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Comparative Econometric Study on the Contribution of Investment to Gulf Cooperation Council's Knowledge Economy over the Period (2000-2015): Evidence from Panel Data

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Abstract: The study sought to elucidate the link between investments, oil and non-oil exports, human capital, capital goods imports and GDP on the one hand and knowledge economy in GCC countries on the other hand. The importance of the study lies in analyzing the impact of investments in the knowledge economy in the GCC during the period (2000-2015) where it has tracked the size of these investments and the extent to which GCC countries benefit from them in achieving their development. The study also contributes to the economic literature by investigating the factors affecting the four pillars of knowledge economy, using disaggregated data of the GCC economies during the 2000-2015 periods. Employing panel data analysis, we found that the expansion of capital goods imports, human capital and output reflects in strengthening the pillars of the knowledge economy in the GCC countries. Interestingly, the effects of gross fixed capital formation and oil exports were insignificant, contrary to the economic theory and the hypothesis of the study. Accordingly, it can be inferred that more investment expenditure on fixed capital formation and more efficient use of oil export earnings on knowledge-extensive activities are needed. In addition, the study uncovered the importance for the GCC countries to agree on clear and transparent objectives towards the orientation of the knowledge economy. The findings draw some main policy implications-namely, the importance of targeted education and innovation-based policy.

INTRODUCTION

In the name of God, thanks God, God blessings and peace upon our Prophet Muhammad. There is no doubt that investment is one of the main engines of any economic system and this is what made most of the countries of the world seek to pursue sound policies to attract different kind of investment. The requirements of globalization and the rapid acceleration of knowledge production in many countries, make it important for the knowledge economy to be with vital role, especially in this era characterized by speed and development. The extent to which the knowledge economy contributes to the progress of the economies of countries is linked to

attracting more investment. Since, the GCC countries are not immune from the countries of the world, the study will focus on the role played by knowledge Economy and associated investments in the GCC countries, during the period (2000-2015). The following is a brief reference to the themes of the intellectual frameworks of the study:

Study problem indication: Although, the GCC countries enjoy huge financial surpluses resulting from oil revenues and in a desire to correct the existing conditions and allocate resources effectively, the GCC decision makers had a strong will to catch up with developed countries and emerging economies that have achieved tangible progress in the field of knowledge economy, to overcome obstacles that hinder the building of the knowledge economy and regulate the feasibility of investing in various branches of knowledge. Hence, the problem of the study lies in how to direct investments towards building the pillars of the knowledge economy and how to manage efficiently the revenues resulting from the optimal use of the state revenues

Study objective: The importance of the study lies in knowing the capabilities of the GCC countries in the adoption of the knowledge economy in the form that makes them keep up with the pioneer's countries in this field. That happens by identifying the most important strategies, methods and mechanisms on which the knowledge economy is based. Additionally, the study is interested in identifying the most important challenges facing the GCC countries in investing in the knowledge-content economy and in diagnosing the policies package and mechanisms aiming at removing the existing obstacles and giving a strong motivation to investing in the knowledge-content products.

Previous related empirical studies: Al-Hayali[1] in a study on knowledge economy determinants in GCC Countries concluded that the results of the model estimation showed a direct relationship with a significant impact between two independent variables; information technology and economic incentive scheme, on the dependent variable (GCC Knowledge Economy Index).

In his model estimation, the determination coefficient R^2 showed that 99.2% of the changes of the dependent variable (GCC Knowledge Economy Index) are explained by ICT variable (Information and Communication Technology). On the other hand, 88.3% of the changes of the dependent variable are explained by economic incentive scheme variable Compared to the other two explanatory variables (innovation variable and education variable) which were less significant.

The computed F statistic with 0.05 significance level and (2,3) degrees of freedom showed that the Model is significant for the economic incentive scheme. The results also showed that at 0.05 significance level and (4,1) degrees of freedom, one unit change in the economic incentive scheme variable and one unit change in ICT variable cause a corresponding change in the GCC Knowledge Economy Index by (0.60335) unit and (0.43678) unit, respectively.

Mohammed[2] used a linear regression function based-model for two countries of Saudi Arabia and the United Arab Emirates. The model included 3 independent variables (domestic investment, total exports, total imports) and dependent variable gross domestic product (GDP). As for Saudi Arabia, the study found a positive relationship between two independent variables (domestic investment and total exports) in one hand and the dependent variable (GDP) on the other hand. Moreover, the study showed a negative relationship between the independent variable (total imports) and the independent variable (GDP). The study also examined the causal relationship between GDP and total exports and the 98.6% coefficient of determination illustrated that 100% increase in GDP leads to an increase in total exports by 119.6%.

