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Knowledge in Economic Growth of Developing Economies

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Knowledge in Economic Growth of Developing Economies

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Abstract

In the modern era, the success of a developing economy has become more dependent on the capacity to produce and use knowledge, thus leads to the emergence of a knowledge economy. Keeping in view the significance of knowledge economy in economic growth of economies, in the present study, an attempt has been made to examine the inter-country differences across the selected developing economies. In addition to it, to analyze the impact of knowledge on economic level as well as on economic growth across 42 selected developing economies, regression analysis has been applied. The results of the study reveal that there is positive correlation between knowledge economy index and economic level, but there is very weak marginal effect of knowledge economy on the economic growth.

Keywords: Innovations, Knowledge-Based Economy, Economic Growth, Developing countries.

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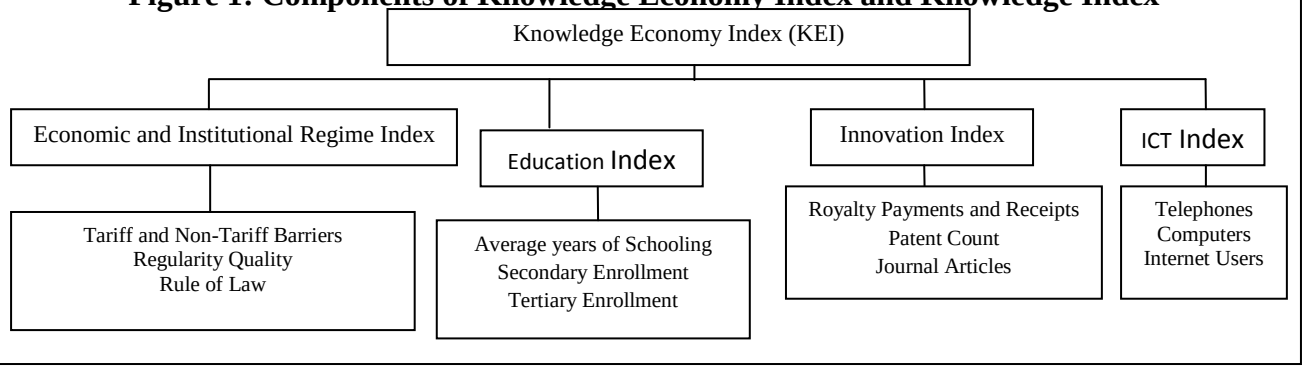
Introduction

The world economy has undergone various phases of development during the last three decades, thus, altering the type of inputs determining the level of competitiveness of economies. Modern economic growth of an economy depends more on the level of technology and knowledge possessed by an economy rather than depending only upon the physical factors of production. Thus, leading to the emergence of knowledge economy in which increasing level of intellectualization and the transition of an economy based on knowledge have become the major traits of current scenario of the global economic development. As many advanced economies have achieved a great deal of economic and social development by investing in knowledge and technology, this trend must be considered by developing economies in determining their strategic outlook in the direction of the transition to a knowledge-based economy (Vinnychuk et.al, 2014). As a result, knowledge-based economy will serve as a keystone to sustain a rapid rate of economic growth and enhance international competitiveness.

Knowledge-based economy can be interpreted as an economy capable of knowledge production, distribution and use where the knowledge is the founding stone for growth, wealth-creation and employment and the human capital as embodied in human beings contributes to creativity, innovation and generation of new ideas with the help of technology (Karahan, 2012). There are three main characteristics of knowledge that have very significant implications for the knowledge economy: Firstly, knowledge can be used again and again and as well as by number of people at the same time, thus making it different from other goods and services. Secondly, knowledge generates spillovers as it benefits not only its creators but benefits more to society also. Thus, there exist a wide divergence between the private return on investment and the return on investment to the society as a whole. Thirdly, unlike other ordinary goods, its value increases when it is shared, thus benefiting not only the creator of the knowledge but also generates economic value for many other users (Hogan, 2011). Further, knowledge can be decomposed into tacit knowledge and codified knowledge. We define tacit knowledge as the knowledge stored in minds of the persons and it cannot be easily assessed whereas codified or explicit knowledge is easily accessible and transferable (Mehrara and Rezaei, 2015). In addition, knowledge economy does not involve only investment in high technology or information technology rather the successful march towards the knowledge economy also comprises of appropriate investment in its four basic pillars i.e. an economic and institutional regime conducive to market transaction, educated and skilled workers, enhancing innovation capacity and modernizing the information infrastructure (Chadha, 2010). The above mentioned four pillars of the knowledge economy are prerequisites for sustained creation, adoption, adaptation and use of knowledge in domestic economic production which results in higher value of goods and services. These four pillars are further sub-divided into 12 parts where (1) economic incentives and institutional regimes involve tariff and non- tariff barriers, regulatory quality and rule of law (2) education and human resources cover adult literacy rate, secondary and tertiary enrollment (3) innovation system involves research and development, patent application granted by United States Patent and Trademark office (USPTO) and scientific and technical journals articles (4) information infrastructure comprises of telephone, computers and internet users as depicted in Figure 1.

Figure 1: Components of Knowledge Economy Index and Knowledge Index



Source: World Bank (2012)

Thus, almost all the economies have been profited from the knowledge economy as (i) the knowledge economy offers competitive advantages in high-technology product manufacturing and efficient service sectors for advanced industrialized countries with high labor and infrastructure costs and (ii) it offers improved technologies and higher-value added products with closer customer linkages, as well as a path for sustainable development for natural- resource-based economies (iii) lastly, for developing countries, knowledge economy offers possibilities to short cut development phases, leapfrog technologies, and more quickly integrate into the global economy by becoming more attractive to international investors (Dahlman et.al, 2006). Recent thinking in economic growth has stressed the role of new ideas that determine long run rate of growth of an economy (Romer 1986, 1992). The most important underlined feature of these kinds of models of economic growth is the capacity of new knowledge to prevent diminishing returns to scale on capital to occur. Therefore, increasing returns to scale origins from the capacity of new knowledge but it is prone to diminishing returns to scale. It also generates agglomeration economies through spillover effects. Therefore, it is very important to understand how knowledge growth is taking place in the developing countries and how knowledge affects economic growth. In this paper, an attempt has been made to examine through empirical analysis the relationship between level of knowledge and economic growth across developing economies.

