

The Impact of Research and Development on Economic Growth in Arab Countries

تأثير البحث والتطوير على النمو الاقتصادي في الدول العربية

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Abstract

This study aims to measure the impact of scientific research on the economic growth of six Arab countries (Algeria, Egypt, Kuwait, Morocco, Saudi Arabia, Tunisia) during the period from 2000 to 2014, and to achieve the goal of the study was the use of Panel Data Method through the application of Pooled regression Model (PRM) and the Fixed Effects Model (FEM), by using E_VIEWS programs.

The main results of this study are the presence of positive and non-significant effect of Research and Development on economic growth in Arab countries, and this means that it is necessary to increase spending on research and development in the Arab countries to increase economic growth, and interest in scientific research that benefits the community and make it progress.

Keywords : *Research and Development, Economic Growth, Arab Countries.*

JEL classification: O30, I25, A10

ملخص

استهدفت هذه الدراسة قياس أثر البحث العلمي على النمو الاقتصادي لعدد 6 دول عربية (الجزائر، مصر، الكويت، المغرب، المملكة العربية السعودية، تونس) خلال الفترة من عام 2000 إلى عام 2014، ولتحقيق هدف الدراسة تم استخدام منهج بيانات السلاسل الزمنية المقطعية Panel Data Method من خلال تطبيق نموذج الانحدار المجمع (PRM) ونموذج الآثار الثابتة (FEM) باستخدام برامج E_VIEWS.

وتتلخص نتائج الدراسة في وجود أثر موجب وغير معنوي للبحث العلمي على النمو الاقتصادي في الدول العربية محل الدراسة، وهذا يعني أنه لا بد من زيادة الانفاق على البحوث والتطوير في الدول العربية لزيادة النمو الاقتصادي، والاهتمام بالبحث العلمي الذي يفيد المجتمع ويرفع من تطلعاته ويزيد من تقدمه.

الكلمات الدالة : البحث و التطوير، النمو الاقتصادي، الدول العربية.

Introduction

1.1 Introduction

Knowledge is power and it is a crucial element in identifying the kind of life the society lives. Therefore, the difference in growth among the world countries is not only related to difference in wealth but also to the difference in knowledge store in addition to the ability of the country to make the best use of its knowledge. Carrying out applied scientific researches that serve the society can be considered a measure of countries' progress and their technological, economic and social growth. These researches enable them to excel economically and militarily and to increase their scientific and cultural contributions in the human civilization.

Islam is characterized by developing the human mind and concentrating on encouraging man to practice research and development and to adopt reflection, meditation and scrutiny as a method for his life. Islam also shows the important role of those who give humanity of their knowledge and learning. That is why Islam honors' scientists, scholars, experts, researchers and specialists and raised their position so high in developing societies. Allah the Exalted said in the Holy Qur'an: Proclaim! (Or Read!) In the name of thy lord and cherisher , who created ⁽¹⁾ created man , out of a (mere) clot of congealed blood ⁽²⁾ Proclaim ! And they lord is Most Bountiful ⁽³⁾ He who taught (the use of) the Pen, ⁽⁴⁾ Taught man that which he knew not. ⁽⁵⁾[Chapter 96-verse, No.1-5]

Learning and knowledge have their high rank in the third millennium. There is a boom in using information technology, communication, and accumulation of scientific knowledge and their applications at accelerating rates resulting from the enormous increase of computers, information systems and means of communication. All these factors will lead to deep changes in the concepts and bases on which cultural, social and economic systems and also in individuals ' and societies ' conduct and manners. Moreover, the accelerating growth of the technological revolution led to widening the gap between the developed and the developing countries. Therefore, the activity of research and development has become one of the

most effective ones of growth operation. It has also become necessary for every country to make plans for education, especially higher education, and to direct its capabilities towards devoting attention to research and development and building its institutions in different fields related to the social and economic development.

