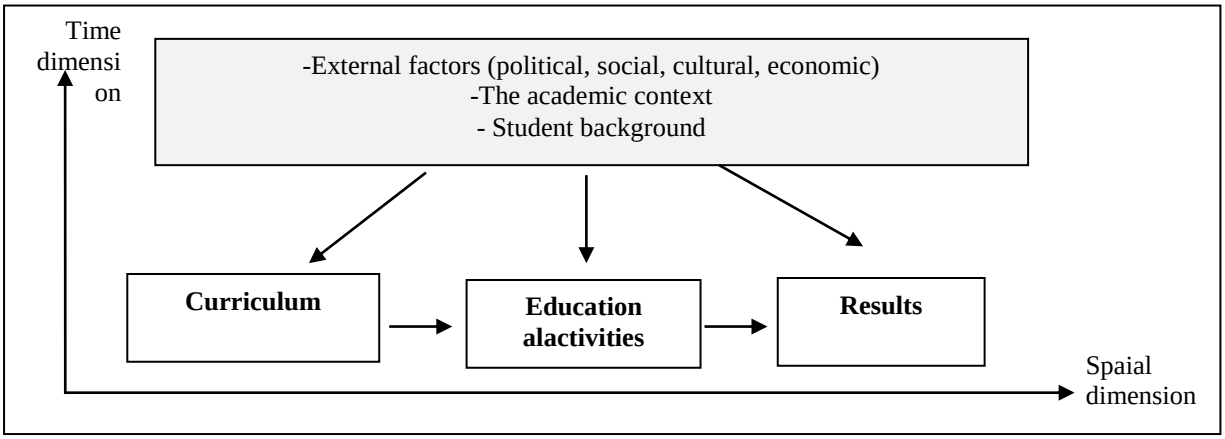
The first who transferred the idea of quality to education in the United States was Malcolm Baldrige. Then American colleges applied the principles of Total Quality Management (TQM) taken from Japan. They were developed at the beginning of the 80s then their application increased in the 90s especially in universities.

The UNESCO Conference in 1998 identified of quality education as a multidimensional concept that should involve all educational functions and activities such as curriculum, educational programs, scientific research, students, buildings, facilities and tools, provision of services to the community and internal self-education, and definition of internationally recognized comparative criteria for quality.

Harvey & Knight (1996) identified five inputs to reflect on educational quality:

- Quality in education can be considered as a distinct exception that can meet the highest standards.
- Quality in the field of education means a state of compatibility between administrative and educational processes.
- Consideration of quality from the point of view of the purpose of product or service.
- Quality is a value that arises from efficiency and effectiveness.
- Quality is a process of qualitative, formal or cognitive change which is appropriate for educational institutions.

Figure 01: University teaching



Source: Ketele, J.MD (2010). University pedagogy: a current in full development (No. 172, pp. 5-13). ENS Publishing.

Most important axes of quality in the educational system:

Institutions differ by their nature (economic, administrative, educational, etc.), so quality varies from one institution to another. For example, higher education institutions do not know the customer, the client or the product, but have inputs and outputs defined by the national center for quality assurance and adoption of the educational and training institutions as the total amount of resources allocated for a particular purpose used to run a system, including human, physical, financial and technical resources, information and time, as for outputs, they are defined as the achievements and final results achieved by the educational system and its outputs are determined according to its mission and objectives. Therefore, it must improve the quality of inputs and follow the learning process to obtain quality outputs that have the ability to compete with the outputs of other educational institutions.