Theoretical Perspective and Empirical Literature

In the last two decades of the twentieth century, there has been increasing interest among the economists to examine the determinants of long run economic growth and consequently rise in both theoretical and empirical economic literature pointing out the importance of knowledge in economic growth. We have very briefly given the glimpses of economic literature on knowledge and growth nexus to identify the gaps and contribution of the present study to fill them up. Economic growth or development has always remained as a main objective on the economic agenda of all the governments of developing countries. Thus, according to different political and economic scenario, all the economies have tried to seek this objective by developing different models of growth. This leads to the emergence of chain of growth theories, emphasizing varied sources of economic growth. In the earlier models (Harrod, 1939 and Domar, 1946) of economic growth, emphasis was on the accumulation of capital, labour and other sources with diminishing returns as the major cradles of growth. These models were further revised by Solow (1957), who added technological progress as another factor of production where this technological change is exogenous to the economy.

As, there is ambiguity regarding the source of technological progress in these models, leading to the emergence of endogenous growth models by emphasizing the inducement of technical progress through the process of learning, investment in research, and capital accumulation.

The main originators of the endogenous growth models are Arrow, Romer and Lucas, among other economists. Arrow (1962) in his Learning-by-Doing theory has brought into the prominence the role of knowledge creation and knowledge spillovers for offsetting diminishing returns to capital. In other words, while investing in capital stock, a firm also becomes experienced in doing its production more efficiently due to its increasing stock of knowledge by producing over time. Further, Romer (1986) in his perfect competitive model with increasing returns and externalities has included a very important factor of production i.e. knowledge in addition to labor and capital which exhibits increasing returns and also generates externalities i.e., production of knowledge by one firm also benefits the others with that knowledge. In the similar vein, to solve this ambiguity regarding the source of growth, Lucas (1988) has developed an endogenous growth model in which growth is governed by the rise in human capital. Thus, in Lucas model, physical capital as well as human capital acquired through schooling and on the job training is the significant factor leading to economic growth. Emphasizing on human capital, Romer (1992) has brought in to prominence the significance of ideas in the economic development of the nations as ideas can contribute a lot to the developing countries as they compensate the shortage of physical capital. Thus, the knowledge base of the major economies has been rapidly growing, making the knowledge a significant determinant of growth process as investment in knowledge accounts for about 4.7 per cent of OECD-wide GDP and the high-knowledge-based economies invest between 5.2 to 6.5 per cent of GDP in knowledge development (Singh, 2006). As developed countries spend a large amount of money and time to develop new knowledge but the developing countries due to shortage of money rely on developed countries to acquire this knowledge. Thus, the developing countries can adopt following three measures to acquire knowledge (1) Acquiring knowledge through proper trade regime, foreign investment and licensing technologies (2) Absorbing information through ensuring universal primary education and lifelong learning (3) Communicating knowledge through ICT and various other channels. Closing these knowledge gaps and solving information problems have become an important determinant for the development of developing countries. So, they should take measures to deal with both of these problems simultaneously (World Development Report, 1998-99).

After reviewing the theoretical literature, establishing the ground for the significance of knowledge accumulation for growth, there has been quantum jump in the number of empirical studies establishing the relationship between investment in knowledge and economic growth. Thus, in this context, a very significant study conducted on 15 member countries of European Union covering the period of 1990-2003 for the purpose of analyzing the impact of indicators of knowledge economy on GDP growth revealed that coefficient of determination (R-Square) for international openness, research and development abroad, youth educational level and ICT and IT investment were found to be 0.431 , 0.457 , 0.462 and 0.501 respectively, reflecting the importance of knowledge economy for economic development (Karagiannis, 2007). Further, Hwang and Gerami (2007) examining the link between investment in knowledge with multifactor productivity and patents reveals that the multifactor productivity enhances with investment in knowledge and it also augments the number of patents in a country which brings into prominence the innovation enhancing capacity of knowledge. Then, Bacovic and Bozovic (2010) have studied the impact of investment in two major components of knowledge i.e. expenditure on higher education and

R&D on economic growth and estimated that one additional percentage point of R&D share in GDP causes 0.138 average percentage change in GDP per capita and increase in public expenditure on education causes 0.105 average percentage change in GDP per capita from time to time. Realizing the significance of human capital in economic growth, Dias and Tebaldi (2011) in their study, while establishing the prominence of structural institutions over political institutions in determining long- run economic performance stated that the growth of physical and human capital instead of their levels determines long-run economic growth. Similarly, Isola and Alani (2012), while investigating correlation between expenditure on education and health and economic growth of Nigeria estimated that 1 percent increase in literacy rate and life expectancy results in 2.46 and 2.73 percent increase in growth rate of GDP. Further, the results of a study conducted by Lopes et.al (2005) to access the impact of Fixed Capital (FCI) and Knowledge Capital (KCI) growth on GDP growth of Portugal reveal that the impact of knowledge capital investment on GDP growth is greater than fixed capital one with FCI estimated coefficient equal to 27.7 percent and KCI coefficient about 30 percent. In the similar vein, a study conducted by Vinnichuk et.al (2014) investigating the impact of Knowledge economy components on the GDP per capita of Ukraine, Poland, Germany and Lithuania for the period 1996-2011 reveals that the component of information and communication technology (38.0784 %), has the largest impact on predicted GDP per capita followed by innovation system (29, 0488 %), economic and institutional regime (17, 7171%) and education and human resources (15, 1556%).