As for the United Arab Emirates, the model illustrated a positive relationship between two independent variables; namely the total imports and the Foreign Direct Investment (FDI) on the one side and the GDP on the other side, a 100% increase in FDI increases GDP by 24%. The coefficient of determination R^2 amounted to 93.8% gave the model explanatory power. In another context, the independent variable total exports showed inverse relationship with the independent variable GDP.

Ilyas[3] remarked the significance and goodness of fit of the panel data model used for the six Arab countries of the Gulf Cooperation Council (GCC) for the period 2005-2012. The model has shown that the four explanatory variables which constitute the four pillars of the knowledge economy (Institutional System Index, Education Index, Innovation Index, IT Index) control over 98.45% of the changes in Inter-trade among the six countries indicating the strong correlation between the dependent variable of intra-trade as a proportion of GDP and the explanatory variables. This is without taking into account other affecting factors. As for the remaining 1.55%, it is explained by error term in the model.

MATERIALS AND METHODS

The econometric model; Panel data approach: The term panel data means a set of observations that are repeated by a group of individuals at several intervals of time, so that, it focuses on multiple individuals at multiple time intervals and it combines the characteristics of both cross section data and time series data at the same time. In other words, the panel data describes the behavior of a

number of individuals or cross section units such as states, at a single time interval while time series data describes the behavior of a single individual at multiple time intervals.

If the time interval for all individuals is the same, it is called balanced panel data, whereas if the time interval varies from individual to another, it is called unbalanced panel data. In other words, a balanced panel is a dataset in which each single individual is observed every year whereas an unbalanced panel is a dataset in which at least one single individual is not observed every interval.

The importance of the model: Panel data models have recently gained considerable interest in economic studies, since, they take into account the effect of time change and the effect of changing in the difference between the cross section units at the same time. In other words, with panel data models, we can rely on the inter-individual differences to reduce the collinearity between current and lag variables to estimate unrestricted time-adjustment patterns. The most important advantages of panel data analysis is summarized by Hsiao and Clevmakben as follows:

Panel data models control over the individual variation that may appear in the case of cross sectional data or time series models which leads to biased results. In addition, panel data models include more information content than those in the case of cross section or time series models; therefore they provide a better possibility of obtaining estimates with higher confidence and more accurate inference and parameters. In addition, the problem of multicollinearity is less severe than those that characterize time series models. Besides, panel data usually contain more degrees of freedom and more sample variability than cross-sectional data, hence improving the efficiency of econometric estimates.

Moreover, panel data models provide a better possibility to study the dynamics of adjustment that may be concealed by cross sectional data, as they are suitable for the study of periods of economic stagnation when unemployment and poverty prevail. On the other hand, panel data models can link the behaviors of the sample individuals from one time point to another.

Besides, panel data models control the impact of omitted variables by reducing the appearance of the problem of missing or unobserved variables resulting from individual characteristics which lead to biased estimates in individual regressions.

Variables of the model and static panel estimation method:

$$TKA\ I_t = a + ß_t\ TGFCF\ i_t + \beta_2\ TOEX\ i_t + \beta_3 TCLMP\ i_t + \beta_4 TNOEX\ i_t + \beta_5 TGDP\ i_t + \beta_6 THUMC\ i_t + \mu_i + \varphi_t + \varepsilon i_t$$

Where:

TKAM = Log of the index of the total values of the four pillars of the knowledge economy of a country (GCC knowledge economy index)
TGFCF = Log of Gross Fixed Capital Formation of the GCC countries
TOEX = Log of the Total Oil Exports Value of the GCC countries
TNOEX = Log of the Total Non-Oil Exports Value of the GCC countries
TCLMP = Log of the Total Capital Goods Imports Value of the GCC countries
TGDP = Log of GDP of the GCC countries
THUMC = Log of Total Human Capital (Total Population is a proxy)
μ_i = Unobserved cross sectional-varying units observations effects between countries
φt = Unobserved time-varying observations effects between countries
εi_t = The random error term of the model

The challenge of the panel data model used is to control the impacts of the effects of the "unobserved heterogeneity" as when eliminated they lead to biased and inconsistent estimates and therefore these cross section and time effects are tackled in the model either as fixed effects model or as random effects model.

The fixed effects model is based on the assumption that these GCC-specific effects or time-specific effects are correlated to explanatory variables or at least one of them which are the four-pillar determinants of the knowledge economy. And the model also assumes that the intercept varies across countries and time.

