KNOWLEDGE-BASED ECONOMY AND ECONOMIC GROWTH:

EMPIRICAL ANALYSIS OF BRICST COUNTRIES

ÖZGE MEMİŞOĞLU

BOGAZİÇİ UNIVERSITY

2012

KNOWLEDGE-BASED ECONOMY AND ECONOMIC GROWTH:
EMPIRICAL ANALYSIS OF BRICST COUNTRIES

Thesis submitted to the

Institute for Graduate Studies in the Social Sciences

in partial fulfillment of the requirements for the degree of

Master of Arts

in

International Trade Management

by

Özge Memişoğlu

Boğaziçi University

2012

Thesis Abstract

Özge Memişoğlu, "Knowledge-Based Economy and Economic Growth: Empirical Analysis of BRICST Countries"

Rapid developments in information and communication Technologies (ICT) and intense pressure of globalization have changed trade relations and economic performance in global economy. Particularly the invention of many ICT tools and services, growing demand to technology products, rise of knowledge-based sectors have addressed the role of intangible factors such as education, knowledge, information, innovation and R&D as new source of economic growth. However, with the onset of global financial crisis, many countries have experienced recessions or less growth than before. Lasting uncertainty in macroeconomic stability and concern about the future performance of global market lead governments to realize knowledge-based economy (KBE) as a major solution to problems of the existing economy. Emerging countries are also perceived as the global leaders of KBE due to their better and faster performance in adopting new technologies and increasing their accumulation of knowledge than the advanced countries.

The aim of this study is to analyze major determinants of KBE which are based on World Bank Knowledge Assessment Framework, on economic performance indicators such as GDP, GDP per capita and economic growth rate in Brazil, Russia, China, India, South Africa and Turkey (BRICST) over the period from 2000 to 2010 by using Panel Data Model. The empirical evidence reveal that ICT infrastructure and secondary education are found to be important infrastructure channels that affect GDP per capita positively in the BRICST countries. In addition, the number of R&D personnel as an indicator for innovation potential has positive influence on the GDP per capita. Accumulation of educated people in R&D can affect country's ability to innovate, benefit from ICT and enhance economic performance. Therefore, expansion of ICT infrastructure together with educated R&D personnel have become the major factors that affect economic performance in the BRICST countries.

Tez Özeti

Özge Memişoğlu, “Bilgi tabanlı ekonomi ve ekonomik büyüme: BRICST ülkeleri üzerine empirik bir çalışma”

Son yıllarda, bilgi ve iletişim teknolojilerinde görülen (BİT) hızlı gelişmeler, küreselleşmenin gittikçe artan gücü ticaret ilişkileri ve uluslararası pazardaki ticari ilişkilere ve ekonomik performansa yeni bir boyut kazandırdı. Özellikle birçok bilişim araçları ve hizmetlerinin ortaya çıkması, teknoloji ürünleri için pazarda giderek artmakta olan talep, bilgi odaklı sektörlerdeki yükseliş, eğitim, bilgi,enformasyon,yenilik ve araştırma ve geliştirme (Ar-Ge) gibi fiziki olmayan faktörlerin rolü ekonomik büyüme için yeni kaynak olarak ifade edilmektedir.Diğer taraftan, küresel mali krizin başlangıcı ile birlikte birçok ülkede resesyon yada daha önceki yıllara nazaran daha düşük ekonomik büyüme oranları yaşanmaktadır. Makroekonomik dengenin sürdürülebilirliği konusunda devam eden endişe ortamı ve pazarda geleceğe yönelik öngörüler konusundaki belirsizlik süreci, ülkelerin bilgi-odaklı ekonomiyi şu anki pazarda var olan problemlerin çözümü için alternatif bir yol olarak benimsemelerini sağlamıştır Yeni teknolojilere adaptasyonda daha iyi ve hızlı performansa sahip olamaları ve gelişmiş ülkelere göre, bilgi stoklarını giderek arttırmaları nedeniyle, büyüyen pazar ekonomileri, aynı zamanda, bilgi odaklı ekonominin global liderleri olarak işaret edilmektedir.

Bu çalışmanın amacı bilgi-odaklı ekonominin, Dünya Bankası Bilgi Değerlerndirme Metodolojisine göre belirleyici unsurlarının gayri safi yurtiçi hasıla(GSYH), GSYH gelişme hızı ve kişi başına düşen GSYİH gibi eknomik performans indikatörleri üzerindeki etkisini Brezilya, Rusya Hindistan, Çin Güney Afrika ve Türkiye’de (BRICST) 2010 ve 2010 yılları arasında panel data modellerini kullanarak ölçmektir. Empirik analiz sonucu BİT altyapısı ve eğitimin seçilen ülkelerde kişi başına düşen GSYİH’yi pozitif yönde etkileyen önemli altyapı kanalları olduğunu ortaya çıkarmıştır. Bununla birlikte, araştırma ve geliştirme (Ar&Ge) personel sayısının da kişi başına düşen GSYİH’ye üzerinde pozitif etkisi bulunmaktadır.Böylelikle, BİT altyapısı ve Ar&Ge personeli BRICST ülkelerinin ekonomik performansını etkileyen temel unsurlar olmaktadır.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks my thesis advisor, Assoc. Prof. Emine Nur Özkan Günay, for her professional help and encouraging and tolerant assistance in the preparation of this thesis.

I would also like to thank Assist. Prof. Aslı Deniz Helvacıoğlu and Assist. Prof. Ali Coşkun for their participations and contributions to this work by their distinctive comments.

I am also gratefully thankful to Assoc. Prof. Dr. Nisan Selekler Gökşen for her special participation and support in this study.

Finally, I am indebted to my parents and my brother for their unending love, support and motivation.I am dedicated this thesis to my great family.

CONTENTS

TABLES

FIGURES

ACRONYMS/ABBREVIATIONS

ABINEE	Brazilian Electrical and Electronics Industry Association
APEC	Asia-Pacific Economic Cooperation
AUD	Australian Dollar
ADB	Asian Development Bank
BCG	Boston Consulting Group
BRICS	Brazil-Russia-India-China-South Africa-
BRICs	Brazil-Russia-India-China
BRICST	Brazil-Russia-India-China-South Africa-Turkey
DST	Department of Science and Technology
EMs	Emerging Markets
EU	European Union
EUROSTAT	European Union Statistical Office
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
G-6	G-7 countries excluding Canada
G-7	Canada, USA, Japan, UK, Germany, France, Italy.
ICT(s)	Information and Communication Technology/
IMF	International Monetary Fund
INSEAD	European Institute of Business Administration
IT	Information Technology
ITU	International Telecommunication Union
KIBS	Knowledge-intensive business services
KBE	Knowledge-Based Economy
KIS	Knowledge-Intensive Services
OECD	Organization for Economic Cooperation and Development

PCs	Personal Computer(s)
R&D	Research & Development
SME	Small- and Medium-sized Enterprise
SPO	Turkey State of Planning Organization
UNCTAD	United Nations Conference on Trade and Development
UK	United Kingdom
USA	United States of America
USPTO	United States Patent and Trademark Office
WEF	World Economic Forum

CHAPTER I

INTRODUCTION

The role of science and technology has changed in the 1990s. The diffusion of information and communication technology (ICT) accelerated after 1995 as a new wave of ICT, based on applications such as the World Wide Web and the browser, spread rapidly throughout the world. For the last decade, developments in ICT have attracted increasing attention.