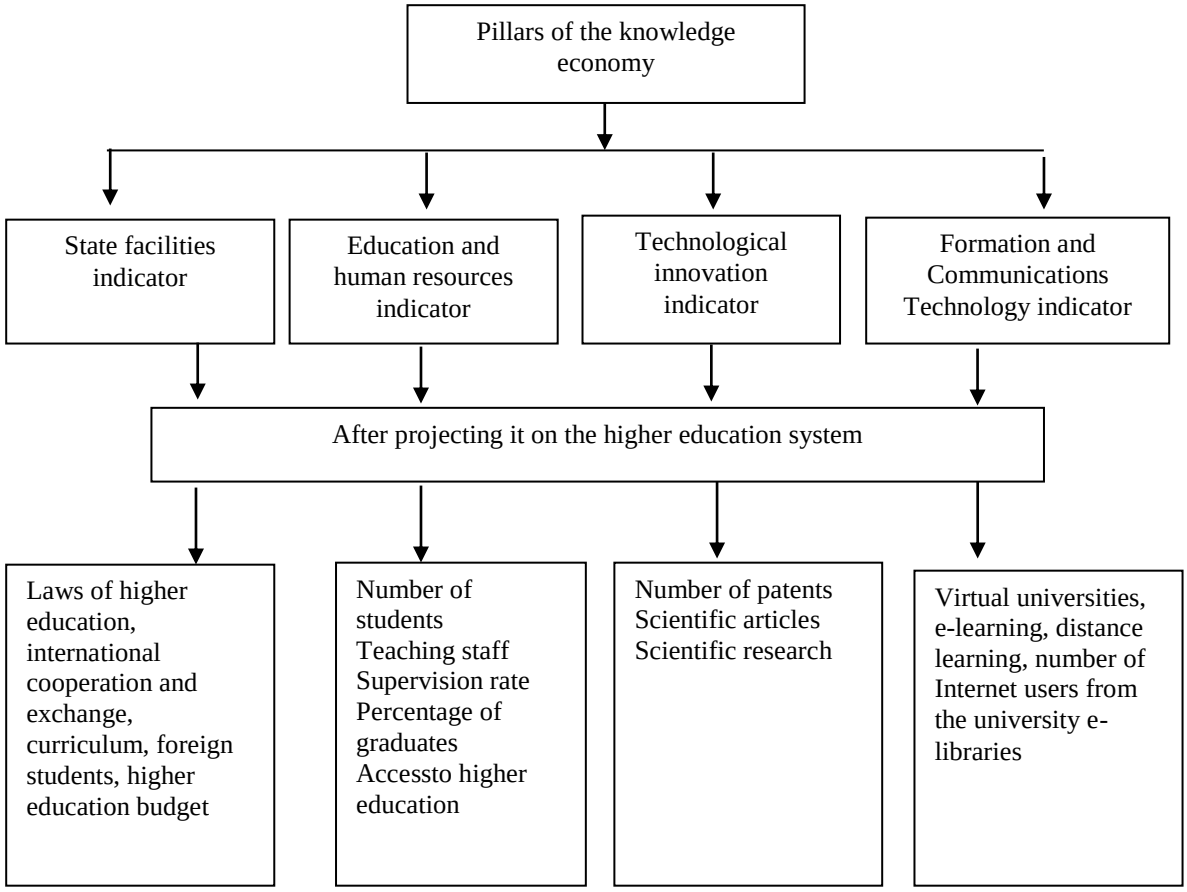
While Ketele (2010) believes that "higher education depends primarily on teaching, so attention must be given to it and the latest methods must be followed to achieve this process. He also considered that all the other activities in the educational institution are only integration with the teaching activity. The teaching function is affected by two main factors: curriculum (programs) and various factors, internal (Ex. insufficient experience of teaching staff members) or external factors (regulations and legislation)"

2. STANDARD STUDY OF THE IMPACT OF ECONOMIC INDICATORS KNOWLEDGE ON THE QUALITY OF HIGHER EDUCATION:

2.1 The empirical model:

The sample of the study is based on the World Bank sample shown in the following figure which shows the four pillars of the knowledge economy. We try to project it on the educational system and its impact on the quality of higher education

Figure 02: Pillars of the knowledge economy



Source: Prepared by the researcher based on the World Bank

Based on theoretical rooting, we will build the study model using The panel data in measurement, the basic model of the spreadsheet.

$$Y_{it} = \beta X_{it} + U_{it} .....(1)$$

Where Y is the dependent variable, i is the unit, t is the time, X is the independent variables, U is the structure of the error limit which is not specified in this equation which seems independent for the units i and time t.

In order to address such issue, we used in this standard study a combined database of 10 countries and at the same time, each series contained 15 years of study, i.e. during the period 2000-2014. In this period especially, the concept of quality spread and all countries sought to achieve their principles and interest in international ranking of countries increased according to the extent of application of the quality principles in their educational institutions. Thus, the number of observation used in the total sample is N = 150.