Based on the review of above mentioned studies, it has been noticed that most of the studies have examined the impact of knowledge economy on economic growth by concentrating on its one or two pillars but there is dearth of the studies examining the impact of all of the four basic pillars of knowledge economy on economic growth of the economies. Thus, the present study will try to bridge this gap, by analyzing the impact of knowledge on economic growth of 42 developing economies where the knowledge economy index has been used as a composite measure of knowledge economy and which is an average of all four pillars of the knowledge economy.

Objectives of the Study

To overcome the above mentioned research gaps, the present study strive to fill these gaps by proposing to analyze the following specific objectives

- To assess the inter-country differences among selected developing economies on the basis of Knowledge Economy.
- To examine the correlation between knowledge economy index and level of economic development of selected developing economies.
- To examine the impact of knowledge economy on economic growth of selected developing economies.

Database and Methodology
Model Specification

To study the impact of knowledge economy index on economic growth of the 42 selected developing economies, we have followed the regression analysis tradition pioneered by Barro and Sala-i- Martin (2004). Furthermore, we have examined GDP growth rate of 13 years i.e. from 2000-2012, on the values of the KEI of 2000 with the help of following regression equation.

$$\text{GDP Growth Rate}_i = \beta_1 + \beta_2 KEI_i + \varepsilon_i \text{ ------- (1)}$$

Where GDP growth rate represents the growth rate of 13 years from 2000-2012 and KEI represents the Knowledge Economy Index of 2000.

To measure the extent of knowledge in a particular economy, the World Bank's Knowledge Assessment Methodology produces the Knowledge Economy Index (KEI) – an aggregate index representing the overall preparedness of a country or region towards the Knowledge Economy (KE) using 148 structural and qualitative variables. These variables are measured in different units and on different scales. Later on, to calculate aggregate knowledge economy indexes, as well as to simplify graphic representation of countries' comparative performance, all the indicators have to be converted to same standard of measurement through the process known as normalization. Firstly, countries are ranked in order from "best" to "worst" using their actual scores on each variable. Then, their scores are normalized on a scale of 0 to 10 against all in the comparison group by using the following formula.

$$\text{Normalized (u)} = 10*(1-Nh/Nc)$$

Where, Nh refers to the number of countries with higher rank,
Nc refers to total number of countries in the sample.

In this index, 10 is the top score for the top performers and 0 the worst for the laggards. The top 10% of performers gets a normalized score between 9 and 10; the second best 10% gets allocated normalized scores between 8 and 9 and so on. In other words, the 0-10 scale ranks the performance of each country on each variable relative to the performance of the other countries in the sample. KEI is the simple average of the normalized performance scores of a country or region on the key variables in four knowledge economy pillars – education and human resources, the innovation system and information and communication technology (ICT), economic incentives and institutional regimes (World Bank, 2012).

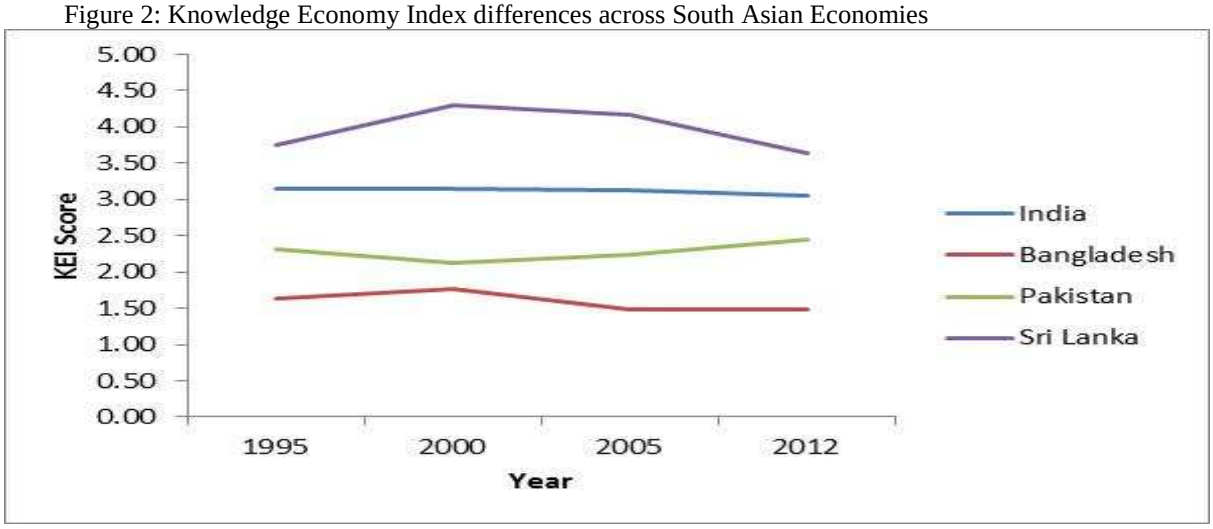
In the present study, data for 42 developing economies on the knowledge economy index and GDP per capita have been taken at four points of time i.e. 1995, 2000, 2005 and 2012 and this selection of time period is governed by the availability of data. The main source of data is World Development Indicators (WDI) of the World Bank. To analyze the inter-country differences across 42 developing economies, we have used the scatter diagrams and coefficient of variation in the Knowledge economy index (KEI) has been estimated. To study interrelation between KEI and the level of economic development, we have estimated the correlation coefficients between KEI and GDP per capita of 42 developing economies at four points of time.