After the recent financial turmoil of 2009, ICT market has demonstrated 4% growth rate in 2010. Number of mobile phone subscribers has reached about 4.6. billion by 2010, sales of PCs and other ICT devices have skyrocketed. Number of internet users in the world has reached to 2.2. billion people in 2011 and 44.8 % of these users come from the Asian region. Moreover, world ICT trade has achieved to show significant growth rate following the sharp decline during the period of 2008-2009. The volume of ICT good trade tripled since 1996 reaching USD 4 trillion in 2008.The share of ICT trade in total world merchandise trade reached 15.5% .However, it declined to 12.5% in the crisis period.

Along with these developments, sovereign debt crises and on-going economic turmoil since 2008 has caused uncertainty in the market in terms of future growth rates and economic stability in national markets.

Thus, positive outlook in ICT sector and declining performance of current economies which are based on industrial production have led a tendency towards transforming into KBE which relies on wealth creation through application of human knowledge , entrepreneurship, innovation, R&D, diffusion of technologies and intangible sources (software, patent, trademarks), all of which are now counted as the new engines of growth in the global economy. In this respect, KBE has become the answer for existing and future problems in world market.

The role of knowledge in economic performance is neither a new idea or issue that is discovered recently. Since the introduction of endogenous growth theory in 1980s which indicates that long-term growth depends on the accumulation of knowledge through technology diffusion and contribution of human capital and innovative practices, the importance of new growth components have been put into the policy agenda of countries and international institutions. But recently, the presence of KBE has come to the forefront with the successful demonstrations of countries particularly those of EMs.

Countries such as the USA, Denmark, Finland, and Switzerland are widely recognized as leaders in successfully transforming to KBE, increasing their productivity. Although many statistical indicators address these countries as the center of innovation and knowledge-intensive sectors, many emerging countries have already demonstrated remarkable success by reaping the benefits of KBE in their markets. In 2010, Brazil, Russia, India, China (BRIC) are accounted for 13% of global demand, with spending of about € 328 billion in ICT . In 2009, 46% of Internet users (1.8 billion global Internet users) concentrate in five countries, which include BRIC countries with USA.China alone plays an increasing role in goods production networks that import high-value electronic goods, which makes China as largest exporter of ICT goods. Along with BRICS, Turkey, which is one of the fastest growing economy in the world, and aims at increasing its share of R&D in GDP to 2% by 2013,have already taken necessary actions to provide market that encourages innovation and R&D investments by launching research programs by national and international level and providing incentives for business sector that can enhance the accumulation of knowledge through using and investing on ICT tools and improving the innovation skills of its human capital, which in turn can boost productivity.

Although they dealt with some challenges such as lack of technology infrastructure, lack of public support for research activities at national level as well as for private sector and R&D investments, the problem of brain drain, BRICST countries are considered as important players in transforming the current economies into KBE due to their effective way of adapting and absorbing knowledge from other countries and implement these knowledge to increase their capacity to act.

All those issues show that BRICST have potential to bring alternative way to sustain macroeconomic performance in the realm of financial turmoil by boosting productivity.

Along with the attention that given to KBE in policy agendas and implementation in the market, there are abundance of empirical studies that confirm the positive contribution of ICT, innovation and human capital in terms of realizing productive economic growth.

Under these given context, this study will emphasize the role of KBE in BRICTS countries in terms of increasing economic growth, maintaining their power in the global market and dealing providing economic and social benefits. In the second chapter, features and various definitions of KBE will be presented.Then general outlook to global high-technology manufacturing, R&D investment, balance of ICT goods trade will be explained. Third chapter will focus on the importance of BRICTS in KBE compared to advanced countries. The fourth chapter summarizes different types of indices to measure KBE potential and compares countries' potential in KBE.In the fifth chapter,the existing literature on KBE is discussed by categorizing the studies under firm level, advanced countries, emerging countries and Turkey.The sixth chapter discusses the methodology and data used in this study.The seventh chapter introduces Ordinary Least Square Models (OLS) to determine the impact of KBE factors on GPD,GDP growth rate and GDP per capita, also the seventh chapter presents empirical results and discussion of the findings.The last chapter presents conclusion and policy recommendations.

This study may serve as a roadmap for policy makers in BRICST countries in transition to KBE as well as for the government in implementing accurate innovation and technology strategies and policies at the appropriate time.

CHAPTER II

KNOWLEDGE BASED ECONOMY AND ITS IMPLICATIONS

In this introductory chapter, an overview of the concept of KBE is discussed while the various definitions of KBE and its characteristics are introduced. Lastly, global trends in KBE have been presented and discussed.

Definitions of Knowledge-Based Economy

Recent changes and shifts in science and technology such as invention of personal computers, internet, software programs, all of which lead information and communications technology (ICT) revolution that boosts innovation, productivity and the development of the information societies and the rise in knowledge intensity of economic activities in a way of combination of scientific, and industrial achievements of the last century.

ICT revolution together with the pace of globalization whose distinctive features show itself through increasing international trade, deepening economic integration, especially in emerging economies, and geographic expansion of production processes leads to more complex global value chains. In this trend of growth, there is a challenge on the sustainability of exiting strategies as well as the capability of countries to meet the needs of people.

As Friedman and Mandelbaum (2011) has mentioned, all this realm makes the world moves from stage of Flat World 1.0 to the stage of World 2.0

(hyperconnected world), which means that changing face of global economy through outsourcing activities, easy access to information anywhere and anytime thanks to internet, search engines, digital devices (i.e. mobile phone, PCs) opens the way for producing goods and services on technology and encouraging people to use them in global platform (stage 1.0) but now people do not only use information access systems but also they can produce and distribute their own knowledge throughout the world by using the technology tools (stage 2.0). This brings a new form global field where the growth of PC shipments jumps from 3.8% (IDC, 2011) to 10.9% (IDC, 2012) countries such as China has approached 900 million mobile phone subscribers by 2012.

All these developments together have constituted a resonance point for innovation, communication and commerce, which are the basic factors leading to rapid transformation of the industrial economy into the knowledge economy, where the accumulation of intangible assets through education, research and investment has taken the role of accumulation of physical capital (Houghton & Sheehan,2000; Friedman, 2005; Friedman & Mandelbaum 2011).

In that context, the application of human knowledge and creativity are outpacing steadily; Innovation and knowledge are increasingly seen as being critical for effectively meeting these challenges. They are considered to play a major role in lifting economies out of the downturn and finding new and sustainable sources of growth and competitiveness.Many of the sectors which benefit from rapid growth in both production and employment are knowledge-intensive such as telecommunication, finance, education and IT. All these sectors help countries to provide efficient and sustainable development. Due to the fact that an engineer, an economist or a teacher each may have different perspectives to efficiency and sustainability, it is difficult to define what knowledge economy is- which also known as digital economy, information economy or knowledge society, even is called as weightless economy (Quah, 1997; 1999; 2001) or globalizing learning economy (Lundvall & Borras, 1998; Archibugi & Lundvall,2001; Archibugi & Coco, 2005).