We will choose the dependent variable that expresses quality and the best variable that can be used is the number of scientific articles indicator which is an indicator that shows the percentage of scientific research in the institution. We have also selected the following countries: Korea, Jordan, Algeria, Malaysia, Turkey, Morocco, Tunisia, France, Spain and Italy. Considering that the State of Korea is at the forefront of creativity and innovation, so we have taken it as a reference country to find out the reality of its higher education, Jordan, Malaysia and Turkey is an Arab and Islamic country in addition to its high quality in higher education, Morocco and Tunisia are almost the same neighbors of Algeria. The economic

and social situation, France being a country with a place and an honorable ranking in the field of higher education in addition to the fact that Algeria derives from most of the educational programs, Spain and Italy, is considered as two developed countries and Algeria has partnership agreements with it in the field of cooperation and exchange between Universities. There are studies that considered the number of scientific articles indicator as an indicator of quality. (Christine Musselin, 2008) This study addressed the French higher education reforms in the recent years and which were executed in early 2000s, the April 18th, 2006 research law led to the creation of ANR (National Research Agency) and AERES (Evaluation Agency for Research and Higher Education). We note that higher education was at the center of politics in most European countries for the transition to the knowledge economy and strengthening the link between economic progress, innovation and research. Universities were put at the center of government's concerns and many decisions led to transform higher education from a mere extension of secondary school curriculum into centers for knowledge dissemination and the creation of scientific research according to the market requirements.

Stady of (King, 2004) This study touched on the order of nations based on publications, to measure the quantity and quality of research in different nations and their martyrdom, and provided all thomson data known as the Institute of "Technical Information" and indexes of more than 8000 journals in 36 languages and considered scientific articles as one of the most important criteria Ranking and achieving quality.

Study of(Lincoln, 1995) shows the importance of scientific research, criteria of evaluating these researches and their impact on educational quality.

2.2 Model formulation and source of data:

We have n for the observation measured in t for time periods; the Panel data sample is defined according to the following model mathematical formula:

$$ARTS_{it} = C_1 + C_2ENCDT_{it} + C_3ETDIS_{it} + C_4ETDB_{it} + C_5BRVT_{it} + C_6TSB_{it} + \varepsilon_i$$

i: Number of states, t: Time period, ε: Random error value

Several studies linked between the knowledge economy and the quality of higher education. Based on that we chose the education variables as follows:

- **Scientific articles:** The dependent variable (Continued variable) in i-watching is represented at the time period we choose because it reflects the quality of higher education and the results of scientific research. It is a very important variable because it measures the educational process outputs and one of the most important criteria for the world ranking of universities, in addition to quality of the database where scientific articles are published such as Thompson and Scopus and the number of citations, thus the variable of scientific articles moved from quantity to quality.
- Patents: (Independent variable) is a clear guide to creativity and innovation in the scientific field, namely, the number of privileges formally awarded to an inventor within a specified period of time.
- Framing rate: (Independent variable) is the ratio of students to faculty, which is a very important and direct indicator because it shows the extent to which the university adheres to the direction of the educational process and is one of the reliable indicators in the classification of universities

- **Number of registered students**: (Independent variable) the student is the focus of the educational process in order to reach graduates of high-quality universities, who have the greatest knowledge and contribute to development.
- **Gross registration rate in higher education**: (Independent variable) the number of students enrolled in higher education is expressed as a percentage of the population of the age group that corresponds to this level of education.
- **Number of students registered abroad**: (Independent variable) shows the process of exchange and cooperation between countries and the extent of the state's facilities in the field of higher education and the extent of the state's support and encouragement of the process of opening up higher education to the outside world, and this indicator helps to a large extent to develop higher education and reach the level required to achieve Development goals.

Table 01: Nature and source of variables

Variable	Study period	Code	Source
Number of scientifc articles	2000-2014	ARTS	SJR (Scientific Journal Rankings)
Framing rate	2000-2014	ENCDT	UNESCO
Number of registered students	2000-2014	ETDIS	UNESCO
Number of students abroad	2000-2014	ETDB	UNESCO
Patents	2000-2014	BRVT	SCOPUS
Gross registration rate in higher education	2000-2014	TSB	UNESCO

Source: Prepared by the researcher.

a. Homogeneity test:

We conduct a homogeneity test using Fisher's statistics under the following assumptions: H_0: sample without effect, H_1: sample with effect Through the following formula

$$F^C = \frac{SCR_0 - SCR_1}{SCR_1} * \frac{dl(H_1)}{dl(H_0) - dl(H_1)} \quad or \quad F^c = \frac{(R_1^2 - R_0^2)/dl(H_1)}{(1 - R_1^2)/dl(H_0) - dl(H_1)}$$

