The relationship between the knowledge economy and economic growth (A standard study using the Panel Model for 18 leading countries in the field of knowledge economy during the period 1996-2020).

La relation entre l'économie du savoir et la croissance économique (étude standard utilisant le modèle de panel pour 18 pays leaders dans le domaine de l'économie du savoir au cours de la période 1996-2020).

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Abstract :

In the modern era, capitalizing on knowledge and scientific discoveries has rapidly become a significant factor in achieving modern economic growth.

This paper seeks to investigate the empirical relationship between knowledge economy and economic growth in 18 leading countries in knowledge economy over the period of 1996 – 2020 using an econometric analysis..

Jel Classification Codes: O11, E27 , F43

Résumé:

A l'éré moderne la capaitalisation des connaissances et des découvertes scientifiques est devenue rapidement un facteur important de la croissance economique moderne.

Ce document vise à étudier la relation empirique entre l'economie de connaissance et la croissance economique dans 18 des principaux pays de l'economie de connaissance au cours de la période 1996-2020.

Mots clés: *connaissane; economie de connaissance; croissance economique; econométie*

Jel Classification Codes: O11, E27 , F43

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1. INTRODUCTION

The economic growth is considered as the biggest challenge that economists have faced, whether in the agricultural economy, the industrial economy, or even in the knowledge economy. The problem that has always been raised is how to maintain growth in the long term, especially in the face of two obstacles: the relative scarcity of economic resources and the law of diminishing returns. Many theories came explain this, including the Solow 1956 model, in which my tried to answer the problem of the wealth of countries and the poverty of other countries? He used in that the Cobb de Glass function, which consists of the element of labor and capital, but it appeared that this model does not give a more explanation, so he added the element of technological progress and considered it as an external factor. This model was also criticized for not giving a more explanation of economic growth in the long term, which resulted in the emergence of new theories that introduced the element of technological progress into their models as an internal factor, including the ROMER model, Lucas and others. These models show that the human element, innovation and knowledge are The actual engine of economic growth in the long run, since knowledge grows with time and does not decrease.

The technological progress has contributed to improving productivity. The agricultural revolution in Europe in the 18th century witnessed a development and the agricultural production increased by many times, following the developments of the agricultural machinery after the invention of the steam engine and its use in agriculture. The industrial revolution in the 19th century also led to an increase in activity and an expansion in the size of Factories, which led to an increase in the volume of production and consumption and this is the result of the inventions including : the invention of the engine for polton-wite 1969, and the development of the first steam turbine (Charles Parsols 1884), which was credited with all the developments that occurred after that, and in the field of energy they started generating electricity Thomas Edison in the 19th century (Solow R M 1956, p65).

In the modern era, technological progress has increased, as it has contributed to increasing productivity and improving the standard of living. Solow says that 34% of economic growth leads to the growth of new knowledge, in addition to 16% of economic growth is the result of

investment in the human element. Accordingly, 50% of Economic growth is about knowledge. (Romer P M1986, p 1004).

Based on the above, we can pose the following problem: **What is the influence of the knowledge economy on economic growth?** To answer this question , we divided the research paper into two main axes: From the knowledge economy and economic growth, while the second axis was devoted to the standard study, with the aim of selecting a group of 18 leading countries in the field of knowledge economy, including (Switzerland ; United States ; Finland ; Sweden ;Netherlands ; Luxembourg ; Singapore Denmark ; United Kingdom ; Germany ; Japan ; Norway ; Austria ; Belgium ; Iceland ;Korea. Rep ; France ; Canada.). And study the impact between the knowledge economy and the economic growth of these countries using the Panel model during the period between (1996-2020).

Study hypotheses

There is a direct relationship between the knowledge economy and economic growth.

2-Theoretical aspect of the study

2-1-Defining the knowledge economy

The essence of the knowledge economy is the flow of huge investments in human capital as well as information and communication technology, and these investments are the main tools for creating added value (M.Grundstein & C.R.Sabroux 2007.p 02), And the Organization for Cooperation and Development (OCDE 1996) defines it as an economy that directly depends on the production, distribution and use of knowledge and information, and (HEPROR & THAND)(Smith.K 2000 p02), believes that the knowledge economy constitutes one of the pillars of the economic unit and individuals to acquire, create, disseminate and use knowledge in an orderly manner. It is also known as the economy In which knowledge is the main driver of economic growth through continuous investment in education, innovation, information and communication technology, and economic and institutional infrastructure (Word bank 2012).