Knowledge Economy: Inter Country Differences

Although, the present position of developing economies in KBE development is not too good, in comparison to the developed economies, but they accounted higher pace of KBE development during last few decades. Thus, in our study, we have taken the data of all developing economies Continent wise i.e., South Asia, Sub-Saharan Africa, East Asia and Pacific, Central Europe/Asia, EU, Latin America and Middle East and North Africa.

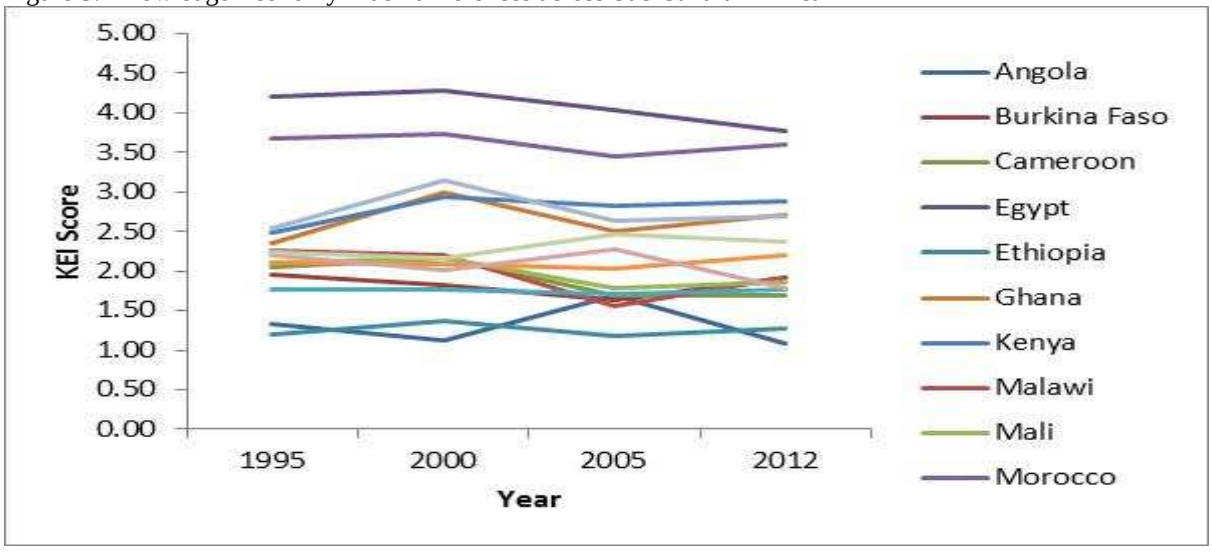
Firstly analysis of the economies of South Asia reveals that India and Sri Lanka have been remained at the top on the KEI index at all of these four points of time i.e. 1995, 2000, 2005 and 2012 followed by Pakistan and Bangladesh as shown in Figure 2. Average score calculated for all of these economies of South Asia reveals that its score has increased from 2.71 in 1995 to 2.83 in 2000, after that there has been slight decline in it to 2.66 in 2012.In addition to it, coefficient of variation calculated for these respective points of time has shown very little variations, as it has increased from 34.44 in 1995 to 34.45 in 2012 which implies that there has been very low degree of divergence across these economies of South Asia. As depicted in Figure 3, in the region of Sub-Saharan Africa, Egypt has scored the highest value at all four points of time i.e. 1995, 2000, 2005 and 2012 and it is closely followed by Morocco by scoring 3.68, 3.74, 3.45 and 3.61 in 1995, 2000, 2005 and 2012 respectively. While these scores of KEI for all other economies has remained between 1-4 points, a slight decline has also been observed in the average of KEI for all these economies i.e. from 2.30 in 1995 to 2.24 in 2012 in addition to that the coefficient of variation calculated for all economies at these points of time has also shown very little variations.