So, at this point, it is important to clarify how knowledge is defined by different institutions and scholars in order to have better understanding the contribution of knowledge to economies. The term of knowledge must also be separated from the notion of information in the sense that knowledge is a much broader concept than information, which is generally "know-what" (what is called as information) and "know-why" (scientific knowledge of the principles and laws of nature) components of knowledge (OECD, 1996; ADB,2007). These are types of knowledge which are likely to be economic resource to be fitted into economic production functions and be easily reproduced and distributed at low cost to a broad set of users, Other types of knowledge such as "know-how" (skill and capability of individual firms to produce something) and know-who (skill and capability of experts within the organization) – are more "tacit knowledge" and are more difficult to codify and measure without establishing linkages in terms of network and apprenticeship relationships (Lundvall & Johnson, 1994).

Sveiby (1997), in his book "The New Organizational Wealth, Managing and Measuring Knowledge-Based Assets", describes knowledge as capacity to act and it is the most critical competitiveness factor in global economy.

Stiglitz (1999) provides many characteristics of knowledge from economic perspective:

•First and most fundamental fact is that knowledge is a public good, once knowledge is discovered and made public ,there is essentially zero marginal cost to adding more users.

•A pure public good is a good that is non-rivalries- means that it cannot be excluded from certain users. Knowledge is to some extent excludable-access to knowledge can be controlled at least in principle (Warsh, 2006). That's why intellectual property rights or other means of protection is necessary when knowledge-based economy operates.

Stiglitz (1999) emphasizes on the necessity of intellectual property rights for efficiency of knowledge-based economy. If these basic rights are routinely violated, then the supply of knowledge will be diminished due to the lack of market transaction (Stiglitz, 1999). In addition, since the knowledge is assumed as public good with some externalities, excessive reliance on the market may not result in economic efficiency and that is why collaboration between private and public sector would be supportive. Besides, integrating knowledge into standard production function is challenging task because there is a lack of capacity to use it in meaningful ways as well as its slow diffusion (Sveiby, 1997; Coates &Warwick, 1999).

Leaving aside these differences, there are three basic views about significance of knowledge. Firstly, it suggests that knowledge, qualitatively and quantitatively is more important than before as an input. According to Drucker (1998), knowledge is becoming to one factor of production, sidelining capital and labor. OECD (1999) also emphasizes that the role of knowledge has taken on greater importance compared with natural resources, physical capital and low-skill labor. Knowledge is not a good as the traditional ones, therefore its factors can be seen as inputs -

preconditions for the generation of the transmission of knowledge, e.g. IT infrastructure, measures of education, R&D, conferences and fairs- and outputs - product of knowledge in forms of transferable and utilizable, e.g. patents, publications (Lever, 2000).

Secondly, it is said that codified knowledge is what essential to economic performance and necessary for facilitating economic analysis (OECD 1999, 1996; Abramowitz &David, 1996; Houghton &Sheehan, 2000; Smith, 2002; Piech, 2004). When knowledge is being codified and transmitted through computer and communication networks, it reduces duplicative investments in acquiring knowledge as well as 'dispersion' of knowledge. These developments promise an acceleration of rate of growth of stocks of accessible knowledge, with positive implications for economic growth.

Therefore, it is challenging to mention one common definition to describe what knowledge-based economy is. Therefore, in the literature and institutional reports, we come across various explanations.

One of the earliest and most accepted definition of knowledge-based economy was introduced by OECD (1996) in its annual report entitled "Knowledge-Based Economy" –which is the first comprehensive report on the subject and its components- as "economies which are directly based on the production, distribution and use of knowledge and information and. The term "knowledge-based economy" results from a fuller recognition of the role of knowledge and technology in economic growth, since the definition of OECD, this new economy has been highly emphasized by many countries, organizations, and academic institutions. It is expected that the convergence of knowledge and computer technology is to become the main driver of growth, wealth creation and employment across all industries (APEC,2000).

According to United Nations (1997), knowledge economy is one in which the production, distribution and use of knowledge constitute the main driver of growth, wealth creation and employment across all industries. Economic integration across national boundaries is accelerated with an increasing pace of flow and transformation of information and knowledge along the movement of goods, services and capital in the region. Technology and globalization of trade and investment increase importance of technological capabilities and knowledge as sources of competitiveness for countries as a whole.

Stiroh (1999) uses the term “new economy” to describe KBE and he mentions three main features of KBE: (a) it may affect the business cycle, (b) ICT and globalization may change the short-run tradeoff between inflation and unemployment and as a result, the economy can expand for a longer period without inflationary pressures emerging. In this view, ICT puts downward pressure on inflation, while increased global competition keeps wage inflation in check (c) The sources of growth are different in the new economy. Certain parts of the new economy may benefit from increasing returns to scale, network effects and externalities. ICT and Internet applications, for instance, increases as more people are connected. This situation entails considerable spillovers, and these contribute to fuel further growth.

Along with the definitions above, Asia-Pacific Economic Cooperation (APEC) (2000) characterizes KBE as an economy in which the production, distribution, and use of knowledge is the main driver of growth, wealth creation and employment across all and features of an ideal KBE include: an openness to trade, new ideas and new enterprises; sound macroeconomic policy; the importance attached to education and lifelong learning; and the enabling role of information and telecommunications infrastructure industries.

According to Houghton and Sheehan (2000), KBE emerges from the rise in the knowledge intensity of economic activities, which is driven by the combined forces of ICT revolution and the increasing pace of technological change, and increase in the globalization of economic affairs which consists of national and international deregulation and IT related communications revolution. Houghton and Sheehan (2000) list characteristics of KBE as follows:

- Knowledge has fundamentally different characteristics from ordinary commodities. For instance, what we understand from the meaning of "scarcity" of resources cannot be interpreted in the same way in the knowledge-based economy. Scarcity is defying the expansiveness of knowledge and once knowledge is discovered and made public, there is essentially zero marginal cost to adding more users.

- The increasing rate of accumulation of knowledge stocks is positive for economic growth

- Initiative, creativity, problem solving and openness to change are increasingly important skills.

These authors state that once the KBE becomes dominated, we are required to change not only the way we act but also how we approach to the problems in this new economy, i.e.; the increasing inter-dependence among trade, investment, technology and capital flows suggests a need for deep integration of policies in these areas. Besides, when exchanging product and services based on knowledge-intensive activities, KBE is likely to contribute to an acceleration of technical and scientific advance which relies on intellectual capabilities rather than physical inputs or natural resources (Powell& Snellman,2004)

Apart from these definitions, Quah (1997) has used the term of "weightless economy" which is based on the claim that in all fast-growing successful countries, growth in information technology has contributed positively both to increasing weightlessness, means that greater value(as a fraction of GDP) resides in economic commodities that have little or no physical manifestation and to economic growth and the richer the country, the higher the contribution to growth of information technology and services.

According to World Bank (WB) (2011), "knowledge economy is one where organizations and people acquire, create, disseminate, and use knowledge more effectively for greater economic and social development." The framework for knowledge-based economy is described as follows (WB, 2011): An economic and institutional regime that provides incentives for the efficient use of new knowledge. Educated and skilled population that can create, share, and use knowledge well, an efficient innovation system of firms, research centers, universities, think tanks, consultants, and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology and ICT that can facilitate the effective communication, dissemination, and processing of information.