2-2- Characteristics of the knowledge economy

The knowledge economy is characterized by a clear tendency to increase the use of knowledge in many aspects of the new economy(Sheephan P 1999 p05). The traditional economy depends on muscle effort and reliance on the machine with little knowledge. Here, this can be clarified through the following table:

Table 01. Data about two companies (whatsapp and Turkish airline)

Turkish Airline	whatsapp	
1933	2009	Establishment Year
23160	55	Number of Workers
04Billion dollars	19Billion Dollar	Market Value
Airplanes	computers	Main invested assets
Sending People	Sending Letters	Missio,

Source : Knowledge economy (future and modern prospects) on the following site : https://www.ar-economist.com/news/1479, view date : 26.11.2021.

2-3- Elements of the knowledge economy

The knowledge economy is based on four main components: education, research and development, information and communication technology, and governance(GKI2020).

2-3-1-Education

Education is the fuel of the knowledge economy (the main engine).

2-3-2- Research and Development (R&D)

It is represented in innovation and development. We find that countries have invested in this element through the construction of universities and institutes, as the percentage of spending on R&D has increased, especially in Asian countries, led by China, which has increased its investment rate by more than 10% in The year, but with all this, the United States of America has still led the way in investing in R&D over the past 50 years. (Industries Research Institute 2017, p 18).

2-3-3- TIC

The use of information and communication technology will transform the world from an industrial society to an advanced information and communication society and will create value-added (E- Japan Policy Program 2002) just as the industrial revolution transformed the world from an agricultural society to an industrial society.

According to the estimates of the International Telecommunication Union, the number of mobile cellular subscriptions reached 608 billion and about 2.7 billion Internet users across the world by the end of 2013(ITU2018), as at the end of 2018, half of the world's population was connected to the Internet, with an estimated rate of 51.2%, which is equivalent to 3.9 billion

people, and the International Telecommunication Union aims to reach a penetration rate of more than 70% by 2023 and 75% in 2025.

2-3-4- Governance

Represented in the practices of economic, political and administrative authority to manage state affairs. This indicator included the following**(**Thomas, M.A,2010 **,**p03):

- ❖ voice and accountability.
- ❖ political stability.
- ❖ Government effectiveness.
- ❖ Regulatory quality.
- ❖ Rule of law.
- ❖ Control of corruption.

2-4- Measuring the knowledge economy

By knowing the strengths and weaknesses of any country, and this is by following the knowledge assessment methodology (Maurseth P.B?2008, P18). This methodology is based on the basic components of the knowledge economy represented in (education, research and development R&D, TIC, governance). A set of indicators also fall under these pillars. It is calculated based on the average performance of any country (Derek.H & Dahman C.J2006 p09).

2-4-1-General Indicator

It includes both the Knowledge Index and the Knowledge Economy Index.

2-4-2-Knowledge Index KI

Knowledge Index = (TIC Index + Research and Development Index + Education Index).

KI = (ICT + R&D + Education index).

Knowledge Economy Index = (Knowledge Index + Economic Incentives and Institutional Systems Index).

KEI = (KI + Economic incentive regime).

2-4-3- Basic Score Card

This card contains 14 basic indicators, as each foundation of the knowledge economy has three indicators, in addition to the knowledge indicator KI, which gives the basic average of the performance of the three indicators (education, research and development, and TIC) as well as the KEI Knowledge Economy Index, which measures the performance of all major indicators.

2-4-4-Custom Scorecard

It contains all the detailed indicators consisting of 109 indicators that determine the integration of countries into the knowledge economy.

2-4-5- Overtime Comparison

Showing the development of countries in the field of knowledge economy starting from 1995 to the most recent year available.

2-4-6- Cross country comparison

It allows using graphs to compare indicators of knowledge and the knowledge economy and the contribution of each of them to determining the general readiness for knowledge.

2-4-7-World Map

In this scale, the names of countries are found in different colors, and each color reflects the performance of this country and its contribution to determining the general readiness for knowledge and the knowledge economy.

3- The relationship of knowledge to economic growth

The relationship can be clarified by referring to some of the following economic models:

3-1- Solow (1956) model

Through which he revealed the importance of other (remaining) factors in increasing production, other than capital and labor factors. Education, knowledge, technological (technical) progress and scientific research represent the largest part.