The random effects model treats cross section-specific effects and time-specific effects as random parameters rather than fixed. This assumption is based on that the individual-specific effects and the time-specific effects are random variables with zero means and constant variances and that means the random effects are not correlated to the explanatory variables of the model and are become part of the model's error term and are typically assumed to be uncorrelated with explanatory variables. Thus, the model assumes that each individual (country) or each time observation varies in its random error. In the case of both cross section-specific effects and time-specific effects, the model is referred to as the error components model or the variance components Model since the random effects are included within the random error term so it became as follows:

$$\varepsilon i_t = \mu i + \gamma t + v i_t$$

To estimate the parameters of the model in the dual logarithmic formula, the goodness of fit indicators such as coefficient of determination R^2, adjusted R^2, F statistic, T

statistic will be used. The true values of the parameters in the model are estimated for GCC countries during the period 2000-2015, using the Knowledge Assessment Methodology (KAM) adapted by the World Bank Institute. The statistical and econometric analyses of the data will be done using E-Views statistical package.

Tests of hypothesis of the model: The hypothesis of the study to be tested are as follows:

- Raising investment rates in the GCC countries in the field of education strengthens the pillars of the knowledge economy (economic and cognitive incentives for the institutional system, education, innovation system and information and communication technology)
- Raising exports in the GCC countries leads to the growth of spending on the pillars of the knowledge economy
- Raising the technological import volume and the imports of capital goods in the GCC countries, improves the pillars of the knowledge economy
- The nature of government's investment orientation towards strengthening the knowledge economy will accelerate economic growth and diversify the productive structure, in addition to improving the international competitiveness of the GCC countries

RESULTS AND DISCUSSION

Reliability and validity tests: Cronbach's alpha is a measure used to assess the reliability or internal consistency of a set of scale, data or test items. In other words, the reliability of any given data measurement refers to the extent to which it is a consistent measure of a set of scale or test items. The computed a coefficient of reliability ranges from 0 to 1. If all of the scale items are entirely independent from one another (i.e., are not correlated or share no covariance), then $\alpha = 0$ and if all of the data items have high covariances, then α will approach 1. In other words, the higher the a coefficient, the more the items have shared covariance and vice versa. Hence, the higher a coefficient is, the more credibility of data used.

In the same context, the validity coefficient-known as the validity of the test-can be calculated as equal to the square root of the reliability coefficient. Generally, the reliability means that the scale is non-contradiction with itself and that means that the scale gives the same results with a probability of equal value of the coefficient if it is reapplied to the same sample but validity means that the scale measures what it is supposed to measure[4].

Table 1 shows the Cronbach's alpha reliability statistics. Table 1 indicates that the value of Cronbach's alpha coefficient is 0.806 which is high and with positive sign, that means the covariance is positive between the data. However, the results of validity coefficient indicate that the variable (total non-oil high-technology exports value) weakens the scale and as a result it was deleted from the model. The remaining variables make the value of the Cronbach's alpha coefficient raise to 0.840 instead of 0.806. On the other hand, the coefficient of validity test which is the square root of the reliability coefficient amounted to 0.898 which means that the selected independent variables measure the total value of the four pillars of the knowledge economy with a high degree of reliability, validity and credibility.

Table 1: Reliability statistics

Cronbach's alpha	Cronbach's alpha based on standardized items	No. of items
0.806	0.902	6.0

Prepared by the researcher

Estimation results: In the first static panel model of the determinants of the knowledge economy in which all variable were included in the analysis, some variables showed either negative signs such as GDP or non-significance as total non-oil exports value. So the panel model was reviewed using a combination of economic variables in order to identify the most influential variables in the knowledge economy index of the GCC countries. Table 2 shows the static panel model estimation. The estimated model, after excluding the total non-oil exports value was updated as follows:

$$TKAM\ i_t = \alpha+\beta_1\ TGFCF\ i_t+\beta_2\ TOEX\ i_t+\beta_3\ TCLMP\ i_t+ \beta_4\ THUMC\ i_t+\beta_5\ TGDP+\mu i+\gamma t+\varepsilon i_t$$

The model was estimated in three methods: pooled OLS, one way fixed effects method and one way random effects methods. The results of the estimated updated models were as shown in Table 3-5, respectively.

According to the estimation results, we find that the best method to estimate the static panel model is the fixed effects method. In comparison with pooled OLS method, we find that the (F) statistic is significant and therefore we reject the null hypothesis that the intercepts are the same (homogenous) which indicates the importance of including the cross sectional effects μi and the time effects γt. To choose between the fixed effects model and the random effects model, we used Hausman test which showed that the estimators of random effects model are inconsistent and the estimators of the fixed effects model are most appropriate, since, they also lead to the improvement of some statistics such as standard error, the adjusted coefficient of determination, however, the presence of positive serial correlation is still exist.