The success of social and economic development is related to achieving high standards of scientific progress and technological development. "R&D" is not only limited to creating new innovation , but a significant part of it is specified to solve problems related to productive operations in industry sector, and another part focuses on developing products, particularly, the consumer products and the consumers ' wishes. Accordingly, those who possess sophisticated technology, possess the competitive advantage, so they remain on the lead . Countries who seek to get that technology will be dependent on those who possess it .

If we have a look at the problem that faces Arab countries, we'll find that it is not caused only by the mere lack of information, especially the scientific and technological information, but it is also related to lack in institutions that can transfer knowledge, understand it and spread it. So, the crisis of R&D and research centers in fact reflects a three-dimension cultural crisis , which contains research culture , information culture and institutions culture .

Higher education in the Arab world started before other areas of the world; it began accompanying to and simultaneous with religious movements, (Al-Quarawiin University was established in Fas in 859 and Al-Azhar university was established in Cairo in 970 , and Al-Mustanseriah University was established in Baghdad in 1227 , all of which emerged out of the different intellectual movements such as the human and the school movement.

All these movements helped science and learning to prosper and flourish in the West after the 12th century, However, higher education in Arab countries currently witness several problems . Some of these problems are : the quantitative expansion in higher education; great numbers of students are admitted every year, scarcity

of the production of R&D and its weakness, in addition to the insufficient finance and spending on higher education, shortage of awareness of the importance and the impact of researches and development in the Arab world and brain drain of scholars to foreign countries. More than 100,000 scientists, physicians, engineers leave Lebanon, Syria, Iraq, Jordan, Egypt, Tunisia, Algeria and Morocco for foreign countries every year; 70% of them do not come back to their mother nations (Abu-Orabi, 2012, 14).

Studies illustrate (Alreban, 2012) that what is published annually in the Arab world do not exceed 15,000 researches but the productivity rate is about .03 as the number of the teaching staff is 55,000. It is worth mentioning that the minimum rate of productivity of each researcher is 2 researches annually. In addition, scarcely can we find that the real research activity of every staff member in private universities in 2011 (they are about 193 universities) and the governmental universities (they are about 206 universities) reaches the rate % 5-10 of the member's academic tasks but in the European and American universities, it reaches 35-50%.

In addition to what was mentioned before, there is scarcity in the number of researches working in R&D for every million people. The ratio of Arab researchers working in research and development reached 450 (including university professors) for every million people, compared to 5000 researches for every million people in the developed countries (Abu Orabi, 2012, 58). Moreover the rate of Arab scientific researches published internationally reaches % .05 compared to

% 34 for the European union countries, and % 31 for the United states (Abu Orabi, 2012, 60).

Hence emerges the problem of research that can be drafted in the following key question: What is the impact of research and development on economic growth in Arab countries?

The following questions arise from this question:

1- What is the reality of research and development in Arab universities?

2- Is there a positive impact of research and development on economic growth in the Arab World?

1.2 Previous Literature

Economists started to introduce science and technology in their models. They focused on the impact of researches and development (R&D) on economic growth and productivity. Solow's methodology is quite evident in linking research development and productivity together. He is the first economist who put into consideration that the result depends on work and capital. In his equation, the remaining is counted by science and technology although it includes more than only science and technology.

After Solow, other economists developed his method and his analyses of costs and benefits. They developed political economy models to try to measure the impact of researches and development on economic sides. A great number of studies focused on estimating revenue rate on investment in researches and development R&D as illustrated in the following table (1-1).

Table (1-1)
A number of previous studies that dealt with the economic dimension of R&D

The impact R&D on production and productivity	The impact of R&D on the rate of return on investment
Coe and Helpman (1995)	Bernstein (1988, 1989)
Caneo-Mairesse (1984)	Bernstein and Nadiri (1988)
Englande – Mittelstadt (1988)	Clark – Griliches (1984)
Griliches (1980)	Evenson (1968)
Lichtenberg (1992)	Hanel (1988), Nadiri (1993)
Mansfield (1988)	Suzuki (1993), Walf-Nadiri (1993)
Nadiri (1980)	

The table was prepared by the researcher.

Since that time, studies on the economic impact on research and development focused on two main topics: productivity and spillovers (from the university and governmental finance for research in all sectors and industry.