3-2-- The (Romer 1986) model

The macro model developed by (Ramsay 1928), (Cuss 1965), (Koopman 1965), constitutes the theoretical basis for many economists for economic growth in the long run. (Technological progress is variable. Internal to this model and the accumulation of knowledge is the first basis in the long run, and the most important thing that Romer brought is the division of economic goods into things and ideas.(Romer P.M,1986).

***3-3- Model (Luccas 1988*)**

In this model, human capital replaces the technological progress in the Solow model, while retaining the hypothesis of a closed economy that consists of two sectors: the production sector that produces one homogeneous commodity and the education sector for the formation of human capital. (Guellec;D & Ralle.p 2003).

3-4- Model (Romer 1990)

Romer takes the privacy of technological knowledge as a non-competitive economic good (Jones, CI (2019), as it is used by one person or several people or institutions at the same time and can be prevented in some cases or Selling them as patents. Based on this, Romer proposed three sectors to his model: (research and development sector, intermediate goods sector, and consumer goods segments).

3-5- Aghnion Er Howitt Model (1990)

This model is related to Schumpeter's idea of moral destruction so that growth occurs according to this model to qualitative improvements in goods resulting from the activity of researchers, which in turn results from competition between the research company that generates innovations.(Aighion, P ,1990, p327)

3-6- Model (Gresmman & Helpman 1991)

Creating new goods based on innovation is the source of long-term growth.

4- Previous studies

4-1- Steve Dowrik (2002)

Analyzing the contribution of expenditures on education, research and development to economic growth in Australia and knowing the difference in the return on education for males and females, especially as Australia suffers from aging. The study found an increase of 0.8 in the average years of schooling in the labor force, which represents 11.4 years, and will lead to an increase of 0.33% in the rate of productivity, and investment in research and development leads to an increase of 0.25% in productivity growth. The summary of this study is that investing in knowledge leads to positive expectations for productivity growth, as education for males contributes a greater percentage to productivity growth, unlike education for females.(Dowrick,S,2002).

4-2- The study of Utka, I & Fatima, m (2003)

Focused on the role of the various indicators of the knowledge economy in the economic growth and future performance of 20 countries in the Middle East and North Africa for the period (1980-2014) and compared it with 18 countries from Latin American countries, where the study concluded that knowledge economy indicators have a positive impact on economic growth in countries, especially in the long run. (Utka,I & F.M,2003).

4-3- Stelio Karagiannis study (2007)

Estimating the impact of the knowledge economy on economic growth by focusing on policies and investments related to research and development, and the study used the growth equation of the Barro model (1995), during

the period (1990-2003) for 15 member countries of the European Union The result was that investment in research and development has a positive impact on economic performance.(E, Karagiannis,2007, p65).

4-4- Agyapong.B & all (2015)

Analyzing the relationship between economic growth and the knowledge economy by comparing three regional blocs in Africa. The study concluded that all countries' performance was weak in all knowledge economy indicators, which is much lower than the global level. The reason is due to the low level of education compared to the economies of developed countries.**(**Agyapong.B & all, 2015, p200).

4-5- Study of Manjinder.Kam & Lakhwinder.Singh (2016)

Explanation of the relationship between the knowledge economy and the economic growth of 42 developing countries during the period (2000-2012). The result showed that there is a positive relationship between economic growth and the knowledge economy.(Kam, M & Singh,L,2016, p205).

4-6- Study HON Yan & all (2017)

I examined the relationship between the knowledge economy and economic growth for 55 countries consisting of: (12 countries from Western Europe, two countries from the Atlantic Ocean, 06 countries from East Asia, two countries from South Asa, 15 countries from Europe and Central Asia, 06 countries from Latin America, and 05 countries from the Middle East and Group of Seven countries) for the period between (2000-2012).

The study concluded that all indicators of the knowledge economy have a significant impact on economic growth, especially for the G7 countries.(Tew,J.H & all ,2017).

5- The applied aspect of the study (standard study)

This study tests the impact of the knowledge economy on the economic growth of a sample of 18 leading countries in the knowledge economy according to the classification of the United Nations Development Program for the year 2020. For the period (1996 - 2019). We take a set of variables that express the knowledge economy as explanatory variables, as shown in Table No. (02), and the per capita GDP as a dependent variable to express economic growth, using Data Panel models, by applying the Eviews12 program.