The results of the fixed effects model estimation indicate that the total capital goods imports value, total

Table 2: Static panel model

Static panel model	F	R^2	Sig.
LnTKAM = 0.1.198-0.156LnTGFCF- 0.113LnTOEX-0.008 Ln TNOEX+0.325 Ln TCLMP (-4.080*)-2.542)*(-1.569) (10.418) (1.272)+0.051 Ln TGDP-0.084LnTHUMC+0.002γt-0.01 μi (0.784) (-3.072)* (-0.579) (-1.145)	49.190	0.830	000

Table 3: Pooled regression

Pooled Regression	F	R^2	Sig.	D.W
LnTKAM=1.836+0.008LnTGFCF-0.072LnTOEX+0.231 Ln TCLMP-0.104 LnTHUMC-.072 Ln TGDP (-0.309))-1.808) (9.920)*(-8.655)*(-1.746)	54.379	0.737	000	0.562

Table 4: One way fixed effects

One way fixed effects	F	R^2	Sig.	D.W
LnTKAM = 3.158-0.015LnTGFCF-0.015LnTOEX+0.292 Ln TCLMP-0.220 LnTHUMC-0.147LnTGDP (-1.481))-1.667) (5.658)* (-4.140)*(-2.086)*	12.401	0.750	000	0.617

Table 5: One way random effects

One way random effects	F	R^2	Sig.	D.W
LnTKAM = 0.2.898-0.026LnTGFCF- 0.030LnTOEX+0.285 Ln TCLMP-0.164 LnTHUMC-0.139 Ln TGDP (-.796))-0.729) (6.977)* (-3.239)*(-2.230)*	8.817	0.611	000	0.331

The values in parentheses represent computed t statistic; *significant at the 0.05 level; Prepared by the researcher

human capital and GDP of the GCC countries were key determinants of the GCC Knowledge Economy Index during the study period. Moreover, the regression slopes were statistically significant and consistent with economic theory. The results also revealed that the total capital goods imports value and then a reasonable increase in import volume from knowledge-content goods reflected on improving the pillars of the knowledge economy of the GCC countries. Further, the GDP slope coefficient was significant; however, it was not in line with the economic theory which argues that increased GDP results in increasing the rates of investment in education and thus, strengthening the pillars of the knowledge economy.

Besides, estimation results highlighted that the regression coefficients of both gross fixed capital formation and total oil exports value are insignificant and not in compliance with the hypothesis of the study and the economic theory with regard to the signs of the coefficients, reflecting the low investment expenditure on knowledge economy infrastructure . The "F" statistics was significant which means that the entire model fits the data and provides significant joint effect of all the variables together. The adjusted coefficient of determination R^2 amounted to 75% which means that changes in the explanatory variables interpret 75 % of the change in the knowledge economy index. So, we can conclude that the explanatory variables used in the model contribute to the improvement of the knowledge economy's pillars in the GCC countries.

The impact of explanatory variables on the knowledge economy of each GCC country: With regard to the impact of the explanatory variables of the study on the knowledge economy of each GCC country separately and according to the data applied for each country over the period (2000-2015), a panel model was applied after the exclusion of the previously eliminated total non-oil exports value variable. Table 6-11 below disclose the results of the analysis.

Table 6 shows that the contribution of gross fixed capital formation variable in explaining the changes in TKAM amounted to 18.91% while the total oil exports value variable amounted to 8.57% which is the least influential in the knowledge economy among other variables, while the contribution of total capital goods imports value variable was 19.48% whereas the GDP variable was 10.80%. The total human capital impact amounted to 24.93% which is the most influential among other variables.

As for the UAE data, Table 7 reveals that the impact of gross fixed capital formation variable amounted to 3.67% which is the least influential among the variables while the total oil exports value variable amounted to 26.02% which is the most influential in the knowledge economy among other variables. On the other hand, the contribution of total capital goods imports value variable amounted to 14.97% while the impact of GDP variable was 10.48%. The highest impact on the knowledge economy was the total human capital with 19.86%.

As for Qatar data, Table 8 reveals that the data on gross fixed capital formation variable was not available. However, the total oil exports value variable amounted to 22.63% while the impact of the contribution of total capital goods imports value variable amounted to 23.88% and the impact of GDP variable was 23.07%. The highest impact on the knowledge economy was total human capital with contribution amounted to 24.47%.