Other studies such as those of (Posner, 1961, Vernon, 1970) deal with the impact of R&D on international trade. They introduced science to standard models to show its impact on foreign trade. Those economists saw that R&D represents an important factor in interpreting the types of international trade. They discussed, "why do some countries take the lead in international trade while others are not, and why is there a gap between them and those that devote their attention to researches and development?"

The impact of technological researches also drew the attention of many researchers such as (Gibbons and Johnston, 1974, Mansfield 1991, 1991, 1998, Rosenberg and Nelson , 1996), Those researchers showed the importance of academic research in achieving progress in industrial innovation. Mansfield proved that a large rate of companies did not have any development in their products and their productive operations, with the absence of academic research.

But when we look at Arab studies , we notice that there are some of them by (Ali , 2010) (Al-Zubair, 2011) (Halawa , 2011) and others that are related to R&D their institutions and their relation with development in the society in which they live . These studies reached the following results: the importance of research and development in social and economic development, the importance of solving the problems that hinder R&D and establishing remarkable research centers that solve the problems of the society and achieve the citizen's welfare.

However, these studies did not concentrate on the real solutions to improve R&D and to benefit from the findings of R&D, theses in universities and higher education institutions in serving the development operation. This study we are presenting, which deals with the impact of research and development on economic growth in Arab countries, is one the important studies that approach this topic which suffers from an evident research scarcity. In addition,

other studies in this field deal with methods of survey and examination to illustrate the role of research and development in development operation. These methods are mostly biased and inaccurate. This present study uses Econometrics method in addition to the realistic analysis method in measuring the impact of research and development on economic growth in Arab countries accurately that is what other studies really lack.

Moreover, this study manifests the importance of R&D on economic growth and the increase of its role in the future. It also urges Arab universities to devote their attention to R&D to make the different changes and to reach economic progress standards that achieve welfare for the Arab citizen.

1.3 The theoretical framework of the research

Although many researches devote their attention to the role of research and development, the university research, the role of universities in developing the society, knowledge and culture and quality of education, there is a relative scarcity especially in quantitative studies, that had interest in the impact of research and development in on the economic growth in the Arab World.

So the theoretical framework of this research concerned with the impact of research and development on economic growth in Arab Countries is presented in the following points:

The first point : The reality of research and development and its importance in the Arab World and its obstacles.

The second point : The analytic frame of the relation between economic growth and research and development in Arab Countries.

The Third point : Measuring the impact of research and development on economic growth in Arab Countries.

1.4 Methodology of the research

The research is based on the realistic analytic method in displaying the nature of the relation between R&D and economic growth in the Arab World, in addition to using Econometrics in measuring the impact of

R&D on economic growth in Arab countries.

Data from the world development indicators of the International Bank, UNESCO and International financial statistics are be used. We may refer to the sources of national data in case data are not available when the previous model of Panel Data evaluates a number of Arab countries (Algeria, Egypt, Morocco, Tunisia, Kuwait and Saudi Arabia) about which we can get data in a certain period of nearly 14 years (2000-2014) and by using E-views.

The research depends on references and Arab and foreign periodicals which approach the relation between R&D and economic growth, which are scarce because there is no research that measures the impact of R&D on Arab countries using Econometrics method. It also depends on data sources of the International Bank and UNESCO.

1.5 The reality of R&D in Arab Countries

R&D of our Arab Universities and research institutions has certain features⁽⁶⁾. They include repetition and similarity in gathering, classification and reproduction. Results most researches reach are descriptive more than analytic which makes them researches of the past. It is known that R&D presents qualitative addition in its field so that it becomes new or innovative. But, in fact, most of what is presented do not approach problems related to reality, which means that the new discovery is missing.

R&D, is a reflection of the society's requirements done by the researcher who belongs to the same social surrounding. It is one of the basic functions of universities that are directly related to other institutions of the society⁽⁷⁾.