However, It is neither a new idea nor a fact that knowledge which has always played a major role in economic development is a crucial factor in economic, social and political issues. In Wealth of Nations, Adam Smith (1776) emphasized on new layers of specialists who are men of speculation and who make important contributions to the production of economically useful knowledge. Knowledge-based economy has also been studied by Drucker (1969, p: 25) mentioned in his book " The Age of Discontinuity" about "knowledge workers" who are characterized by the increased importance of knowledge, both technical knowledge (know-how), and knowledge about attributes and a well-trained workforce that can apply not only know-how, but is also capable of analysis and decision making based on information. Porter (1990) points out that a nation can no longer rely on abundant natural resources and cheap labor, and that comparative advantage is increasingly based on combinations of technical innovations and creative use of knowledge. Besides, as Schwartz (1993) indicates traditional factors of production – land, labor and capital – becomes restraints rather than driving forces and in this point, knowledge is considered as critical factor of production.

New technologies are expected to contribute the economic- well-being of developed economies. In the United States, for example, productivity growth almost doubled in the course of the past ten years. New information technologies are widely held to account for most of that acceleration. In the EU, despite low productivity growth rates, ICTs appear to explain half of the gains (EC, 2006), There is evidence that ICTs facilitate economic growth, principally by increasing productivity, though this is a long-term rather than immediate outcome of ICT investment (Elci & Karatayli, 2009).

In developing countries, the role of KBE, particularly in the context of ICT usage has not only provided potential for reducing poverty, but also increased the conditions for better health, education, livelihoods and empowerment. In this perspective technology enhances human capabilities. On the other side, the role of ICT on economic growth in developing countries can be emphasized through the productivity gains it generates. It raises the crop yields of farmers, the output of factory workers and the efficiency of service providers and small businesses. It also creates new activities and industries—such as the information and communications technology sector—contributing to economic growth and employment creation.

In addition to these, social and political freedom, participation and access to material resources create conditions that encourage people's creativity. Therefore, human development and technological advance can become mutually reinforcing, creating a virtuous circle (UNDP, 2001).

The collaboration with the MENA region on knowledge-based economy issue, WB and the Islamic Educational, Scientific and Cultural Organization (ISESCO) have adapted Tunis Declaration which is an important step in moving the countries of the region toward knowledge-based economy that encourages job creation, increased competitiveness and balanced development.

Kołodko (2001) claims that the "new economy" only the positive feature and a chance of post-socialist countries in order to catching up with the other states under the condition of proper economic policy (coordination of fiscal and monetary ones, planned industrial and trade polity), and subordinating the structural reforms to the growth policy.

In view of the pressing need of countries to start preparing for the post-petroleum and post-carbon future, as well as for major water, energy, food, and climate change in decades to come addresses re-thinking on the development and growth strategies in order to take advantage of transformative policies, innovation projects and renovation plans, which have become associated with moving towards KBE. Countries that introduce R&D and innovation supported policies aim at increasing their competitiveness during the crisis period can obtain strong economy and advantage in global market even after the crisis (SOP, 2011).

Despite of the many benefits that are introduced with the knowledge-based economy, there can be social difficulties, with assimilating it and the technological advances. Countries may not be able to adapt rapid changes, while being without proper learning capabilities. It can delay the economic growth (Dyker & Radosevic, 2001). As countries move up the economic scale, the more they thrive on knowledge to ensure their competitiveness in world markets.

The broad set of factors creates the foundation that supports innovation-intensive economic growth. Harnessing the potential of ICTs, innovation and enhancing human resources are essential for growth in the KBE. ICT reduces the costs of outsourcing and co-operation with entities outside the firm. It helps break down the natural monopoly character of services such as telecommunications, speeds up innovation process and reducing cycle times, which in turn fosters greater networking in the economy (OECD, 2000).

Remarkable importance of KBE encourages policy-makers in all countries to recognize and try to adapt this new economy. For instance, KBE was added to the agenda of European Union at the Lisbon Summit in March 2000, when European heads of state decided that Europe, as well, must become much more digital economy and they set a goal for being most competitive knowledge-based society in the world by 2010 through developing better policies for the information society and R&D, as well as by stepping up the process of structural reform for competitiveness and innovation (EC, 2000). However, the EU has already started to achieve this objective since November 1999 by introducing the initiative e-Europe, which consists of four programs: e-Learning, e-Health, e-Government and e-Business (EC, 2002). In recent report of European Commission (2007) entitled "The Lisbon Strategy and the Information Society", use of ICT is considered as key to modernizing the economy.

Since then European Union has accelerated its studies and actions on creating digital economy despite of the recent financial turmoil. It has only developed many types of policies (i2010 and Lisbon Strategy, European Broadband, e-Europe 2005 and 2002) and published reports (EU Digital Competitiveness Index, Digital Economy) but also introduces seminars, programs such as Dot.EU, IPV6, Safer Internet.

With European 2020 strategy, "The Digital Agenda" is included as first of the flagship initiatives for smart, sustainable and inclusive growth and it aims to ensure that every European citizen has access to faster, cheaper, secure internet (broadband access for all by 2013, access for all to much higher internet speeds (30 Mbps or above by 2020) as well as new information and communication technologies which have great potential for creating new and better jobs, and generating greater prosperity. In this way they will provide economic growth, job creation and allow European countries to build on their competitive advantages in areas such as mobile phone technologies.

The figure 1 shows the impact of labor, productivity and capital within the role played by innovation and technological change, and information technology. The changes in economy's production can be attributed to changes in the quantity of labor or capital employed, to changes in the quality of these inputs or to advances in technology and efficiency. The central part of figure represents determinants of growth including investment in fixed capital, human capital and innovation, the degree of an economy’s interaction and openness, the strength of the diffusion process, mobility of human resources and cost factors. The right-hand part, on the other hand, is related to the central part and addresses the role of macroeconomic policy, product, financial and labor market policies, regulatory reform, technology and innovation policy.

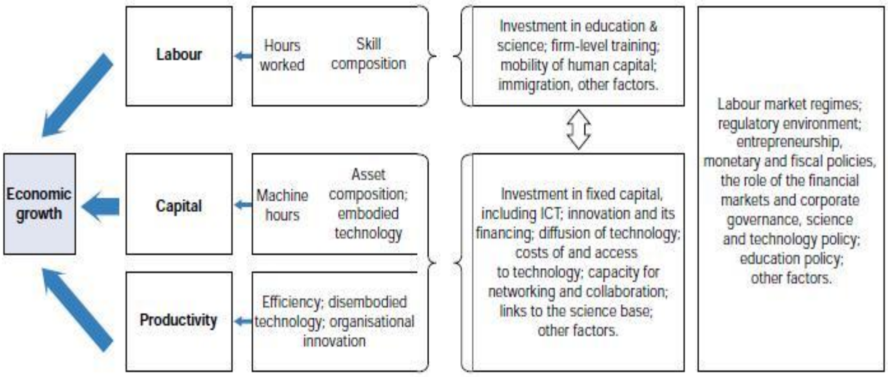


Figure 1. Analytical framework of the relation among innovation , technology and economic growth (OECD , 2000)

Certain common features emerge, perhaps best summarized in a World Bank study (Dahlman&Aubert, 2001). In the contemporary world, rapidly developing economies tend to be those in which economic growth depends increasingly on the creation, acquisition, distribution, and use of knowledge. Four pillars of a knowledge-based economy have been identified: (1) an educated and skilled population able to advance and productively employ knowledge; (2) an effective innovation system, forming a network of research and development, R&D institutions, higher educational establishments, and firms and other organizations able to harness, adapt, and assimilate the existing stock of knowledge and create new knowledge and technologies; (3) dynamic information infrastructure that can facilitate the effective communication, dissemination, and processing of information; and (4) an economic and institutional regime providing appropriate incentives to promote the efficient use and development of knowledge.