By applying the first sample we find:

$$dl(H_1) = N - 1 = 10 - 1 = 9$$
$$dl(H_0) = N * T - K = 10 * 15 - 6 = 144$$

And the refore

$$F^c = \frac{(0{,}891 - 0{,}538)/9}{(1 - 0{,}891)/144} = 55{,}71$$

Fisher's tabular at 5% equals F^t =1 .90, the result of Fisher calculated is bigger than the tabular. So, we reject H_0 for homogeneity. And the refore the sample is the Panel sample

b. Correlation study:

The purpose of the correlation study is to measure the strength of the linear correlation between the two variables. The nature and amount of correlation between the dependent variable and the independent variables are determined while the linear coefficient is a measure of strength of the linear relationship between x and y and it measures the extent of change y in case x is increased, so does y increase by the increase of x (positive correlation)

or decrease by its increase (negative correlation) or doesn't it get affected by x increase (no correlation)? The following table shows the correlation coefficients between the variables:

Table 02: Correlation between variables

	ARTS	BRVT	ENCDT	ETDB	ETDIS	TSB
ARTS	1					
BRVT	0.005	1				
ENCDT	-0.241	-0.292	1			
ETDB	-0.404	-0.403	-0.003	1		
ETDIS	0.346	-0.492	-0.151	-0.085	1	
TSB	0.602	0.550	-0.343	-0.711	0.004	1

Source: Prepared by the researcher based on Eviews 8 program

Based on the table above which shows the volume and nature of the relationship, we can conclude the following:

- There is a strong positive correlation between the variable of the scientific articles indicator and the gross registration rate variable in higher education where the correlation rate is estimated at (0.602).
- There is a weak positive correlation between the variable of the scientific articles indicator and the independent variables: number of students registered and the number of patents where the correlation rate is estimated at (0.346, 0.005).
- There is a strong negative correlation between the variable of the scientific articles indicator and the independent variables: framing rate and the number of students registered abroad where the correlation rate is estimated at -0.241, -0.404 respectively.

c. **Sample test**:

Before we select the sample to be used in the study, we must first determine the best method between the fixed effect sample and the random effect sample (by using Hausman test).

Table 03: Sample test

The dependent variable: Education indicator **DARTS**			
Period : 2000-2014	I=10	T=15	**Number of Panel views:** 150
Explanatory Variables	**Aggregate Regression Sample**	**Static Effects Sample**	**Random Effects Sample**
R-squared	0.538	0.891	0. 3072
	(0.0000)***	(0.0000)***	(0.0000)***
Constante	-0.165783	-0,0315	-0.0662
	(0.2900)	(0.8153)	(0.6567)
DBRVT	1.840	5.440	1.8807
	(0.0000)***	(0.4532)	(0.7825)
DENCDT	-0.0001	-0.002	-0.0017
	(0.5955)	(0. 5456)	(0.5972)
DETDB	0.349	-0,662	-0.4762
	(0.5892)	(0.3956)	(0.5254)
DETDIS	0.154	0.0744	0.1099
	(0.0344)**	(0.3908)	(0.1738)
DTSB	0.006	0.0060	0.0058
	(0.0000)***	(0.0000)***	(0.0000)***

*, ***, *** represent the statistical value of t.statistic which means that the parameter is significant at the level of 10%, 5% or 1% respectively

Source: Prepared by the researcher based on Eviews 8 program

d. Hausman test:

As mentioned previously, there are three main samples of Panel data samples. Based on that, we ask the following question: what is the most appropriate sample for a study data? To answer such question, we will conduct the Hausman test by setting up the following hypotheses: Random effect $\rightarrow H_0$ Fixed effect $\rightarrow H_1$

Table 04: Hausman test

Correlated Random Effects - Hausman Test			
Equation: Untitled			
Test cross-section random effects			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	2.621083	5	0.7582

Source: Prepared by the researcher based on Eviews 8 program

Based on the table results, the **Hausman** test shows that the statistical value (**Chi-Sq. Statistic**) equals 2.621 which is smaller than the value of (Chi-Sqd.f) which equals 5 and shows that the value of probability (P-Value) is 0.7582 which is bigger than 0.05, so we accept the null hypothesis $H_0$and reject the alternative hypothesis H_1 which confirms the choice of random effect. After examination of the results illustrated in the table above which shows the effect of independent variables on the dependent variable random effects sample, we found out the following results which can be interpreted as follows:

- The validity test of the sample shows that R-squared known as the coefficient of determination is estimated at 0.30, which shows the relationship between the actual value and the estimated value. Framing rate, number of registered students, number of students registered abroad, patents and the gross registration rate in higher education were able to explain 30% out of the number of scientific articles indicator, while the remaining 70% was due to random errors.
- Through examination of the F-Statistic Prod value which is zero, the sample is significant at all degrees of significance, and F-statistic is bigger than (F-Statistic Prod).