The importance of the university shrinks in the presence of illiteracy, negligence, absence of awareness, the increase of different problems that face researchers such as shortage of finance, their engagement in other non-research tasks and their individual tendency in doing researches.

In addition, there is absence of co-operation and collaboration among universities in the same country, and among⁽⁸⁾ universities in Arab countries. Libraries also lack many references and important sources

of information in addition to the isolation of R&D from production units and private sector in Arab countries.

The reality of R&D in Arab countries is inconsistent with their large available materialistic and human potential. This means that it is necessary to remove the obstacles that block R&D, in addition to getting rid of instruction education methods and to release to thinking, contemplation, creativity and creating the culture of R&D.

We can state some facts about the reality of R&D in Arab countries as follows⁽⁹⁾:

1) Financing R&D in Arab countries is weaker than the World rate of spending on R&D as it reaches nearly on average of 0.2% of the world spending compared with Israel which spends %7 (that is 4 times as much as the Arab World) of the World expenditure. U.S.A spends %35 of the world expenditure. The rate of spending on R&D to the national income in Arab countries ranges between 0.2 - 0.4% on average and it is limited to the governmental sector. But the developed countries spend about 3 - 5% of the gross national income for R&D. It is worth mentioning that %80 of this expenditure is given by the private sector.

2) The decrease in numbers of researchers in Arab countries

We find that the rate of Arab researchers working in research and development reached 450 (including university professors) for every million people, compared to 5000 researchers for every million people in developed countries.

3) Number of researchers and productivity of research

No more than 15000 researches are annually published in the Arab World. The numbers of university staff members are about 55000, so their productivity rate is about %3 but the minimum productivity rate required from researchers should be 2 researches for every researcher every year. Moreover, there is a drop in Arab countries share of scientific citation to less than one sixth of world's population according to scientific citation Index, on the contrary, Israel's share of scientific citation reaches near to ten times as their share of World population.

When we look at the rate of production of research papers in the Arab World (Al-Rabban,2012) to the World production is low compared with the rate of the number of population, which is estimated by about %0.4

The following table illustrates the rate of Arab production to the Arab World production in each of the following specializations during the period of (2006-2012).

Table (1-2)
the percent of the Arab world production from researches papers to universal production

Specialization	Universal issues	Arabic issues (%)
Engineering	1.069.949	1.54
chemistry	617.600	1.66
physics	704.514	1.24
computer science	608.726	1.29
Materials Science	412.751	1.44
Mathematics	260.827	2.16
Pharmacy and Pharmacology	186.403	1.64
Environmental Sciences	207.586	1.42
Communications Science	169.892	1.58
Internal Medicine	1073951	2.34
Biochemistry and biology	306.025	0.76
Agriculture	138.798	1.67
energy	85.234	2.36
Mechanics	79.055	2.48
Food science technology	79.888	2.23
Surgery	143.210	1.21
Geology	98.483	1.70
Water resources	49.356	3.31
Polymer Science	75.784	2.00
optics	196.672	0.76

Source: El Raban, M(2012) , the scientific research., op. cit, P12.

The table aforementioned illustrates the decrease of research papers rate in biochemistry, biology and optics. These specializations are related to modern technologies. This means that the Arab World still has a large gap in these specializations. The highest share of participation of the Arab World in research papers was in the field of water sources, which reached %3.3 of the World production.

This rate is extremely low in comparison with the number of population of the Arab World on one hand, and with the conditions of Arab countries that have the most scarce water sources in the world, so the increase of water sources rate may show that there is a decrease of the World rate that do not suffer from what we, Arabs, suffer from scarcity of water. Accordingly, these researches are not in themselves so important to these countries as to Arab countries because water issue is considered to be the most important.

Egypt takes the first position as for the rate of number of papers in all specifications except for

internal medicine as it retreats to the third position after Saudi Arabia and Kuwait, by only % 8.7. Egypt participates by % 48.4 of the research papers in pharmacology and it also participates by a rate of more than %54 of polymers.