Measurement of KBE

As Porter (1990) and Schwartz (1993) indicate, establishment of KBE requires to live aside of traditional production factors and add new components that allow us to assess country's competences and capabilities in terms of acquiring, creating and distributing knowledge within its market.

Two new concepts are introduced to call new production factors:

1.Knowledge asset (goods) means stocks of knowledge which services are expected to flow from a period of time that may be hard to specify in advance (Boisot, 1998) and unlike physical asset, the life time of knowledge asset is infinite and this new type of assets requires understanding in terms of quality and content of performance outcomes.

2. Intellectual capital (intangible asset) is also similar to the concept of knowledge asset according to OECD (1999). However, Stewart (1997) defines intellectual capital as knowledge, information, intellectual property, experience that can be put to use in order to create wealth. Main challenge behind these concepts is to realize how its value and potential exist in many sectors of national economy and to decide how they can be recorded in financial reports and statements without a well-defined economic value (OECD,1996; 1999).

In order to establish common framework to benchmark countries and industries, methodological work of OECD classifies manufacturing industries in four categories of technological intensity: high (spending more than 4% turnover), medium-high, medium-low (their spending falls within 1%-4%) and low technology (its spending is less than 1%).This classification is based on indicators of technological intensity which reflect to some degree "technology-producer" or "technology-user" aspects (OECD, 2010).

Besides to that, the term of "knowledge-intensive goods" or "ICT goods" which is the one of the dynamic components of international trade is defined per the OECD's ICT goods classifications, which was first developed in 2003 by OECD and revised in 2009 (OECD, 2009). The table 1 represents the components of ICT goods:

Table 1.Broad Level Categories of ICT Products (OECD, 2011)

Broad level categories for ICT products	Number subclasses (products)
Computers and peripheral equipment	19
Communication equipment	8
Consumer electronic equipment	11
Miscellaneous ICT components and goods	14
Manufacturing services for ICT equipment	5
Business and productivity software and licensing services	11
Information technology consultancy and services	10
Telecommunications services	12
Leasing or rental services for ICT equipment	3
Other ICT services	6
Total	99

These ICT goods are defines as the goods that fulfil the function of information processing and communication by electronic means or use electronic processing to detect ,measure and control a physical process (OECD, 2003). Since the classification does not intend to focus on specific goods/services sectors, it covers more broad and different types of product.Although there is still no generally accepted definition for ICT goods, the classification in the table 1 facilitates the development of internationally comparable indicators on ICT consumption, investment, trade and production.

Knowledge-Based Economy Global Outlook

Progress toward a knowledge economy can be analyzed at a basic level in terms of high-technology exports and imports as a proxy of knowledge intensive, globally competitive production. A look at broad trends by technology intensity shows that the value of OECD manufacturing trade was essentially driven by high-technology manufactures from the second half of the 1990s to the mid-2000s. As it is shown in figure 2,the peak in the value of trade in medium-low-technology manufactures was partly due to the increase in prices for oil, petroleum products and basic metals, notably those required for the manufacture of ICT good (OECD,2011). However, for emerging countries namely, Brazil, Russia, China, India, Indonesia and S. Africa high-technology manufacturing trade has increased continuously in the last 20 years and accounts for 30% of their total manufacturing trade, compared to 25% for the OECD area in the year of 2009.

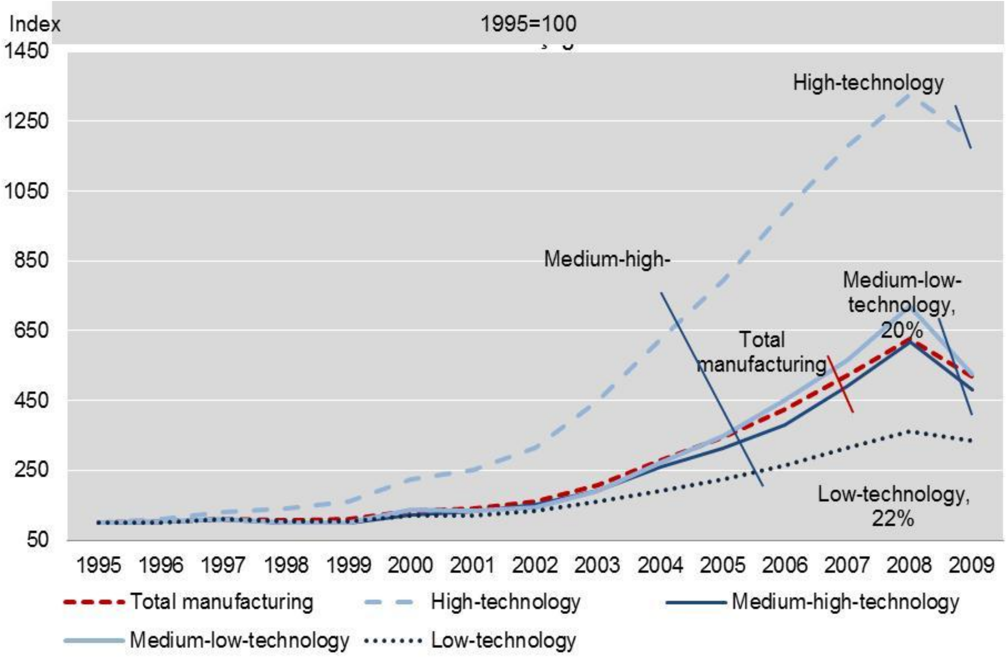


Figure 2.BRIICS manufacturing trade by technology intensity from 1995 to 2009, (OECD, STAN bilateral trade database , 2011)

Also, as it is given in the figure 3, trade in high-technology exports is highest in most of the emerging countries namely China, BRIICS, Poland, Hungary, Turkey, India and Brazil after Slovak Republic, Iceland and the Czech Republic. In terms of medium- high technology export and total manufacturing , these emerging countries are ranked as top in the worldwide whereas Russia shows the worst performance in three of the categories compared to other emerging countries. The growth rate of high-technology and medium- high technology export in advanced countries such as United States, Japan and Canada remain below the average of OECD (7.6 % high-tech; 8.1% medium-tech) , the EU (9.4% ; 9.0%) and accession countries (6.5% ; 11.3%) .