Figure 2: Knowledge Economy Index differences across South Asian Economies



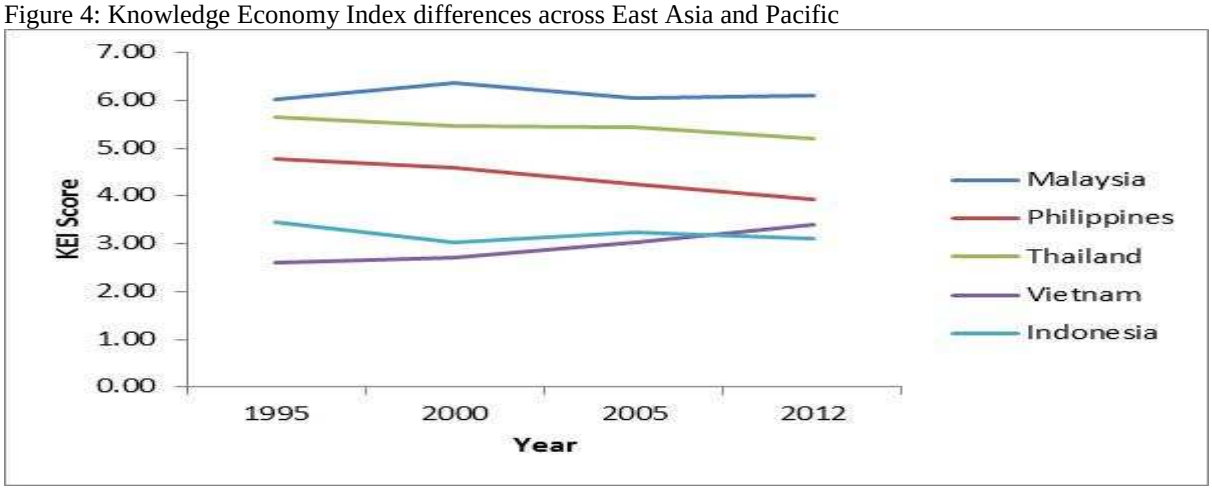
Source: *Authors' own calculations*

Figure 3: Knowledge Economy Index differences across Sub-Saharan Africa



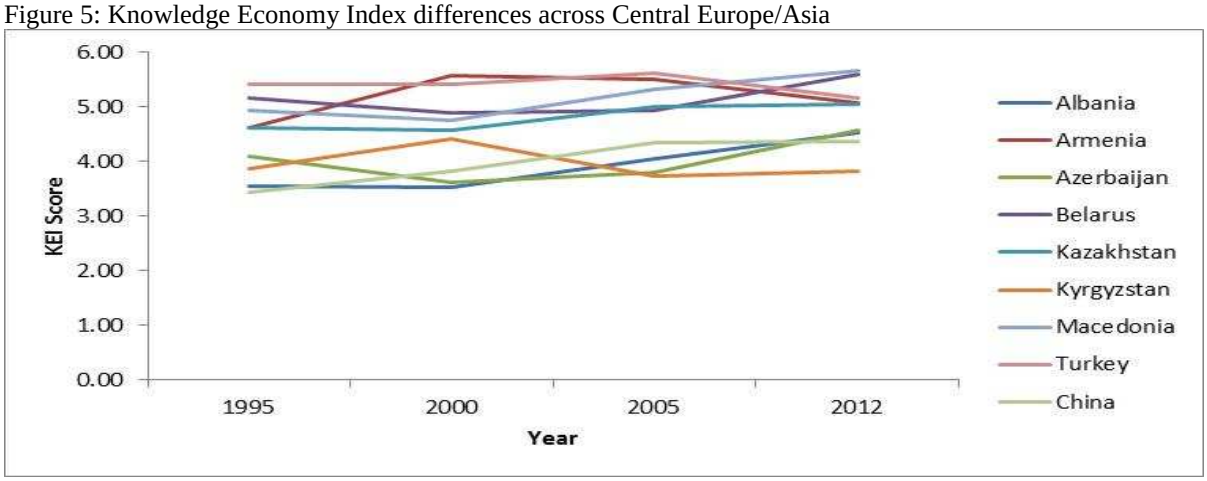
Source: *Authors' own calculations*

Figure 4: Knowledge Economy Index differences across East Asia and Pacific



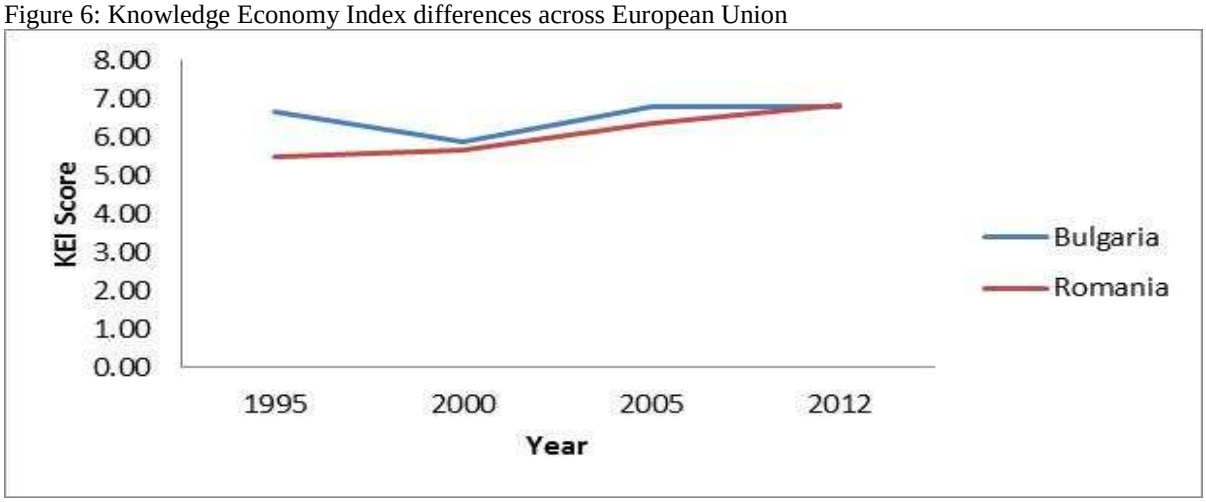
Source: *Authors' own calculations*

Figure 5: Knowledge Economy Index differences across Central Europe/Asia



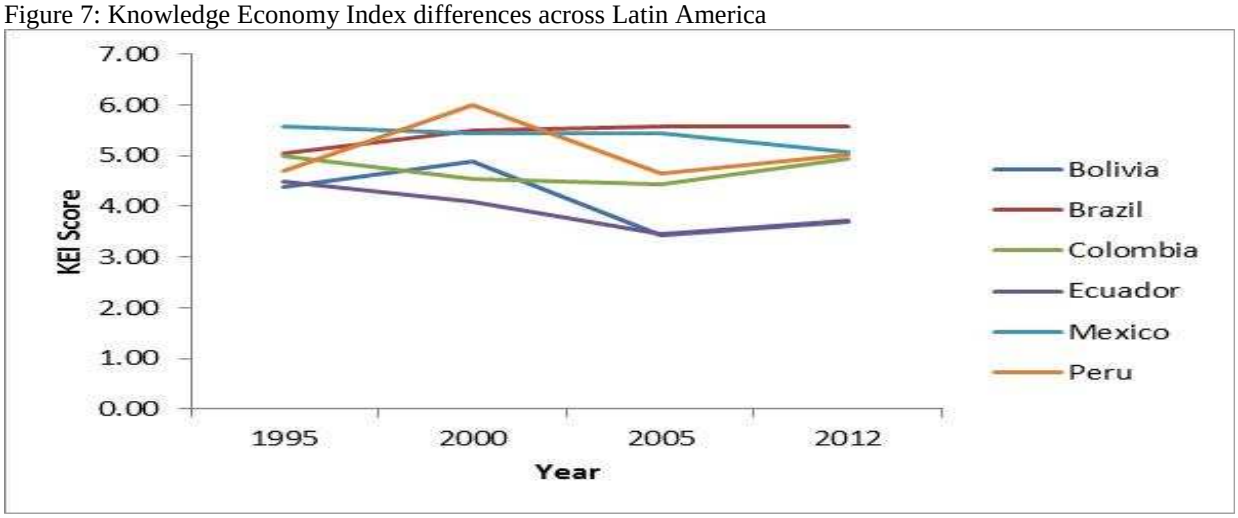
Source: *Authors' own calculations*

Figure 6: Knowledge Economy Index differences across European Union



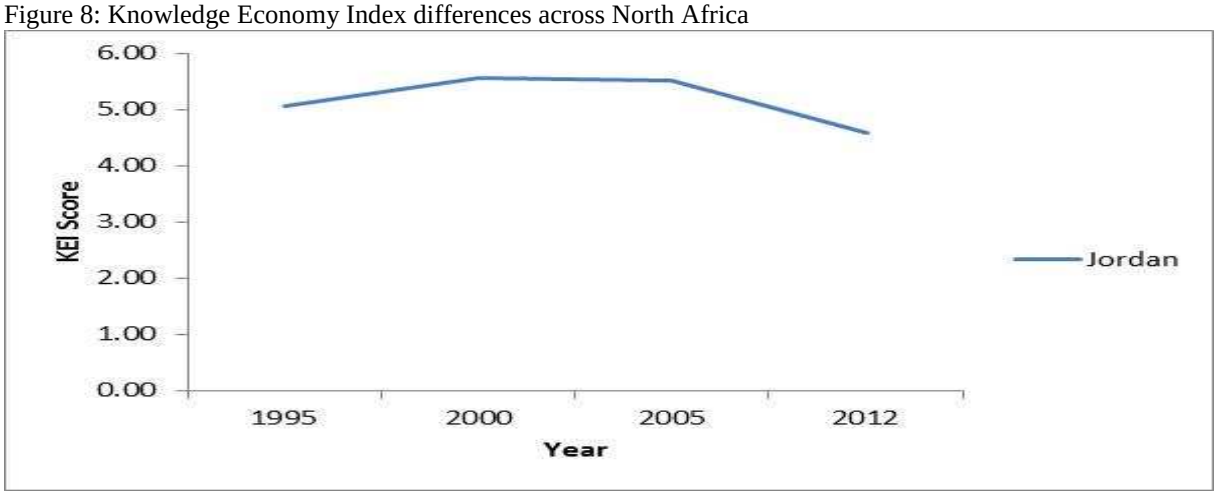
Source: *Authors' own calculations*

Figure 7: Knowledge Economy Index differences across Latin America



Source: *Authors' own calculations*

Figure 8: Knowledge Economy Index differences across North Africa



Source: *Authors' own calculations*

In the East Asia and Pacific, Malaysia has scored the highest value on KEI whereas Vietnam has the lowest value in this region as shown in Figure 4. There have been very little variations in the average of KEI index calculated for this group of economies. The average score of this region has shown very little variations, but the value of coefficient of variation has been declined for this region from 32.16 in 1995 to 29.09 in 2012.

In Central Europe/Asia as shown in Figure 5, Turkey has scored the highest value on knowledge economy index closely followed by Belarus. In addition to it, Armenia has shown a good performance on its knowledge economy index over this time as its index has improved from 4.62 in 1995 to 5.08 in 2012. The mean value calculated for this region has remained almost same at these four points of time as it has improved from 4.41 in 1995 to 4.87 in 2015, whereas there has been a decline in coefficient of variation estimated for this region i.e. 16.11 in 1995 to 12.26 in 2012.

In European Union as depicted in Figure 6, although Bulgaria has recorded a higher score on KEI than Romania, but its growth on knowledge economy index has not remained smooth as in it falls down from 6.40 in 1995 to 5.89 in 2000 and again in 2005 it has increased to 6.80 in 2005 and has remained same for 2012.The average value of KEI for EU has increased from 6.07 to 6.81. On the other hand, there has been very steep fall in