Whereas Tunisia is one of the first five countries in all specializations and takes the second position in 8 of specializations. Saudi Arabia appears in all specializations except for agriculture and water sources. When we look at Algeria, we find that it participates in 14 specializations within the 5 big positions, followed by Morocco, which participates in 11 specializations. Jordan and U.A.E participate in 7 specializations. Lebanon takes the fifth position in surgery researches but Syria takes the third position in agriculture.

When we consider the high quality of published research papers and their scientific value or the average of number of quotations for the paper, we'll find that values of average number of quotations for the same paper in all the most outstanding countries

in publishing researches, especially Egypt, Saudi Arabia and Tunisia, come close to each other, in fields that have the greatest number of publications. This is illustrated in table (1-3).

Table (1-3)
The average number of citations per paper Between Egypt and Saudi Arabia, Tunisia
(2006-2012)

Specialization	Egypt		Tunisia		Saudi Arabia	
	Researches numbers	Citations average	Researches numbers	Researches numbers	Citations average	Researches numbers
chemistry	4204	4.82	1248	4.82	5.34	1245
physics	2676	4.76	1087	3.14	4.22	1063
computer science	1632	1.28	1301	0.66	1.63	885
Pharmacy and Pharmacology	1479	5.91	228	6.63	5.44	437
Environmental Sciences	754	5.85	463	5.60	4.48	274
Biochemistry and Molecular Biology	819	6.52	476	6.50	8.09	300

Source: ElRaban, M (2012), the scientific research....., Op.cit., P.14.

From the table, we notice that there is an evident superiority for Saudi Arabia in biochemistry in quotations average although it has the least participations in published researches. Tunisia is excelling in pharmacology in quotation average. Egypt excels in physics and ecology sciences.

We also notice that number of published researches

for every million of population does not exceed 80 researches in 2013 although it is about 34 and 360 researches in Iran and Turkey respectively, where as it reaches nearly 1650 researches in Israel. The following table (1-4) illustrates the ratio of the number of researches in the Arab World to World researches in 2012.

Table (1-4)
the percent of published researches numbers of population and the world researches.

country	The proportion of population to the world population %	The proportion of researches number to the world researches %
Arab world	5.2	1.92
Iran	1.09	1.74
Turkey	1.05	1.84
Israel	0.11	0.94

Source: El Raban, M(2012), the scientific research in the Arab world....., Op.cit., P14

The aforementioned table (1-4) illustrates that the Arab World produces less than its rate of population number, whereas the neighboring countries compared, participate with a higher rate.

Although there is an increase in the rate of the number of published research papers in the Arab World in addition to the fact that some Arab countries began to

take decisions to increase spending on R&D, yet the Arab World is still participating with a less number of published research papers than world countries. The same is applied to what the Arab World adds to science.

The increase in the number of published researches is not an end in itself if these research papers, the

brains, the efforts exerted and money spent, if they all are not used to achieve sustainable development and set up institutions which can benefit from these published researches and apply them so that they can benefit the country.

4) Due time is not given to R&D, as we notice that researchers are engaged in different administrative and financial problems concerning their work.

5) The society does not benefit from R&D as we find that there is shortage of real and productive cooperation and collaboration among the different civil community institutions and research institutions.

6) The absence of evident strategies and future plans for R&D that identify the goals and priorities.

7) There is no relation or correlation between R&D and the problems of the society as many of research projects lack the applicability value.

8) Imitating R&D and tending to quotation, not creativity, besides, there is no sufficient international scientific contact that improves doing valuable scientific researches.

9) Brain drain and the emigration of well-qualified scientists on whom the country depends in planning, development, and doing R&D and applying their findings. This is due to the fact that those scientists wish to gain skills that are not available in their countries. In addition, they suffer from social injustice, the scarcity of motives and bonuses and the need for infra structure and the appropriate general atmosphere.

Depending on the aforementioned facts, we can safely say that the world is in a raging and wild racing to reach the highest possible amount of the productive accurate know ledge that achieves man's welfare however different and multiplied his culture is . The need for R&D has become urgent in putting R&D in a high rank as a result of changes that happen on the scientific domain in which countries try to remain on the lead level, especially R&D is no longer an academic luxury practiced by a group of researchers. R&D has become the stimulant of economic growth. This requires that we should remove obstacles that hinder R&D and to seek promoting its rank in the

Arab World.