With regard to Kuwait's data, Table 9 shows that the contribution of gross fixed capital formation in explaining the change in TKAM amounted to 14.80% while the total oil exports value variable amounted to 3.65% which is the least influential among the variables. As for the contribution of total capital goods imports value variable

Table 6: The impact of explanatory variables on the knowledge economy in Saudi Arabia

TKAM	TGFCF	TOEX	TNOEX (HTE)	TCLMP	TGDP	THUMC	Total
R	0.739	0.335	0.676	0.761	0.422	0.974	3.907
Saudi Arabia (%)	18.91	8.57	17.30	19.48	10.80	24.93	100

Table 7: The impact of explanatory variables on the knowledge economy in United Arab Emirates

TKAM	TGFCF	TOEX	TNOEX (HTE)	TCLMP	TGDP	THUMC	Total
R	0.090	0.638	0.613	0.367	0.257	0.487	2.452
UAE (%)	3.67	26.02	25.00	14.97	10.48	19.86	100

Table 8: The impact of explanatory variables on the knowledge economy in Qatar

TKAM	TGFCF	TOEX	TNOEX (HTE)	TCLMP	TGDP	THUMC	Total
R	0.000	0.922	0.216	0.973	0.966	0.997	4.074
Qatar (%)	0.00	22.63	5.30	23.88	23.71	24.47	100

Table 9: The impact of explanatory variables on the knowledge economy in Kuwait

TKAM	TGFCF	TOEX	TNOEX (HTE)	TCLMP	TGDP	THUMC	Total
R	0.389	0.096	0.031	0.917	0.358	0.837	2.628
Kuwait (%)	14.80	3.65	1.18	34.89	13.62	31.85	100

Table 10: The impact of explanatory variables on the knowledge economy in Kingdom of Bahrain

TKAM	TGFCF	TOEX	TNOEX (HTE)	TCLMP	TGDP	THUMC	Total
R	0.910	0.908	0.583	0.908	0.975	0.984	5.268
Bahrain (%)	17.27	17.24	11.07	17.24	18.51	18.68	100

Table 11: The impact of explanatory variables on the knowledge economy in Sultanate of Oman

TKAM	TGFCF	TOEX	TNOEX (HTE)	TCLMP	TGDP	THUMC	Total
R	0.822	0.514	0.479	0.653	0.742	0.511	3.721
Oman (%)	22.09	13.81	12.87	17.55	19.94	13.73	100

Prepared by the researcher

amounted to 34.89% which is the most influential among the variables while the explanatory power of GDP was 13.62%. And the total human capital contribution amounted to 31.85%.

On the same approach, Table 1 on The Kingdom of Bahrain's data shows that contribution of gross fixed capital formation in explaining the change in TKAM amounted to 17.24% which is the least influential among the variables and on equal foot with the contribution of total capital goods imports value variable amounted to 17.24%. As for the GDP variable, the explanatory contribution was 18.51% while the highest impact on the knowledge economy was attributed to total human capital contribution amounted to 18.68%.

Finally, Table 11 shows Oman's data on the impact of the explanatory variables on the knowledge economy during the study period. It's obvious that the contribution of gross fixed capital formation in explaining the change in TKAM amounted to 22.09% which is the most influential among other variables. The explanatory contribution of the total oil exports, total capital goods imports and GDP variables amounted to 13.81, 17.55 and 19.94, respectively. In addition, the total human capital contribution was 13.73% which is the lowest among variables.

It is noted that the previous empirical analysis of the GCC's data on the impact of the selected explanatory variables on the determinants of the knowledge economy, shows that there is a noticeable variation between the contribution ratios of the impact of these variables on knowledge economy from one GCC country to another and this shows that factor endowments, policies and orientations vary from one country to another in relation to adopting the knowledge-based economy. Table 12 shows the highest and lowest influential variables on knowledge economy index of each GCC country.

One limitation of this study is that the dataset of some qualitative variables are not available. With more data we may be able to relax and test empirically restrictions of equality of other variables across the 6 countries. In future research, dynamic model may be considered.

International experiences in the knowledge economy and lessons learned: This section argues the experiences of some countries in knowledge economy; they are China's experience, India's experience and Malaysia's experience.