5-1- Sample of the study

The study sample is represented in 18 leading countries in the field of knowledge economy, which are shown in the following table:

Table 2 . Sample of Study

N	Country	N	Country	N	Country
1	Switzerland	**7**	Singapore	**13**	Austria
2	United States	**8**	Denmark	**14**	Belgium
3	Finland	**9**	United Kingdom	**15**	Iceland
4	Sweden	**10**	Germany	**16**	Korea, Rep.
5	Netherlands	**11**	Japan	**17**	France
6	Luxembourg	**12**	Norway	**18**	Canada

(Created by researchers)

5-2- Model Variables

Table 3. Interpretation of Model Variables

Source	Variables explanation	Variables
The World Bank	GDP per capita (in current US dollars)	**GDPP**
The World Bank	Education spending (% of GNI)	**EDC**
The World Bank	Patent applications	**PRT**
The World Bank	Fixedtelephonesubscriptions (per 100 people)	**FT**
The World Bank	Mobile cellular subscriptions (per 100 people)	**MT**
The World Bank	Individualsusing the Internet (% of population)	**INT**
The World Bank	Control of Corruption: Estimate	**CC**
The World Bank	GouvernementEffectiveness: Estimate	**GE**
The World Bank	PoliticalStability and Absence of	**PS**
The World Bank	Rule of Law: Estimate	**RL**
The World Bank	RegulatoryQuality: Estimate	**RQ**

(Created by researchers)

Table 4. Statistical description of the variables

	GDPP	EDC	PRT	FT	MT	INT	CC	GE	PS	RL	RQ
Mean	71.85	5.063	6308	49.93	92.80	66.61	1.825	1.749	1.033	1.684	1.534
Median	79.99	4.926	3136.	50.59	100.6	78.00	1.967	1.799	1.094	1.759	1.605
Maximum	127.6	8.360	6214	74.98	172.1	99.01	2.469	2.436	1.760	2.129	2.260
Minimum	8.281	2.200	24.00	4.862	4.245	1.624	0.322	0.363	-	0.798	0.283
Std. Dev.	34.16	1.366	1314	12.93	38.27	27.80	0.461	0.315	0.393	0.270	0.335
Skewness	-	0.186	2.496	-	-	-	-	-	-	-	-
Kurtosis	1.518	2.606	8.373	4.182	2.538	2.563	4.707	5.189	2.855	3.996	3.840
Jarque-	40.11	5.295	968.3	79.72	30.45	64.24	184.0	173.2	33.64	111.7	62.28
Probabilit	0.000	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sum	31042	2187.	2725	2157	4009	2877	788.7	755.8	446.6	727.6	662.9
Sum Sq.	50295	804.2	7.45	7210	6313	3332	91.95	42.92	66.62	31.61	48.63
Observati	432	432	432	432	432	432	432	432	432	432	432

(Prepared by researchers based on the outputs of Eviews12)

Table 5. Correlation Matrix

	GDPP	EDC	PRT	FT	MT	INT	CC	GE	PS	RL	RQ
GDP	1										
EDC	0.3998	1									
PRT	-	-	1								
FT	-	-	0.0083	1							
MT	0.2690	0.120	-	-0.4667	1						
INT	0.3726	0.235	-	-0.4052	0.8743	1					
CC	0.5431	0.404	-	-0.0518	0.1125	0.0783	1				
GE	0.4203	0.225	-	-0.0549	0.0835	-	0.8543	1			
PS	0.2253	0.188	-	0.0146	-	-	0.6427	0.6030	1		
RL	0.6667	0.498	-	-0.1362	0.2606	0.2241	0.8558	0.7301	0.5864	1	
RQ	0.5166	0.093	-	-0.1503	0.2359	0.1570	0.7669	0.7655	0.3728	0.6912	1

(Prepared by researchers based on the outputs of Eviews12)

We note through the correlation matrix between the study variables; There is a direct relationship between the dependent variable and the independent variables, except for patents PRT and FT, which were negative and weak. We also conclude that the governance variables represented in: (Rule of

Law RL, Organizational Quality RQ, Control of Corruption CC) had a strong relationship more than other variables.