Table 05: Significance and effect of variables on the dependent variable

Variable	Significance	The effect on the dependent variable
Patents	0.7825 insignificant	1.8807 positive effect
Framing rate	0.5972 insignificant	- 0.001774 positive effect
Number of students abroad	0.5254 insignificant	- 0.476209 negative effect
Number of registered students	0.1738 insignificant	0.109948 positive effect
Gross registration rate in higher education	0.6567 insignificant	0.066224 positive effect

Source: Prepared by the researcher based on Eviews 8 program

e. **Simultaneous integration test:**

Simultaneous integration test in case the variables are stabilized in the same order. This test can identify the variables that can affect the evolution of the dependent variable. If the relationship involves unstable variables that stabilize at the same degree, the presence or absence of a synchronous integration relationship should be considered. In this context, Kao (1999) points out that the usual test statistics have non-convergent distributions in the presence of pseudo-associations. Synchronous integration relationships are identified by (Pedroni, 1995-1997), Kao (1999) and Bai and Ng (2004) as the test of the root hypothesis and the unit of the integration remainings. The following table shows the results of the simultaneous integration relationship test.

Table 06: Results of the simultaneous integration relationship test

Pedroni Residual Cointegration Test			
Trend assumption: No deterministic trend			
Common AR coefs	**Statistic**	**Weighted Statistic**	**Prob**
Panel v-Statistic	-0.477837	-1.006009	0.8428
Panel rho-Statistic	1.350045	2.131535	0.9835
Panel PP-Statistic	-4.906378	-5.257662	0.0000
Panel ADF-Statistic	-4.776369	-3.814613	0.0001
Individual AR coefs	**Statistic**		**Prob**
Group rho-Statistic	3.572723		0.9998
Group PP-Statistic	-8.799932		0.0000
Group ADF-Statistic	-4.957743		0.0000

Source: Prepared by the researcher based on Eviews 8 program

Through the results shown in the table we, find out that there are four probabilities with a significance of less than 0.001 at a significant level of 1% versus three probabilities with a significance bigger than 0.001 at the same degree of significance. This indicates the existence of the simultaneous integration relationship, i.e. independent variables affect the long-term dependent variable.

f. **Granger causality test:**

The causal relationship means how much the growth of a given variable cause the growth of another variable or not and the opposite, or if there is a mutual effect. The study aims to determine the direction of the causal relationship between the number of scientific articles and other different variables, and the kind of relationship: reversible or reciprocal or no relationship at all.

We will study the causal relationship between the first differences in the number of scientific articles and the first differences of other independent variables. The appropriate test for the causal study is the Fisher test based on the following hypotheses: Y_{2t}: H_0 does not cause y_1t Y_{2t}: H_1 causes y_1t

Test of the causal relationship between variables can be summarized in the following table:

Table 07: Causal relationship between study variables

	Causal based on Granger		**Non-existence of causality**	
	From ART	**To ART**	**From ART**	**To ART**
Patents			×	×
Framing rate	×			×
Number of students registered abroad			×	×
Number of registered students		×	×	
Gross registration rate in higher education			×	×

Source: Prepared by the researcher based on Eviews 8 program

In the above table, we note a one direction causal relationship between the dependent variable, the number of scientific articles, the independent variables, the framing rate and the number of the registered students, actually, framing rate affects the number of scientific articles and the number of scientific articles effect the number of the registered students. We also note through the test of causality between the variables the existence of:

- A causal relationship in both directions between the number of registered students and the framing rate.
- A one-direction causal relationship between the gross registration rate in higher education and the number of registered students.