1.6 The relation between economic growth and R&D in Arab countries

R&D is considered to be the key stimulant for economic growth. It is also the main guide for the welfare of society members through presenting scientific researches to government and private sectors which help to set up projects by using modern technology putting solutions for problems that face the society, increasing training and developing labour force and employing a lot of man labour in work market and increasing exports of new products and improving the existing products through applying R&D.

In addition, goods and services that secure and meet man's daily life requirements are produced to achieve comfort and welfare for all people on one hand, and the power and development of the society on another hand in a world where alliances and blocs dominate and mutual interests and benefits connect all countries.

R&D is considered to be a means of spreading knowledge and producing it through scientific researches in natural human and social sciences and others. Therefore, it is directly connected with the society's development requirements, including agriculture, industry & services. There are results that come out of that relation in raising production rates, improving its quality and introducing modern techniques and methods in commercial, industrial and services activities.

When we look at U.S.A, we'll find that it has been the pioneer leading the way in R&D and technological innovation since 19th century. We ; Arabs , should learn lessons from that country and other ones that are considered to be pioneers in R&D and in using what benefits our Arab countries of methods , means and way that helped advancing R&D and economic growth .

These pioneering countries in R&D considered progress in scientific knowledge as one of the most important main sources of technological progress in addition to the industrial innovation that depends on science. That industrial innovation is one of

the manifest features in the past decades of the 19th century. Applying the basics of chemistry and physics has become a crucial element in commercial success for iron and steel manufacturers, rubber, chemicals and electronics. Industries has become dependent on universities to train scientists and engineers who are employed in their research labs (Goldin and katz , 1999) .

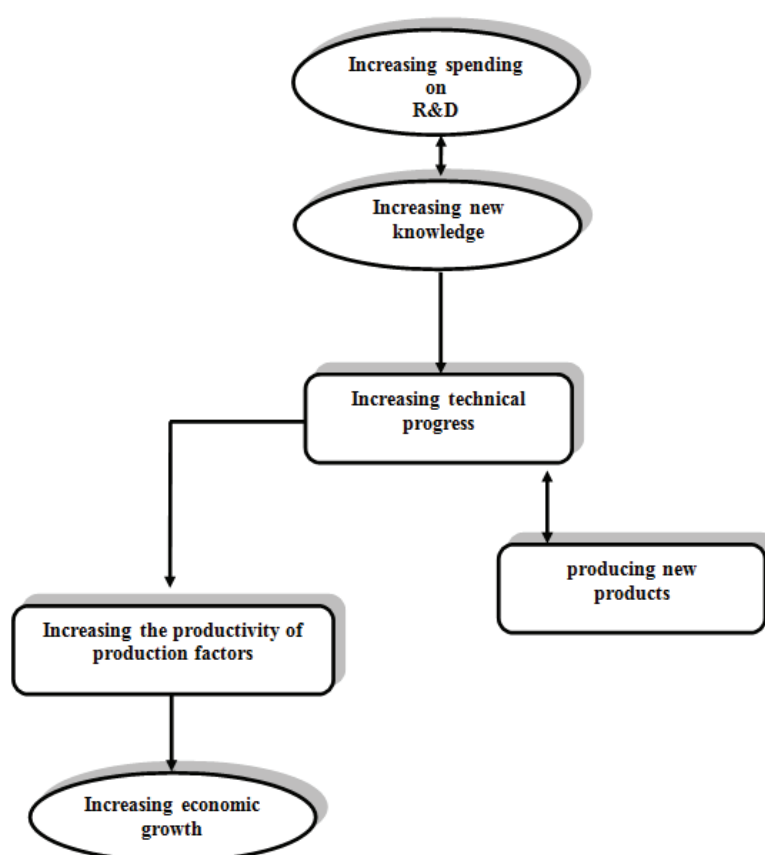
R&D in governmental American universities has its direct contributions in technical progress since the end of 19th century till the Second World War and it was financed by the governments of the states .Consequently, it was directed to solve the scientific problems in local industry. University research and common industry programs were important in the field of technological progress in agriculture, mining and oil exploration (Goldin and katz , 1999) .