5-3- Stability study of time series

Before using time series, we first study its stability using Levin, lin, chu test in order to avoid having a unit root in time series and the results are shown in the following table:

Table 6. LLC Test Results for Time Series Stability

1st Difference			Level			
Non	**Ind.Int .trend**	**Int. Int**	**Non**	**Ind.Int .trend**	**Int. Int**	
—	—	—	6.28227 (1.0000)	-1.7538 (0	-3.8926 (0	**GDPP**
—	—	—	-0.3371 (	-6.0946 (0	-4.8536 (0	**EDC**
—	—	—	- 0.77643	-2.09010 (0.0183)	-1.01517 (0.1550)	**PRT**
—	—	—	- 6.60199	-1.67956 (0.0465)	2.94766 (0.9984)	**FT**
—	—	—	1.92137 (0.9727)	-6.4015 (0	-8.6350 (0	**MT**
—	—	—	2.67423 (0.9963)	-4.28800 (0.0000)	-12.553 (0	**INT**
-14.851 (0	-7.1250 (0	-8.8717 (	-1.0257 (	-0.5183 (0	-0.1119 (0	**CC**
—	—	—	- 1.76715	-1.69220 (0.0453)	-1.00897 (0.1565)	**GE**
—	—	—	- 2.67891	0.13699 (0.5545)	-1.0341 (0	**PS**
—	—	—	0.82095 (0.7942)	-1.37227 (0.0850)	-2.0900 (0	**RL**
—	—	—	0.17316 (0.5687)	-0.51077 (0.3048)	-2.0570 (0	**RQ**

(Prepared by researchers based on Eviews12 outputs).

The values in the table represent the statistic corresponding to each variable, and the value in parentheses represents the probability for it. The series is stable if the corresponding probability of each statistic is less than 5%. Therefore, we conclude that all series are stable at the level except for the variable CC (Anti-Corruption) is stable in the first difference.

5-4- Estimation of the study model

We use in this study three basic models for the Panel series: the Pooled Regression Model, the Fixed Effects Model, and the Random Effects Model, then we differentiate between these models to find appropriate form. The general form of the form is written as:

Table 7. Results of estimating the cumulative regression model, and the fixed and random effects model

GDPP			
Period : (1996-2020) ; number of countries : 18 ; total views : 432			
estimating the random	**estimating the fixed**	**estimating the cumulative**	**variables**
1.866908 (0.0013)	**1.497968** (0.0000)	**3.791318** (0.0004)	**EDC**
3.53E-05 (0.0000)	**3.095700** (0.0000)	**8.07E-05** (0.0000)	**PRT**
-0.193366 (0.0000)	**-0.163952** (0.0000)	**-0.224931** (0.0114)	**FT**
0.047601 (0.0597)	**0.059275** (0.0000)	**-0.334104** (0.0000)	**MT**
0.229836 (0.0000)	**0.204706** (0.0000)	**0.549393** (0.0000)	**INT**
9.671219 (0.0005)	**7.358073** (0.0000)	**2.875538** (0.6463)	**CC**
-16.86988 (0.0000)	**-14.29762** (0.0000)	**-10.01952** (0.1414)	**GE**
10.51513 (0.0000)	**9.092812** (0.0000)	**-3.651617** (0.3487)	**PS**
5.256303 (0.1642)	**2.136132** (0.0022)	**72.26457** (0.0000)	**RL**
2.213306 (0.3052)	**1.988283** (0.0000)	**28.76991** (0.0000)	**RQ**
38.84231 (0.0000)	**46.89909** (0.0000)	**-96.61439** (0.0000)	**C**
0.724625	**0.998721**	**0.635083**	**R-squared**
0.718084	**0.998635**	**0.626415**	**Adj R-squared**
110.7823	**11681.54**	**73.26875**	**F-statistic**
0.000000	**0.000000**	**0.000000**	**Prob(F-statistic)**

(Prepared by researchers based on the outputs of Eviews12).

5-5- Choosing the right model

5-5-1-Lagrange Multiplier Tests

We use the Lagrangian multiplier to differentiate between the associative model on the one hand, and the fixed and random effects model on the other. This model is based on two hypotheses; the first hypothesis ;

- H0: the aggregative model is appropriate, and the second hypothesis
- H1: the fixed effects or random effects model is appropriate.

Table 8. Lagrange multiplier test results

Lagrange Multiplier Tests for Random Effects			
	Cross-section	Time	Both
Breusch-Pagan	2697.399	4.224845	2701.624
	(0.0000)	(0.0398)	(0.0000)

(Prepared by researchers based on Eviews12 outputs).