China's experience in knowledge economy: China is considered one of the countries that achieved economic development and technological progress and tried to catch up with developed countries and took the path of industrialization and technology as a way to reach its desired goal. The world market in the 1990s witnessed the emergence of China as one of the manufacturers of information technology. China's economic development, since, 1979 has been characterized by the intensive use of Foreign loans in the import of technology, particularly

Table 12: The highest and lowest influential variables on knowledge economy index of each GCC country

Country	The highest impact variable	The lowed impact variable
Saudi Arabia	Total human capital	Total oil exports
United Arab Emirates	Total human capital	Gross fixed capital formation
Qatar	Total human capital	Total non-oil exports
Kuwait	Capital goods imports	Total oil exports
Kingdom of Bahrain	Total human capital	Gross fixed capital formation
Sultanate of Oman	Gross fixed capital formation	Total human capital

Prepared by the researcher

direct technology (in the form of licenses, services, consultations or co-production). In addition, China has moved towards diversifying its sources of imported technology, with the USA and Japan being exporters of more than 50% of China's technological imports. China is also one of the major countries in attracting foreign investment. China has made significant progress in information technology and has become a major competitor in the world market and has relied on the import and recycling of modern technology.

China has completed the strategic objectives of the development plan for technical sciences with the aim of reaching knowledge economy. About half of the research and development funds are funded by the government with a large number of local companies expanding into large multinational companies and the state has used some types of incentives to encourage knowledge economy research and development over years including the provision incentive and financing to companies that develop strategic industrial products. The tax system provides a full tax credit on research and development expenses.

China's software industry relied on important parts of the IT industry. China established >50 high-tech industrial development zones at the state level and succeeded in converting >600 scientific research results into products. Recently, China jumped to third place in the world after the United States of America and Japan as the largest high-tech producer.

With regard to the volume of China's exports of these technological products, it exceeded150 billion US dollars, an increase of 63%. China has become the world's largest producer of programmed telephone exchanges, mobile phones, color televisions, screens and spare parts with a production volume ranging from 30-55% of total global production to cover the needs of the entire domestic market as well as the export of nearly 40% to foreign markets. In addition, China's exports of high and new technology products have also expanded as percentage of total exports of China.

Science and technology in China has developed steadily. Until late 2010, the number of specialists in the scientific and technological fields in state-owned enterprises and departments reached 39 million. China has nearly 20 thousands independent state research bodies. The number of employees reached 4 million people, including 2 million specialists and engineers. The Law on Scientific and Technological Progress of China, issued in July 1993, set the objectives of scientific and technological development and its role, sources of funds and the system of scientific and technological activity in a relatively comprehensive manner which is a basic law guiding scientific and technological development. In 2010, the central government launched the state advancement strategy for science and education which helped drive China's science and technology work. In the same year, the government allocated an equivalent of US$10.59 billion in funds for science and technology. China's expenditures on science and technology continued to increase.

India's experience in knowledge economy: Science was the key that India had which led it to become a key player in the global economy and to provide wonderful lessons in the ability of people to challenge the extreme conditions of underdevelopment. India adopted scientific approach to contribute to the progress of the nation and the service of humanity. India's free market and trade liberalization system enable it to progress in knowledge economy.

India is the second most populous country after China with a population of >1.049 billion. However, information technology is the front of the modern Indian economy and is the fastest growing sector with revenues on the country estimated at about US$15 billion per year. The Indian economy ranks 10th in the world in terms of currency exchange. India also records high annual growth rate regularly and has external cash reserves of about US$143 billion. The Indian economy has been one of the world's most important economy dealing in software and management business processing with revenues exceeds US$25 billion.

Recently, India has established software technology zones funded by the federal government and has facilitated the export of software services by providing incentives and simplifying the necessary procedures in addition to transforming the telecommunications sector from a monopoly market to a competitive market. Moreover, the Indian government has intervened to manage direct investments towards the new knowledge and technology sectors and as a result, the share of technological exports increased from merely US$52 million in 1987, to US$485 million in 1995 but the significant increase was recorded in 1999 with Indian IT

Table 13: India's domestic sales and exports of software 1995-2002

Years	Exports	Domestic sales	Total revenues	Domestic sales/ Exports (%)
1995	485	339	824	70
1996	735	487	1222	66
1997	1110	712	1822	64
1998	1790	981	2771	55
1999	2650	1203	3853	45
2000	4000	2195	6195	55
2001	6230	2173	8403	35
2002	7680	2430	10100	32

Tschang, Ted, slicing the knowledge-based economy in Brazil, China and India a tale of 3 software industries<Asian development Bank institute, 2003, P 14

exports reaching US$4 billion and continuing to rise to exceed US$10 billion. India has also paid attention to data entry and outsourcing market, as international companies such as airlines and banks, need to enter huge amounts of data into the computer, to avoid the very high cost of labor in the West. So, the global demand for Indian software has increased, so, widely that it is used today in various services like aviation, banks, engineering companies, Manufacturing companies, space businesses, entertainment units and hospitals. India's software exports grew by 26% on average in the last recent years.

Table 13 shows the successive increase of software exports over years since it jumped from US$485 million in 1995 to US$7680 in 2002 which indicate the revival of this activity.