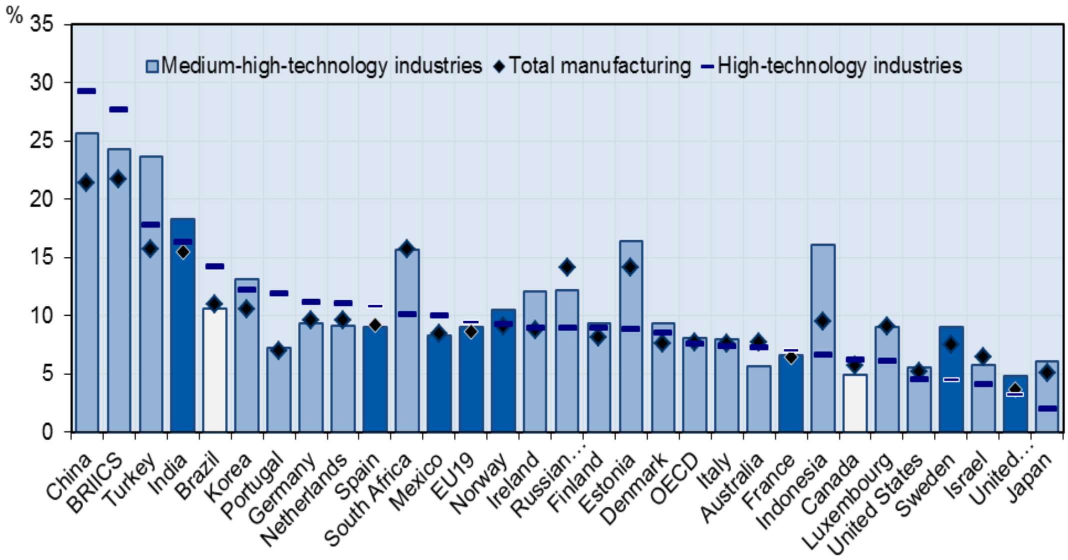


Figure 3.Annual average growth rate of high and medium-high technology exports from 1997 to 2007 (OECD, STAN Bilateral Trade Database , 2011a)

High-tech manufacturing has been the fastest-growing area of world trade and now accounts for one-fifth of the total. The figure 4 displays the share of high and medium-high technologies in manufacturing exports in 2007.The figure shows that the share of high technology manufacturing exports in Turkey, S. Africa and Russia are particularly small and stay below the average of OECD, the EU and Accession countries while Ireland, Switzerland, Korea, USA and China dominate the largest share of high-tech manufacturing export in the world .In 2007, exports were particularly oriented towards high- and medium-high-technology manufactures in Ireland, Japan, Hungary, Switzerland, Mexico and the United States. China's exports were significantly higher than the OECD average, with high- and medium-high-technology exports accounting for about 60% of its total manufacturing exports (OECD,2010a) and growing contribution of high-tech industries to total manufactures exports, which reached 42% in OECD countries by 2007, can be recognized as a confirmation of knowledge usage success.Though high-tech products are still exported for the most part by developed countries such the United States, Japan and Germany, during two last decades a growing importance of China and South Korea can be observed in this field.

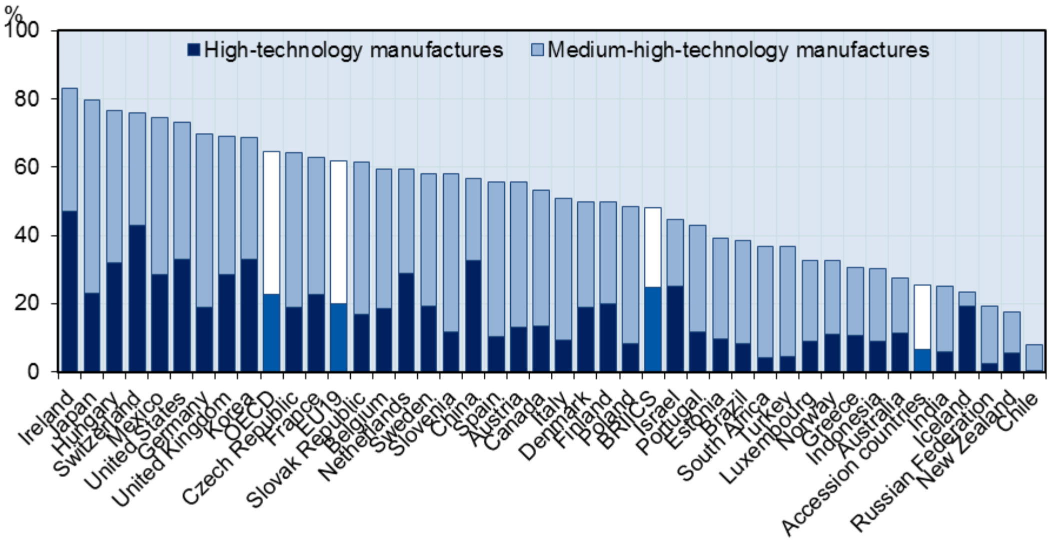


Figure 4.Share of high and medium-high technologies in manufacturing exports by 2007, (OECD, STAN Bilateral Trade Database , 2011a)

Furthermore, an evidence of increasing human and social capital role which are the essential components of KBE, is increasing size of commercial service exports (current US$) which is defined as total service exports minus exports of government services not included elsewhere (WB, 2011) and international transactions in services are taken as the economic output of intangible commodities that may be produced, transferred, and consumed at the same time. The figure 5 shows the volume of commercial export between 2000-2010. While EU and OECD member countries possess the largest volume of export, growth rate of commercial export display the success of emerging countries in that context. For instance, in 2004, India has recorded an increase in the commercial export by 60%, hold the highest rates between 2004 and 2006.

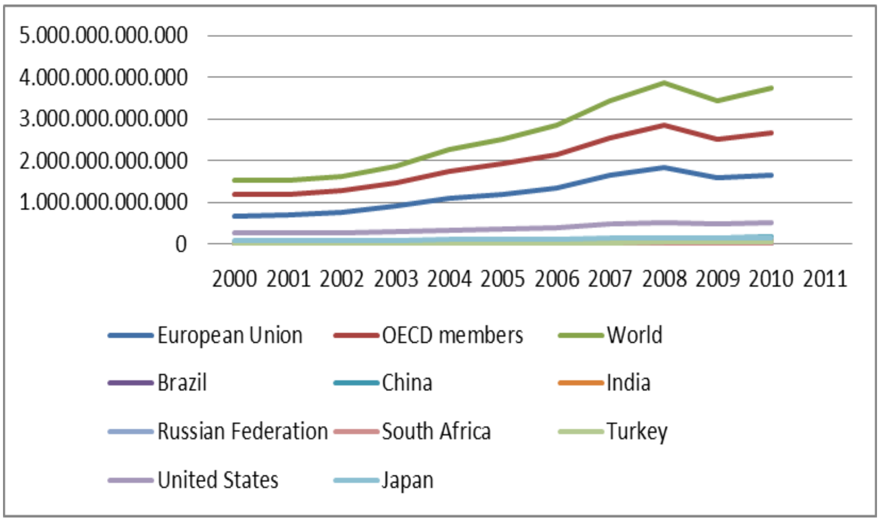


Figure 5.Commercial service exports (USD billion) (WB, 2011)

Country's technological development can also be analyzed through R&D activities within that country or absorption of foreign technology via acquisition of foreign technologies and international trade. Therefore, R&D expenditure and technology balance of payments can provide necessary source of argument.

When looking at the R&D expenditure which is an investment aimed at new knowledge, products or process, it is displayed in the figure 6, United States, with 311.2 billion USD of R&D expenditures in 2008, performs the most research and development (R&D) activities followed by China (USD 125.7 billion), Japan (USD 113 billion). Emerging countries together account for 18.5 % of total R&D expenditure measured in terms both of total researchers and R&D expenditures in 2009.