From the Lagrangian multiplier test, we note that the corresponding probability of this test is less than 5%, and therefore we reject the null hypothesis H0 and accept the alternative hypothesis H1; Which model is suitable is either a fixed-effects model or a random-effect model and to verify this we perform the Haussmann test.

5-5-2- Housman Test

Haussmann's test differentiates between the random effects model and the fixed effects model and is based on two hypotheses:

- H0: the random-effects model is the fitting model.
- H1: the fixed-effects model is the fitting.

Table 9. Haussmann test results

Correlated Random Effects - Housman Test			
Test cross-section random effects			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	28.462854	10	0.0015

(Prepared by researchers based on Eviews12 outputs)

From Table No. (9), we note that the probability corresponding to the Haussmann test is (0.0015), which is less than 5%, and from it we reject the null hypothesis H0 and accept the alternative hypothesis H1, i.e. the fixed effects model is the appropriate model, and it is written as follows:

GDPP = 1.4979EDC + 3.0957PRT - 0.1639FT + 0.0592MT + 0.2047INT + 7.3580CC - 14.2976GE + 9.0928PS + 2.1361RL + 1.9882RQ + 46.8990 ……(02).

After choosing the fixed effects model, we make sure of its quality from Table **(5),** where we note that the probability corresponding to the Fisher statistic is equal to (00000), which is less than 5%, and the model is significant, and the coefficient of determination R^2 is estimated at 0.9987, meaning that the independent variables explain the dependent variable by 99 .87% and the rest are explained by other variables that were not included in the model, as the probability corresponding to Fisher's statistic for independent variables shows that it is less than 5%, meaning that all variables are significant.

5-5-3- Form Validity Test

To ensure the validity of the form, we run a series of tests as shown in the table and figures below:

Table 10. Autocorrelation test between residuals

Residual Cross-Section Dependence Test			
Test	**Statistic**	**d.f.**	**Prob.**
Breusch-Pagan LM	31.47757	153	1.0000
Pesaranscaled LM	-6.946975		0.0000
Bias-correctedscaled LM	-7.338279		0.0000
Pesaran CD	0.080556		0.9358

(Prepared by researchers based on the outputs of Eviews12).

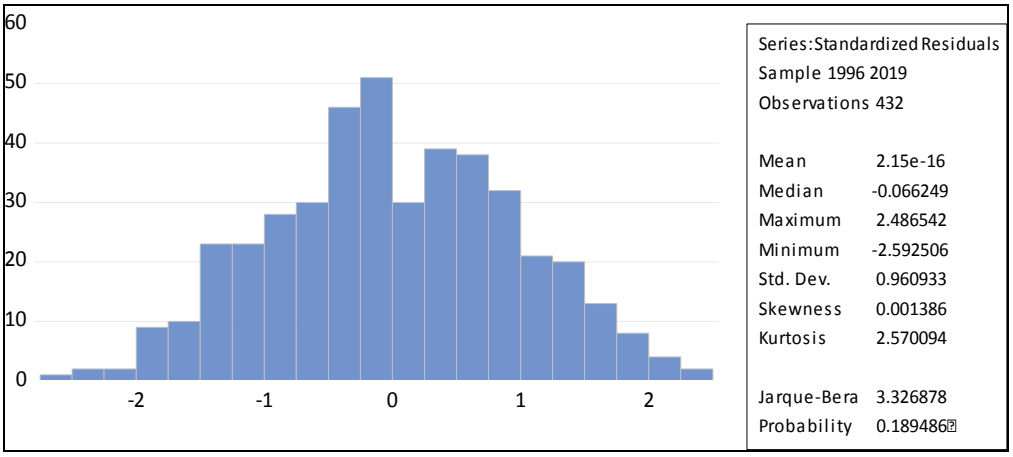

Figure 1. Test for the normal distribution of residuals
(Prepared by researchers based on Eviews12 outputs)