coefficient of variation in this region from 13.41 in 1995 to 0.21 to 2012, which implies a high level of convergence across these economies.

In the case of Latin America in Figure 7, Brazil has scored the highest value for KEI followed by Mexico. The average value of KEI calculated for this region has slightly increased from 4.86 in 1995 to 5.07 in 2000, afterwards followed by a decline to 4.67 in 2012, while the coefficient of variation estimated for this region has almost doubled over this period of time. In the Middle East and North Africa as shown in Fig.7, the KEI value for Jordan has initially increased from 5.08 in 1995 to 5.53 in 2005 and subsequently followed by a decline to 4.59 in 2012.

As the score on the KEI index of different economies reveals that some of these economies i.e. Malaysia, Brazil, Bulgaria and Romania have accorded a quite high value on KEI while others economies like Angola, Burkina Faso, and Bangladesh are lagging behind. The underlying reason behind it is that the leading economies on KEI are making the sufficient investment on the institutions necessary for building knowledge economy i.e. education, ICT, innovations system, economic incentive and institutional arrangements while the economies which are lagging behind are failing to tap the vast and growing stock of knowledge because of their limited awareness, poor economic incentive regimes, and weak institutions (Nour, 2013). In other words, the differences across advanced and lagging economies also arises due to divergence in the countries' ability to effectively absorb new technologies as Accessed knowledge needs to be combined with a sufficiently developed "absorptive capacity" (Lall,1992) and these absorptive capabilities depend on several factors, including the extent to which a country has a technologically literate and highly skilled workforce, encouraging investment climate and presence of adequate public sector institutions to promote the diffusion of critical technologies where private demand or market forces are inadequate (World bank, 2008).