India has also succeeded in building its image as the world's leading source of outstanding computer software to become the second largest in the world after the United States of America. India's software exports are an important source of national income, thus, creating hundreds of thousands of jobs for the country. The service sector contributes about 51% of India's national income and India's tax system supports the software industry. India achieved the largest global growth rate after China in 2004 with its national product increasing by 7% annually and the volume of foreign investment flowing into India reached about US$9,094 billion in the same year.

Malaysia's experience in knowledge economy: Having relied mainly on the export of some agricultural raw materials, Malaysia is now one of the exporters of industrial goods, in the fields of electrical , electronic equipment and machinery. Malaysia ranked ninth among 30 high-tech exporters. Malaysian high-and medium-tech exports as a proportion of total exports amounted to 67.4% on average

Malaysia has been interested in achieving the overall development of both economic and social aspects, while balancing quantitative and qualitative objectives. On the level of material development, it worked to achieve justice between regions, so that the development of one region does not happen at the expense of another as a result infrastructure projects flourished in all Malaysian states. Malaysia adopted the principles of the Islamic economic system which makes man the focus of development activity and the most important element in it, by adhering to moral values, social justice and economic equality. Malaysia has also paid attention to improving social indicators of human capital as well as transferring ownership of economic projects to the private sector or so-called privatization.

One of the most important factors of the success of the Malaysian experience is paying attention to the quality of education. The Malaysian government has supported scientific production and research through the establishment of scientific research institutes and vocational training institutions, by promoting innovation and creativity. Moreover, Malaysia developed educational systems at all stages which was the pillar of graduating a young, educated, highly productive and multilingual workforce. The proportion of spending on education as a proportion of total government spending was 25% on average. The Malaysian government has also adopted a broad manufacturing policy and opened the economy to foreign direct investment. In an interaction between the skilled, multilingual workforce and highly developed infrastructure, it ranked sixth in Asia in industrial competition and the 21st country in the world because it paid great attention to education, especially basic and technical education ;one of the most important educational policies adopted by the Malaysian government.

According to the above, it became clear the difference among the economic systems of the countries mentioned. China relied on the application of the socialist economic system in the success of its economic experience while India relied on the capitalist economic system in the success of its economic experience while Malaysia has become clearly oriented by the Islamic economic system, especially in the financial and banking system and thus, achieved its remarkable economic success depending basically on the development of education. These countries have converged geographically and have diverged intellectually and have made clear progress in their economies, by relying on several common things that contributed to the progress of these countries.

Table 14 presents the indicators of the knowledge economy of the GCC countries compared to these emerging countries that have achieved success in this field. Table 14 shows these indicators for three different periods: 1995, 2000 and 2012.

The three non-Gulf countries, India, China and Malaysia, are among the countries that have made significant progress in the knowledge economy and the knowledge economy index has improved from 1995 to 2012 in China while it became relatively stable in India and Malaysia.

Table 14: Comparing knowledge economy in some countries

Indicators								
Countries	Years	Knowledge economy index	Knowledge index	Economic incentive regimes index	Innovation index	Education index	Information and communication technologies index	Knowledge economy rank
India	1995	3.57	3.57	3.57	3.7	2.51	4.5	106
	2000	3.14	3.00	3.56	3.83	2.3	2.85	104
	2012	3.06	2.89	3.57	4.5	2.26	1.9	110
China	1995	3.99	4.17	3.46	4.07	3.68	4.77	100
	2000	3.83	4.17	2.82	4.35	3.36	4.8	91
	2012	4.37	4.57	3.79	5.99	3.93	3.79	84
Malaysia	1995	6.26	5.96	7.16	6.28	4.62	6.98	47
	2000	6.37	6.45	6.11	6.62	5.41	7.34	45
	2012	6.10	6.25	5.67	6.91	5.22	6.61	48
Bahrain	1995	6.97	6.98	6.96	6.93	6.49	7.52	36
	2000	6.85	6.66	7.45	6.37	6.34	7.26	41
	2012	6.9	6.98	6.69	4.61	6.78	9.54	43
Kuwait	1995	5.71	5.82	5.36	5.5	4.51	7.46	57
	2000	6.16	5.88	7.00	5.38	5.17	7.09	46
	2012	5.33	5.15	5.86	5.22	3.70	6.53	64
Qatar	1995	5.86	5.93	5.64	4.79	5.52	7.49	54
	2000	6.01	5.81	6.64	5.51	4.85	7.05	49
	2012	5.84	5.5	6.87	6.42	3.41	6.65	54
Saudi Arabia	1995	5.02	5.21	4.45	5.00	4.11	6.51	78
	2000	4.60	4.67	4.4	4.24	4.28	5.49	76
	2012	5.96	6.05	5.68	4.14	5.65	8.37	50
Oman	1995	5.34	5.01	6.33	5.48	3.65	5.89	65
	2000	5.28	4.53	7.51	4.25	4.22	5.12	65
	2012	6.14	5.87	6.96	5.88	5.23	6.49	47
UAE	1995	6.39	6.22	6.90	6.59	4.46	7.62	46
	2000	6.05	5.56	7.51	4.32	4.44	7.92	48
	2012	6.94	7.09	6.50	6.6	5.8	8.88	42