The sample should be as follows:

DARTS = 0.007+3.446DBRVT- 0.001DENCDT- 0.445DETDB+0.059DETDIS + 0.005 DTSB

3. ANALYSIS OF RESULTS:

This equation is the ideal sample that can reflect the relationship between the variables of the study where we can note that there is:

- A difference in the relationship quality between the number of scientific articles indicator and the indicator of number of students studying abroad, i.e. there is a reversible relationship, and the more students are studying abroad at 0.44%, the lower the number of scientific articles indicator is at 1%. There are many studies that confirmed the positive relationship between the number of students studying abroad and the education indicator. It was mentioned in the analysis of the results of the first sample of the dependent variable which we identified as the education indicator; because the number of articles is affected by the number of students registered abroad. However, there are other studies that dealt with the reversible relationship between the two variables. We can explain it, as mentioned above, that students who are registered abroad will not return and they will work in the countries where they studied and all their researches will be attributed to the universities where they are employed. This was confirmed by the UNESCO (2004) study on brain drain, which is considered as a loss of victory. Actually, the amount of human capital migration from African countries to developed countries between 1960 and 1975 was about 27,000 migrants who left the continent and about 40,000 persons between 1975 and 1984. EU countries, North America, Japan, Canada and Australia are among the most popular destinations that attract migrants for information and communication technologies and proximity to highly qualified professionals. Thus, the mother country knows a decline in human capital formation and a lack of the scientific outputs which are one of the most important outputs on which it is depended globally for ranking countries in the scientific field.

-A positive relationship between the number of scientific articles indicator and the number of registered students indicator .In fact, the higher the number of registered students is at 0.05%, the more the number of scientific articles indicator increases by 1%. This was confirmed by the study of De Shields Jr, O.W, Kara, A. & Kaynak, E. 2005) which focused on the determinants of student satisfaction and interest in college or university, and which found out that treatment of teaching staff and the college experience affect the student and the registration rate, in addition to the changing nature of the education market and encouragement of officials to pay attention to student satisfaction in higher education institutions and hence, the teaching staff works in an integrated atmosphere with students and scientific research increases.

- A reversible relationship between the scientific articles number indicator and the indicator of framing rate. This was illustrated by several studies such as the study of (Roth, W. M, 1995) which focused on the different aspects of supervising students and their problems and

finding a solution, such as presenting the traditional cognitive sciences and research methods and linking them with the laboratory. It was found out through the previous studies that the lower the framing rate is, the better it is for the teaching stuff to focus on research and scientific outputs.

- A positive relationship between the scientific articles number indicator and the number of patents, the more the number of patents increases by 3.44 %, the more the number of scientific articles increases by 1%. Study of (Narin, F., Hamilton, KS, & Olivastro, 1997) confirms the fundamental role of education in supporting the American industry and emphasizes the positive relationship between researches published in the high-ranking fields, which are written by universities and international laboratories and which affect patents.

- A positive relationship between the scientific articles number indicator and the gross registration rate in higher education. The more the gross registration rate in higher education increases by 0.005%, the more education indicator increases by 1% as confirmed by the study of (Barro, R. J., & Lee, J. W, 2013). This study showed a new set of data for educational attainment in the world between 1950 and 2010. A total of 146 different countries and indicators were used, such as gender, age group, mortality rate and level of education. These data were used to verify how the human capital stock was extracted. The study found out the positive impact of the registration rate on higher education, human capital stock and the production of knowledge and scientific outputs resulting there from.

CONCLUSION:

Through our standard study of the impact of the knowledge economy on the quality of higher education by using the PANEL data, in which we chose a sample of ten selected countries for the several reasons mentioned above, and a study period between 2000-2014 by using a set of variables according to the World Bank sample, consisting in sub-indicators of knowledge economy projected on the educational system, we reached the following results:

- The best sample applied in this study was the random effect sample which showed that impact of the knowledge economy on the quality of higher education varies according to the time factor and differs from one country to another. Each country's characteristics and specifications make the impact of the knowledge economy on the quality of higher education different from other countries.

- There are some variables such as the number of registered students indicator, the gross registration rate in higher education and patents that have a positive impact on the quality of higher education.

- There are some variables that have a negative impact, such as the number of students studying abroad. On the theoretical side, we found out that the openness of the university increases the acquisition of knowledge and a better of human capital formation; this means that students trained abroad have a positive impact. However, the result obtained through the data was the opposite and according to previous studies of the subject, we found out that brain drain and non-return of students is the only rational interpretation of this reversible relationship.

- The framing rate is also a variable that has a reversible relationship with the quality of higher education. The higher framing rate is, the lower quality of higher education is. On

the theoretical side, we found out that the framing rate is very sensitive because it shows the university's commitment to educational process. The result was consistent with the previous studies because the lower framing is, the better it is, teaching stuff focuses on scientific researches and as a result, quality increases. They could also adopt the approach of training competencies because their treatment in classrooms will be with few learners (students) which facilitates dealing with them in a better way.

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