Continuity of R&D activities rely on the degree of funding that a sector can provide either from government (central, regional or local) through grants, loans and procurement, which lead to Government-funded business R&D or from domestic business enterprise sector's contribution in the form of grants, donations and contracts, which result in Business-funded R&D in the higher education and government sectors

More than 15% of business R&D is funded directly by government in the Russian which has the highest increase in Government-financed R&D in business (17%) in the period of 1999-2009 and it is followed by Turkey (14%), S. Africa (11%) and Hungary (10%) respectively (OECD, 2011).Besides, in terms of business-sector funding of R&D in the domestic higher education and government sectors Hungary together with the Netherlands, China, Turkey, the Russian Federation and Germany dominate the high level of increase in the same year.

In addition to these indicators, investment is ICT is important for economic growth. It is a way to expand and renew the capital stock and enable new technologies to enter the production process. In 2007-09, it represents 30% of total fixed nonresidential investment in the United States, about 25% in Sweden and Denmark, and over 20% in the United Kingdom and New Zealand (OECD, 2011a).

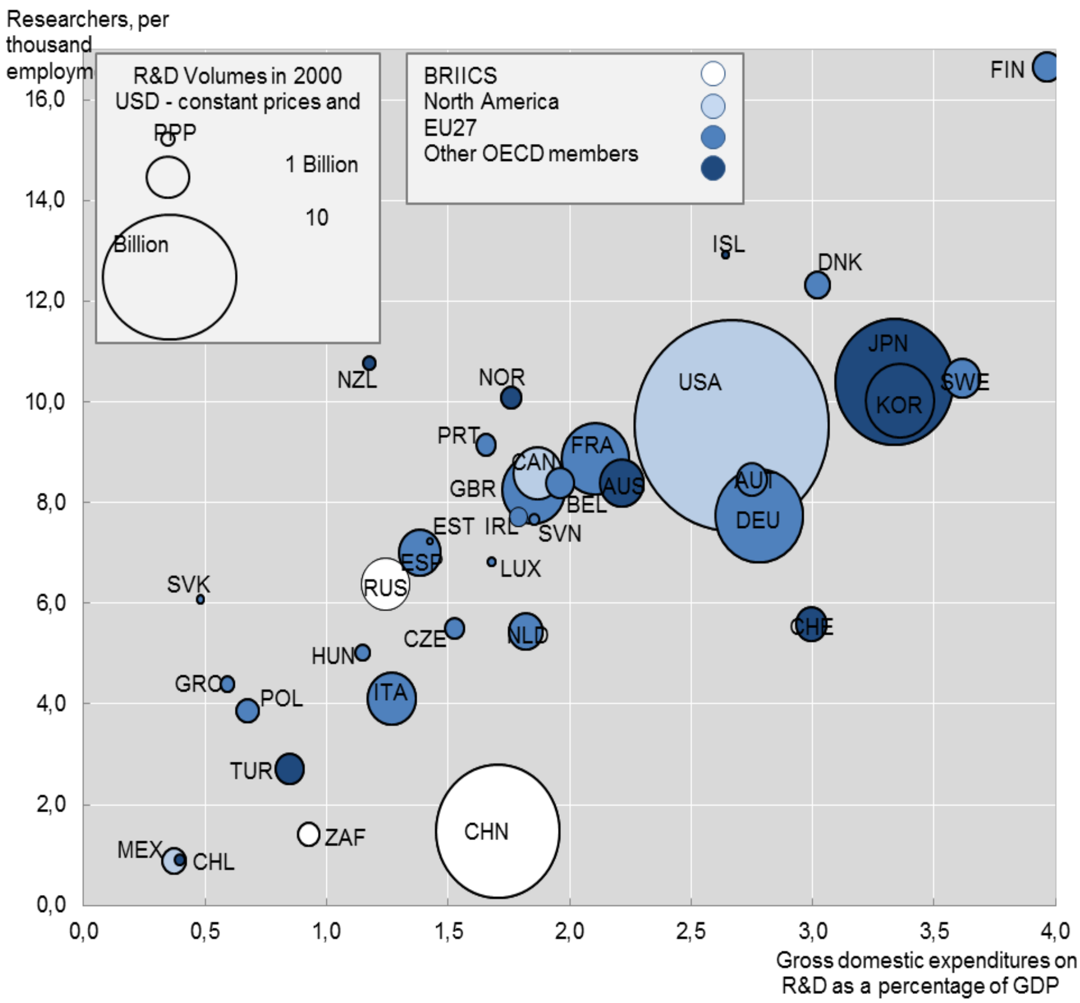


Figure 6.R&D in OECD and non-OECD economies in 2009 (OECD, 2011)

In terms of technology balance of payment (TBP),which is considered as partial measures of international technology flows, registers the commercial transactions related to international technology and know-how transfers and comprises four main categories (OECD, 2002);

- transfer of techniques (through patents& licenses, disclosure of know-how)
- transfer (sale, licensing, franchising) of designs, trademarks and patterns;
- services with a technical content, including technical and engineering studies, as well as technical assistance and industrial R&D.

Although the balance reflects a country's ability to sell its technology abroad and its use of foreign technologies, a deficit does not necessarily indicate low competitiveness. In some cases, it results from increased imports of foreign technology; in others, it is due to declining receipts while surplus in TBP can result from high degree of technological autonomy, a low level of technology imports or a lack of capacity to assimilate foreign technologies (OECD, 2010a).

According to the recent data presented by OECD (2009), the countries that have the largest surplus on TBP as a percentage of gross domestic product (GDP) were Sweden (1.16 %); Austria (0.77%); Norway and United Kingdom (0.55%); Finland and United States (0.46%) ; Denmark (0.40%) whereas countries with the largest deficit are Switzerland (-1.02% in 2007), Hungary (-0.66%), and Luxembourg (-0.46%).

Lastly, for the global ICT trade which has tripled since 1996 to approach USD 4 trillion in 2008, but in the has decreased sharply in the last half of 2008,is expected to be about 3-4% in 2010 and more in 2011. World ICT spending fell by some 4% in 2009 is also expected to grow by some 6% in 2010 (OECD, 2011).

The important point is that trade and production of ICT goods has started to move from advanced countries to emerging countries. For instance, China and India have obtained high growth in ICT goods during the recent financial turmoil (OECD 2011; IMF 2010). In terms of ICT trade balance (Table 3) in 2008, China, Korea, Singapore and Malaysia have not only the largest trade surpluses but also the highest ICT trade volume and they are followed by other emerging countries with relatively small trade deficits such as Philippines, Argentina and India and Turkey.When looking at the BRICST countries bloc in general, Russia holds the largest trade deficit (-23.799 USD billions) but also it is the largest and fastest-growing importer of ICT goods among these countries, due to imports of communication equipment and of computers and peripheral equipment.

Brazil’s ICT market value is estimated to be 7% of its GDP. The largest sub-segments are telecom services (43.14%) and IT services (17.87%). However, the trade balance of the ICT sector is still negative (ANATEL, 2010).Brazil has a large and growing trade deficit in ICT goods but has been increasing its exports faster than its imports and over 60% of ICT goods import relies on Asia; it is projected that volume of ICT trade is to reach 33.4 billion USD by 2011 as well as trade deficit (as % of GDP) is expected to decrease from -1.4 % (2008) to -0.4 % by 2020 (ABINEE, 2009).