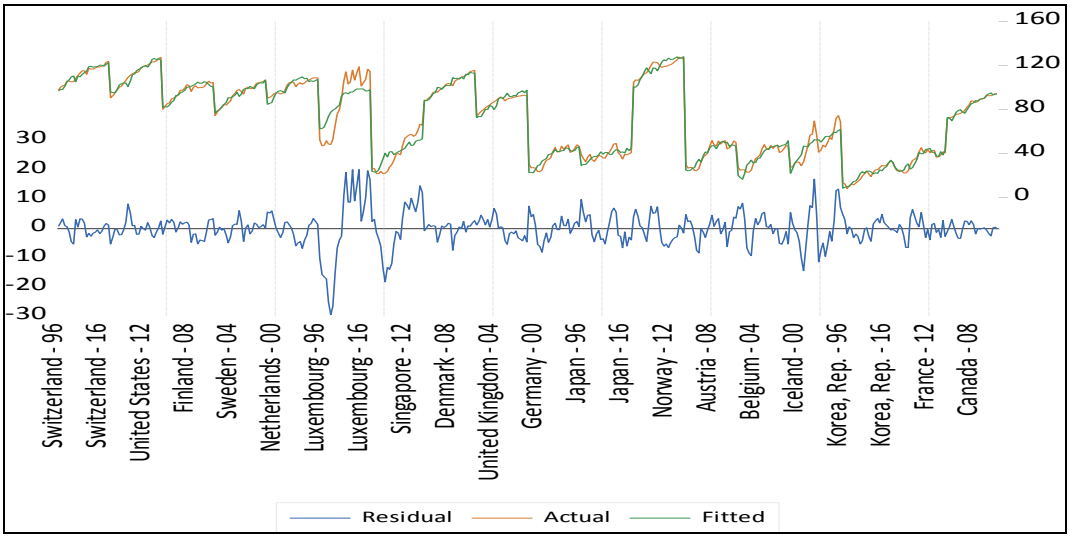

Figure2. Graphic representation of current and estimated values
(Prepared by researchers based on the outputs of Eviews12)

According to the model validity test, we note from Table (10) that the corresponding probability of the LM statistic is greater than 0.05, and therefore there is no problem of autocorrelation between errors. From Figure 01, we notice that the probability corresponding to the jarque-bera statistic is greater than 0.05, i.e. the residuals follow a normal distribution. From Figure (02), we note that the current values match the estimated values, and therefore the model is stable throughout the study period.

5-5-4- Persistent effects of states

Table 11 . Results of Estimation of Fixed Impacts for Countries

N	SERIES01	Effect	N	SERIES01	Effect	N	SERIES01	Effect
1	Switzerland	41.91144	**7**	Singapore	-26.29680	**13**	Austria	-31.12715
2	United States	36.42824	**8**	Denmark	25.71273	**14**	Belgium	-27.44711
3	Finland	17.32683	**9**	United Kingdom	20.44383	**15**	Iceland	-30.44093
4	Sweden	16.68087	**10**	Germany	-31.57089	**16**	Korea, Rep.	-43.70213
5	Netherlands	28.68238	**11**	Japan	-38.88646	**17**	France	-24.04545
6	Luxembourg	12.42892	**12**	Norway	38.96083	**18**	Canada	14.94085

(Prepared by researchers based on the outputs of Eviews12)

From Table No. (11), we note that 10 countries from the sample had a positive impact and the largest value was for Switzerland's share with 41,911, and the rest of the countries had a negative impact and was less valuable than the share of South Korea with a value of -43.045.

6- Interpretation of the results

The model we get (Equation No. 02) shows the following results:

- Positive relationship between spending on education and per capita GDP; Where an increase of one unit of spending on education leads to an increase in per capita GDP by 1.4979 units.
- a positive relationship between patents and per capita GDP; An increase of one unit of patents leads to an increase in GDP per capita of 3.0957 units.
- an inverse relationship between fixed-line users and per capita GDP; Where an increase of one unit of fixed-line users leads to a decrease in per capita GDP of 0.1631 units.

- a positive relationship between mobile phone users and per capita GDP; Where an increase of one unit of mobile phone users leads to an increase in the GDP per capita of 0.0592 units.
- a positive relationship between Internet users and per capita GDP; Where an increase of one unit of Internet users leads to an increase in per capita GDP of 0.2047 units.
- A positive relationship between the corruption control index and the per capita GDP; Where an increase of one unit of the Corruption Control Index leads to an increase in the GDP per capita by a value of 7.3580 units.
- an inverse relationship between the government effectiveness index and per capita GDP; Where an increase of one unit of the government effectiveness index leads to a decrease in GDP per capita by an amount of 14,2976 units.
- A positive relationship between the indicator of political stability and per capita GDP; Where an increase of one unit of the political stability index leads to an increase in the per capita GDP by a value of 9.0928 units.
- A positive relationship between the rule of law indicator and per capita GDP; Where an increase of one unit of the rule of law index leads to an increase in the per capita GDP of 2.1361 units.
- A positive relationship between the organizational quality index and the per capita GDP; Where an increase of one unit of the organizational quality index leads to an increase in the per capita GDP of 1.9882 units.