Knowledge Economy and Level of Economic Growth: Evidence from Developing Economies

Knowledge economy and levels of economic development of an economy are interrelated to each other i.e., the investment made by an economy in the four pillars of knowledge economy leads to increase in the economic level of that country. Thus, in the present study, the relationship between these two variables i.e., Knowledge economy and economic level have been examined by finding out the correlation between these variables at four points of time i.e., 1995, 2000, 2005 and 2012 for 42 developing economies and the respective coefficients between these variables at these four points of time are found to be 0.56, 0.45, 0.59 and 0.60. Although, there is positive correlation between these two variables, but it is difficult to ascertain the causal link between them i.e., economies having higher level of economic growth tends to invest more in knowledge economy as reflected by the regression lines at four points of time in Figures 9, 10, 11 and 12, but the evidence of the impact of knowledge economy on raising the economic development is ambiguous.

Further, examining the correlation among all the four pillars of knowledge economy and economic level of the developing economies in 2012 reveals that the highest degree of correlation is found between Information and Communication Technology (ICT) and economic level across the selected economies followed by other pillars i.e., innovation system, education and economic incentive and institutional regime.

Figure 9: Relationship between KEI (1995) and GDP Per Capita (1995)

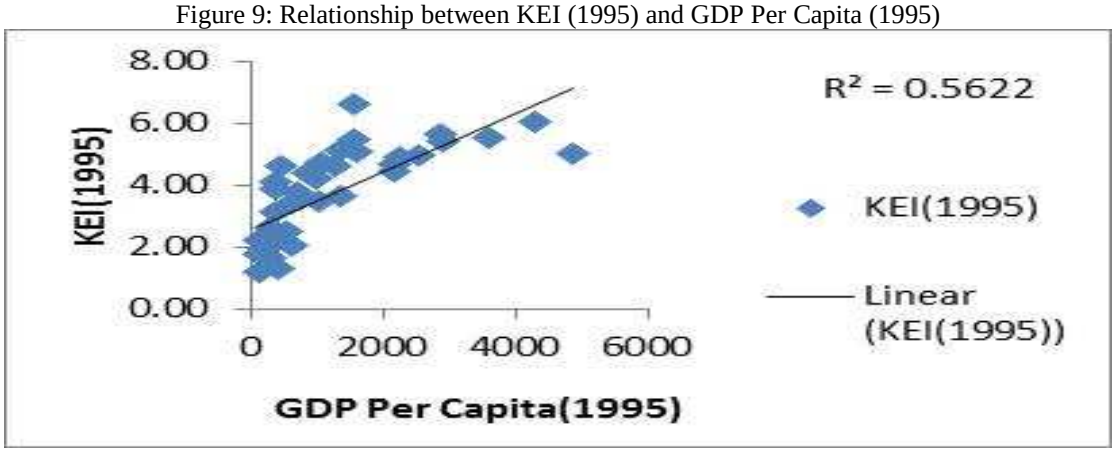


Figure 10: Relationship between KEI (2000) and GDP Per Capita (2000)

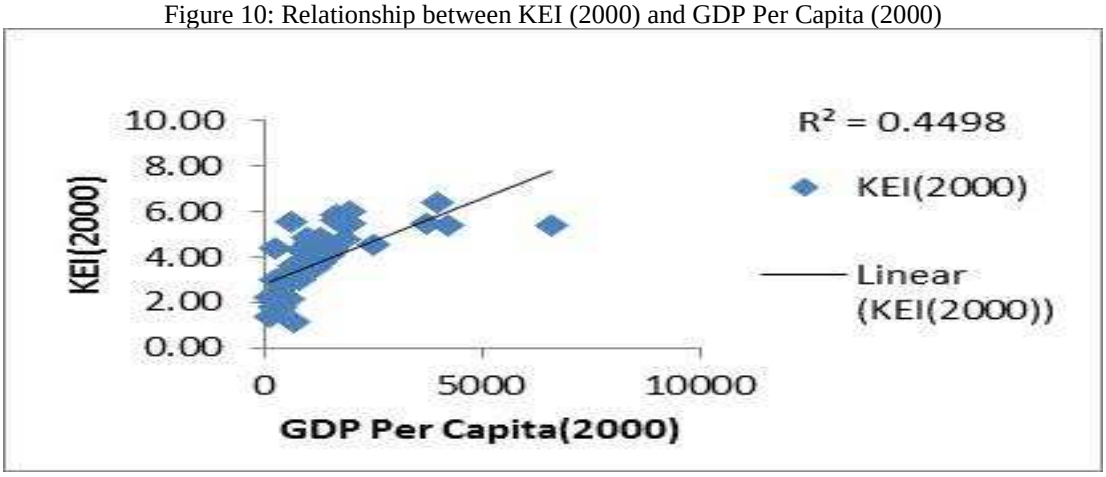


Figure 11: Relationship between KEI (2005) and GDP Per Capita (2005)