Change mostly in volume and attitude in American R&D took its position after the Second World

War when federal governments started excessive campaigns to finance R&D in universities. Between 1940 and 1950, the contribution of federal government in R&D in universities reached about \$39 million, then increased to \$524 million. R&D in universities changed the source of its finance to private sector to be directed so much to local industry as it had already been directed to defense and health fields. In addition, they sought to depend on R&D for solving commercial problems. (Rosenberg and Nelson, 1994)

If we look at figure (1-1), we notice that the increase of expenditure on R&D which leads to increasing the amount of new knowledge .Improving the quality of the current products and producing new ones on one hand and increasing the productivity of production factors of the national economy on another hand depend on that increase of new knowledge. This is what leads, in the end, to achieving high rates of economic growth.

Figure (1-1)
The Relation between R&D and Economic Growth



The figure prepared by the researcher

This is what Romer's model confirms (1986 – 1990), which illustrates that balanced growth is positively influenced by the outside effects of new knowledge . When we look at table (1-5) we find that illustrates the

relation between R&D in Arab countries (spending on R&D) and economic growth in Arab countries subject to this study (Algeria Egypt, Morocco, Tunisia , Kuwait and Saudi Arabia)

Table (1-5)
The Relation between R&D and Economic Growth in Arab countries during (2000-2012)

data Period	The average of spending on R&D in Arab countries as a percentage of GDP	The average of economic growth rate in Arab countries
2000 – 2005	0.31 %	5.03 %
2006 – 2010	1.55 %	5.128 %
2010 – 2012	0.48 %	4.5 %

Source: The table prepared by the researcher based on the World Bank and UNESCO data

The above table illustrates the average of expenditure on R&D in Arab countries subject to this study as a rate of GDP during the period (2000 – 2012). It also illustrates the following :

- The rate of spending on R&D to GDP in Arab countries subject to this study is very low as it represents only about % 0.31 of GDP during the period (2000 – 2005) , then it increased to about % 1.55 of GDP during the period (2006 – 2010) , then it decreased to reach , 0.48 of GDP in Arab countries subject to the study. This study cannot help influencing much. This increase does not lead to a great degree to economic growth.
- The average of economic growth rate in Arab countries subject to the research was about %5 during the first period (2000 – 2005), then increased to about

%0.128 during the second period.

The decrease of rate of spending on researches to GDP in Arab countries subject to the study about %0.48 during the period (2010 – 2012) led to the decrease in economic growth rate during the third period (2010 – 2012) to about % 4.5

1.7 Measuring the relation between the economic growth and R&D in Arab countries:

1.7.1 The model:

Depending on literature concerned with the relation between R&D and economic growth on one hand, and growth equation ((1986) Romer) on another hand, and how far data are available on a third hand . This equation of economic growth used can be stated as follows:

$$Gdp_{it} = e^{\alpha_i} L_{it}^{\beta_1} K_{it}^{\beta_2} RD_{it}^{\beta_3} u_i$$

Gdp the natural logarithm for economic growth rate

L The rate of the participating work force in the economic activity of the overall workforce

K The rate of capital formation of GDP

RD The rate of expenditure on R&D as a rate of the GDP in the Arab countries

u Error correction

1.7.2 The Sample and the period of study

The period of study extends from 2000 to 2014. The sample of study contains 6 Arab countries: Algeria, Egypt, Kuwait, Saudi Arabia, Morocco and Tunisia.

These countries were chosen according to the criterion

of how far data of variables for the current study are available for the study period years. Hence the current study will use Panel Data.

1.7.3 Data sources

Data source of GDP, RD, L, K are from the International Bank concerning world growth and UNSCO indicators.