7- Conclusion

The world is witnessing a major shift towards knowledge economy, which is driven by the production and use of knowledge and by the service sectors that capitalize on selling and marketing it. Accordingly, commodities have acquired an intellectual value rather than a material. Moreover, the added value that can be yielded from knowledge by adding new technology to it is greater than that acquired from the addition of other materials. For instance, downloading a new application to a mobile phone, while keeping the same device and materials, generates more value.

This change has not only played a significant role in boosting productivity, but it contributed largely in giving birth to an economic boom as well. Needless to say, this has led many studies to attempt to link knowledge economy with economic growth. Most of which, have arrived to the conclusion that knowledge economy has a positive effect of economic growth. In the same vein, this study has attempted to investigate the nature

of the relationship between the two by studying the economies of some of the leading countries in knowledge economy. The results have shown that knowledge economy, with all its indicators, has a significant impact on growth economic the results also support the hypothesis. Taken together, the findings of this study confirms theoretically what modern theories of growth have called for; taking into consideration that knowledge has always been the key to progress ,but this fact is more highlighted now than ever.

References

Agyapong.B & all(2015), knowledge and Economic Growth : a Comparative Analysis of The Regional Blocks in Sub-Saharan Africa, Environmental Economics, volume 6, Issue04, 196-208.

Aighion ,P(1990), A model of growth through creative destruction, n,w3223) national office of economic research, p327.

Derek.H & Dahman C.J(2006), The knowledge Economy the Kam methodology and world bank operation, the world bank Washington Dc ; 20433, p09.

Dowrick,S (2002), Investing in knowledge Economy, implication for Australian Economic Growth. The Australian National University ,Canberra ,available at hhtp://ecocomm.anu.edu.au/economics/staff/dowrick/Humcapigrowth.pdf.

E, Karagiannis(2007), The knowledge – Based Economy, Governance and Economic Growth : Evidence From The European Union, The Journal of Economic Asymmeties,4(2), 65-85.

E- Japan Policy Program(2002), Approaches for Systematic Planning of Development Projects/Information and Communication Technology, chapter1 Overview of Information and communication on the following site : https://www.jica.go.jp/jica-ri/02.10.2019.

Global Knowledge index(2020) on the following site : https://www.undp.org/publications/global-knowledge-index-2020 wiev date: 26.11.2021

Indistried Research Institute(2017), R&D Trends Forcust, Research from the Industrial Research Institute's Annual Survey : Slowing economies Slow R&D Investments and mute optimism, Research technology Management,60(1), p 18-25.

International Telecommunication Union(2018) on the following site : https://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ICTOI-2018, view date 26.11.2021.

Jones,C.I(2019), Paul Romer Ideas, Nourrir and Endogenous growth, the Scandinavian Journal of Economic 121(3), p854-883.

Kam, M & Singh,L(2016), Knowledge in the Economic Growth of development Economies, Africa Journal of Science, Technology, Innovation and Development ;8(2), 205-212.

Maurseth P.B(2008), Gouvernance Indicators : A guide tour p 18.

M.Grundstein & C.R.Sabroux 2007, Knowledge management system as a sociotechnical system Paris university p02.

Romer P M(1986), Increasing returns and long-run growth, journal of political economy,94(5),1002-1037, p1004

Romer P.M(1986)

Solow? R M(1956), A contribution to the theory of economic growth, the quarterly journal of economy, p65.

Smith.K(2000), what the knowledge economy ? Knowledge intensive industries and distributed knowledge base pp(15-17), sydney-australia, AEGIS ? waster Sydney university p02.

Thomas, M.A(2010) , what do the worldwide governance indicators measure؟ The European journal of Development research, 22(1) p03.

Tew,J.H & all (2017), Linkage between the role of knowledge Economy and Growth : A panel Data Analysis (doctoral dissertation, UTAR).economic research, p327.

Utka,I & F.M(2003), Knowledge Technological Catch-up and Economic Growth : A dynamic panel Data Analysis for MENA and Latin America In Economic Research Forum Working papers(n,1146).

Word bank(2012).