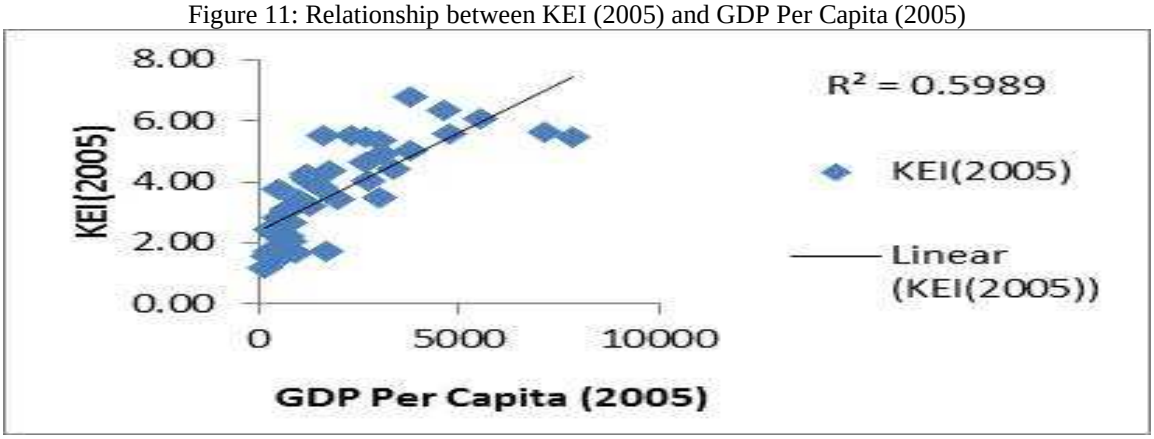
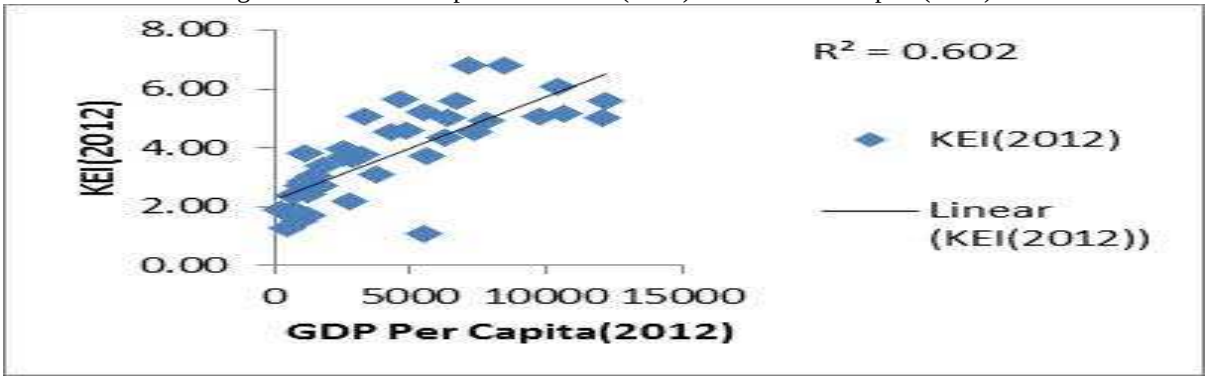


Figure 12: Relationship between KEI (2005) and GDP Per Capita (2005)



Knowledge and Economic Growth nexus

Investment in the knowledge economy is considered as a significant determinant of economic growth across economies. Thus, higher investment in four pillars of knowledge economy i.e, economic incentive and institutional regime (EIR), education and training, innovation and technological adoption, information and communications technologies (ICT) Infrastructure leads to higher economic growth.

Table 1 reflects the results obtained from the regression equation examining the economic growth, measured by GDP per capita from 2000-2012 on the value of Knowledge Economy Index in 2000 as specified in equation 1. From these results, it has been ascertained that better educational institutes and more R&D leads to the positive economic growth across these selected 42 developing economies as depicted by positive coefficient of KEI in the overall regression of all selected developing economies but it is insignificant with very low value of R-Square which implies that economic growth is also determined by large number of other factors in addition to investment in Knowledge.

Table 1: Relationship between Knowledge Economy and Economic Growth

KEI and Economic Growth	Selected Developing Economies	Upper middle Income Countries	Lower Middle Income Countries	Low Income Countries
Regression Coefficient	0.11	-1.04**	0.71	-3.90**
t-stat	0.46	-2.15	1.69	-2.82
Observations	42	18	17	7
Relationship	Positive	Negative	Positive	Negative
R-square	0.005	0.22	0.16	0.61

Authors' own calculations
***represents 5% level of significance*

The Coefficients of regression function for different groups of economies (Table 1) further shows the division of these economies into low income, lower middle and upper middle income economies on the basis of their GDP per capita reflects that in low income economies relationship between GDP Per capita and KEI is negative that is KEI is not resulting into positive Growth rate and the underlying reasons behind this low level of growth rate are low quality of educational institutions and less investment in R&D and poor level of human capital in these economies. Thus, Investment in knowledge economy cannot ascertain the economic growth unless the basic institutions will be developed to comply with knowledge economy.

Secondly, taking the case of lower middle income economies, knowledge economy is positively associated with economic growth but these results are not significant as these economies have not developed enough to reap the full benefits of knowledge economy. Further, the relationship between KEI and economic growth is also found negative in case of upper middle income economies because, in these economies, up to a point, knowledge accumulation leads to the enhancement of economic growth but after that point its impact on economic growth begins to decline.

Conclusions

After examining the inter country differences in the knowledge economy it is observed that the member countries of European Union has attained the highest score on the

knowledge economy index, whereas economies of Sub-Saharan Africa has remained at the lowest value on this index at the four points of time i.e. 1995, 2000, 2005 and 2010 and high degree of dispersion is observed among the economies of South Asia whereas as it is least in case of European Union. Further, analyzing the relationship between knowledge economy index and economic level of these developing economies reveals that although, there is high degree of correlation between these two variables, but there is absence of causal link between them i.e. it is established that affluent economies having higher economic level tend to invest in more in knowledge accumulation. But it is not true for vice-a-versa. While the regression analysis of knowledge accumulation on economic growth leads us to conclude that although there is a marginal positive relationship between these two variables but it is not true for all the economies i.e. in the case of upper middle and low income economies, it is negative, thus underlying the significance of other basic requirements for the success of knowledge economy in enhancing the economic growth.

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