Weighted by population; Index (0 = lowest and 10 = highest); Rank (1 = the best); World Bank Institute WBI; Knowledge Economy Index

The knowledge economy index was lower in the three countries than in the six Gulf countries in all compared years 1995, 2000, 2012. This is because the indicators are weighted by population and the progress in the indicators of the knowledge economy of the six Gulf countries has shown progress because they are countries characterized by a small population density, so, limited progress in the indicators of the knowledge economy is an achievement in light of the small-sized population[5].

The progress made by the six Gulf countries in the field of knowledge economy indicators is due to their support resulting from the availability of oil surpluses that enable them to hire highly skilled specialized workforce from most countries of the Middle East and the Near East which contributed to significant progress in the areas of economic incentives, educational structure and significant progress in providing the structure of communications and information technology.

The United Arab Emirates advanced in the ranking of countries in terms of knowledge economy and ranked 42nd in the world in 2012, four places ahead of 1995 while Bahrain moved from 36th place in 1995 to 43rd place in 2012. Kuwait fell from 57th place in 1995 to 64th place in 2012, while Qatar maintained its position at 54th place whereas Oman improved from 65th in 1992 to 47th in 2012.

The contribution of the telecommunications and information technology sector was relatively greater than all other indicator contributions, followed by the economic Incentive systems index. The lessons learned that can be adopted by the GCC countries are:

- Paying attention to the human element, by developing the technical and industrial education
- Building educational institutions which can contribute to increase in the percentage of graduates that can match the basic requirements necessary for the labor market
- Establishing infrastructure institutions to support of economic activity
- Adopting research and development policy based on innovation and development of facilities for inventors in the required scientific fields
- Provide scholarship for the diligent students to study abroad and return with scientific expertise from developed countries to their countries
- Strengthening the national spirit and cooperation among different groups of the society
- Developing a well-defined plan for a specified period through which work is carried out and evaluated
- More attention to the accountability and accountable management that contribute to the success of the knowledge economy activities

CONCLUSION

In this study, we reviewed the importance of some major variables for building knowledge-based economy in GCC's countries using panel estimation. The model used in the study was very consistent with the carefully selected explanatory variables where they significantly reflected their apparent effects on the dependent variable which is the GCC's knowledge economy index. F statistics and R^2 support the conclusion that the explanatory variables contribute in explaining the changes in GCC's knowledge economy index with 75%. However; these effects are still lower than the global averages achieved by the pioneer's countries in the knowledge-based economy[6].

The study relied on Cronbach's approach to test the reliability and validity of the data used in the model. Accordingly, Cronbach's alpha measure proved that the data reliability reached 80.6% which is high and positive value which means that the covariance between the data is positive.

The most appropriate method applied in the study to estimate the static panel model is the method of fixed effects, in comparison with the method of pooled OLS method, since, we found that F statistic was significant. Also, Hausman test was used to choose between fixed effects and random effects models where the results showed that fixed effects model are more appropriate since it leads to improve some statistics such as standard error, the adjusted coefficient of determination.

The fixed effects model estimation revealed that the total capital goods imports value, total human capital and GDP were key determinants of the GCC's knowledge Economy Index during the study period which means that the expansion of capital goods imports, human capital and output reflects in more investment rates and hence strengthening the pillars of the knowledge economy in the GCC countries.

However, the parameters of gross fixed capital formation and oil exports were insignificant, contrary to the economic theory and the study assumptions. Accordingly, it can be inferred that more investment expenditure on fixed capital formation and more efficient use of oil export earnings are needed.

Finally, it can be implied from the study that, although, the GCC is a united regional organization which membership is limited to the six gulf countries, it seems that they did not agree on clear objectives towards the orientation of the knowledge economy. Since, they have not given much attention to the education and innovation two pillars with a vital role in economic progress. Rather, they relied basically on the pillars of infrastructure of the institutions, information and communication technology which didn't get them to move forward quicklytowards the knowledge-based economy.

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