1.7.4 Applied results

1.7.4.1 Assessment of empirical results

1) Heteroscedasticity problem has been approached by using Heteroscedasticity- consistent covariance Matrix because using that matrix leads to modifying values estimating standard mistakes of regression parameter according to Heteroscedasticity mistakes, so that matrix allows using the estimation results in testing hypotheses of the current study in the presence of Heteroscedasticity problem. In this case, correct deductions will be derived out of these results.

2) To test if there is Multicollinearity in the estimating model, linking parameter has been estimated between every two of the independent variables of this model. The variable that has a strong linking relation with another one within the independent variables of the model subject to estimation has been neglected, so there is no problem of multicollinearity in the estimating model.

3) Wald statistics refers to the presence of statistical significance for all independent variables mentioned in fixed result model.

4) (R^2) refers to the rise of interpreting power of independent variables in the fixed results model, as it reached % 76.

1.7.4.2 Results of measuring the impact of R&D on economic growth in Arab countries

The results of estimating the impact of R&D on economic growth in Arab countries subject to this study can be stated depending on the following table:

Method: Pooled Least Squares				
Date: 06/11/16 Time: 19:02				
Sample (adjusted): 2001 2014				
Included observations: 12 after adjustments				
Cross-sections included: 6				
Total pool (unbalanced) observations: 69				
Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0371	-2.164713	0.425336	-0.920731	D(LRD?)
0.2815	1.093289	0.236802	0.258893	LRD?2
0.0291	2.273320	0.840757	1.911309	D(LK?)
0.9761	0.030169	6.480419	0.195507	D(LL?)
0.0000	5.018162	0.527158	2.645363	C
Effects Specification				
Cross-section fixed (dummy variables)				
Period fixed (dummy variables)				
1.421837	Mean dependent var	0.763431	R-squared	
0.762997	S.D. dependent var	0.553147	Adjusted R-squared	
1.797284	Akaike info criterion	0.510041	S.E. of regression	
2.865770	Schwarz criterion	9.365119	Sum squared resid	
2.221188	Hannan-Quinn criter.	-29.00631	Log likelihood	
1.646868	Durbin-Watson stat	3.630479	F-statistic	
		0.000128	Prob(F-statistic)	

This table illustrates the following:

1) There is a positive and non-significant impact of R&D on economic growth. This means that the increase of expenditure on researches and development leads to the increase of economic growth rate very slowly. All applied studies aforementioned in this study support this result.

But we should put into consideration that the rate of expenditure on researches and development of GDP of Arab Countries is very low in comparison with developed and developing countries where R&D occupies a position in their national strategies and plans.

2) There is a positive and significant impact of capital structure as a rate of GDP. This means that increasing investment leads to the increase of economic growth.

3) There is a positive and non-significant impact such as the rate of the participating work force volume in the economic activity of the overall work force. This means that the work force in Arab countries subject to this study does not yet reach the level that has a substantial impact on economic growth. So they are in need of much training and development from Arab countries.

1.8 Conclusion

This study aims to measure the impact of R&D on economic growth of six Arab countries during the period from the year 2000 to the year 2012. The goal of this study can be achieved by Panel Data Method through applying Pooled Regress, Model (PRM) and Fixed Effects Model (FEM).

This study has results that can be briefed in the presence of positive and non-significant impact on economic growth in the Arab countries subject to this study. This means that there must be an increase in spending on R&D in Arab countries to increase the economic growth and devoting attention to R&D that benefits the society, raise its expectations and increase its progress. Therefore, we should pay attention to the following:

1- We should work on having a national strategy of R&D for Arab countries that works to direct R&D for serving development issues.

2- Providing sufficient governmental finance amount for R&D that depends on supporting national programs that help making development.

3- Urging researchers in different universities, institutes and research institutions to do researches according to the priorities of R&D in each Arab country, to solve scientific problems in these countries and to keep brains from emigrating abroad.

4- Universities should work to connect and link R&D with development plans in the Arab countries.

5- Universities should provide researchers with knowledge and skills that the modern age requires to countries R&D.

6- Encouraging establishing research teams that adapt team work in the field of scientific research that helps growth issue.

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