In terms of its relatively large deficit in ICT goods trade, India’s position is similar to Brazil’s. The ICT sector is centered around IT service exports with revenues growing from US$ 8.3 billion in 2004 to US$ 23.2 billion in 2008 (OECD, 2010). The Indian ICT contribution to GDP (ICT revenue as a proportion of the GDP) has been growing from 1.2% in 1998 to 5.2% in 2007, and 5.8% in 2008 .The Indian ICT manufacturing sector is small when compared to the services, in 2004, manufacturing contributed to only 0.217% of GDP (ICT value-added as a proportion of GDP) (Nasscom, 2009).

South Africa’s ICT goods trade is also somewhat similar to that of Brazil, with a large ICT trade deficit across all segments and exports growing somewhat faster than imports and the volume of ICT trade is remain the smallest among the BRICST countries. However, South Africa’s ICT market is the largest on the African continent, with total spending of more than 25 billion Australian dollar in 2006

(State of Victoria, 2007). Similar to S.Africa, volume of ICT trade in Turkey remains undersized compared to other countries. ICT sector in Turkey has reached to USD 24.88 billion in 2008 and although it declines in financial crisis period, the sector has been able to grow by 4.55% and reach to USD 25.05 billion; share of ICT sector and IT market have remained nearly stable in the period of 2007-2010 (Table 2). Information technology sector and particularly the field of software and services whose market growth rate are 12.07% and 21.98 % respectively has played a remarkable role in the Turkey's transmission into KBE.

Table 2.Market Indicators of ICT Sector in Turkey (SOP, 2011)

Indicators	2007	2008	2009	2010
Market size of the ICT sector (billion US Dollars	22.24	24.88	23.96	25.05
Market growth of the ICT sector (percentage)	N/A	11.87	-3.70	4.55
Share of the ICT sector in GDP (percentage)	3.43	3.35	3.90	3.40
Share of the Information Technologies sector within GDP (percentage)	0.92	0.81	1.08	1.03

n/a: not available

On the other hand, among advanced countries, EU-27 (USD -150 billions) and the United States, which imports most of its ICT goods from India and China, (USD -113 billions) have a significant ICT trade deficit and they are followed by United Kingdom, Spain, Canada and France.

The table 3 lists the countries in terms of their ICT export and import activities. China, whose assembly activities depend on the import of components, is the leading exporter (USD 430 billion) and importer of ICT goods (USD 305 billions) together with EU-27 countries and United States in 2008.In Central and East European region, Hungary (38% compound annual growth rate, CAGR), the Slovak Republic (36%), and the Czech Republic (32%) have demonstrated progressive increase in ICT trade.

Table 3.Balance of ICT Goods Trade in 2008 (USD Billions Current Prices), (OECD, 2010)

	Exports	*Imports*	*Balance*	*Trade*
OECD area				
Australia	2. 895	20 988	-18 092	23 883
Austria	10. 961	12 929	-1 968	23 890
Belgium	14 .889	20 369	-5 480	35 258
Canada	18. 386	40 514	-22 128	58 900
Czech Republic	22 .450	22 076	374	44 526
Denmark	6 090	9 740	-3 650	15 830
Finland	15 834	11 360	4 475	27 194
France	34 491	54 589	-20 098	89 080
Germany	110 559	112 696	-2 138	223 255
Greece	857	5 428	-4 570	6 285
Hungary	26 910	20 065	6 845	46 975
Iceland	23	313	-289	336
Ireland	22 175	15 004	7 171	37 179
Italy	14 507	33 942	-19 435	48 449
Japan	114 219	83 873	30 346	198 093
Korea	115 459	58 226	57 232	173 685
Luxembourg	877	1 375	-499	2 252
Mexico	61 504	59 441	2 063	120 945
Netherlands	71 454	69 777	1 677	141 232
New Zealand	541	3 183	-2 642	3 724
Norway	3 530	8 510	-4 981	12 040
Poland	12 850	20 764	-7 913	33 614
Portugal	4 024	7 511	-3 487	11 535
Slovak Republic	12 188	11 643	545	23 831
Spain	8 282	36 769	-28 486	45 051
Sweden	18 472	18 050	423	36 522
Switzerland	6 905	13 268	-6 363	20 173
Turkey	2 619	9 925	-7 306	12 543

Table 3.contiuned

	Exports	Imports	Balance	Trade
United Kingdom	37 775	69 681	-31 906	107 456
United States	173 950	286 882	-112 933	460 832
EU27, excl. intra-EU trade	159 091	309 357	-150 266	468 447
Accession countries				
Estonia	833	1 197	-364	2 030
Israel	8 069	6 102	1 967	14 170
Russian Federation	2 055	25 854	-23 799	27 910
Slovenia	946	1 769	-823	2 715
Emerging economies				
Argentina	333	5 572	-5 239	5 905
Brazil	3 597	20 433	-16 837	24 030
China	430 478	305 229	125 249	735 707
Hong Kong, China	158 458	164 498	-6 040	322 956
India	2 298	15 593	-13 295	17 892
Indonesia	6 910	12 361	-5 451	19 271
Malaysia	51 293	38 497	12 795	89 790
Philippines	15 188	20 653	-5 465	35 841
Singapore	122 883	90 135	32 748	213 018
South Africa	1 175	8 292	-7 117	9 466

Moreover, there is a changing direction in ICT trade in the sense that the role of non-OECD countries has become significant.Table 3 indicates that non-OECD economies hold a large share of OECD ICT imports.According to OECD (2010), the share of non-OECD countries in importing has increased from 32% to 48% in the period of 1996-2008.On the other hand, among the BRICST countries, while China displays the best performance in terms of importing and exporting of ICT goods, Russia demonstrates the worst performance with the high ICT trade deficit (USD –24 billion).The volume of ICT trade in S.Africa and Turkey remainslightly small compared to other countries in BRICST bloc.

CHAPTER III

KNOWLEDGE BASED ECONOMY IN EMERGING MARKETS

This chapter focuses on the KBE in the context of emerging markets. In ther first part, it is mentioned about the various ways of defining EMs by referring to studies of some scholars and institutions.In the second part, the current state of BRICST countries is addressed in order to understand what kind of actions have been taken for KBE at national level. Finally, common characteristics and challenges faced by BRICST countries are summarized.

Definitions of Emerging Markets

There is no general agreement as to what defines an emerging economy, and many researchers use the terms emerging and developing economies interchangeably.

However, some developing economies exhibit robust, continual economic expansion, resulting in fast growing per capita income, clearly differentiating them from less dynamic developing countries (Roztocki & Weistroffer, 2008).The term emerging market economy, commonly attributed to van Agtmael (1984), thus describes a country or a region with vigorous economic growth. This vigorous growth of emerging economies is typically enabled by decisive authorities who are sincerely dedicated to economic liberalization (Arnold & Quelch, 1998). Recently, Glassman (2010) has used to term “fast-growing” to call emerging markets, “mature” for advanced countries and “aspiring” for developing countries.

Whatever the term is used to name these economies, the main differences between emerging and advanced countries are listed in table 4. Emerging economies are characterized as those that are able to recover from global recessions better than advanced economies and demonstrate high growth rates, improved trade,strong financial and trade linkages with other countries, blooming middle income class which in turn brings growing domestic market; better macroeconomic policies bringing inflation under control, diversification in production and export patterns which provides resistance to global shocks (IMF, 2010).

However, emerging economies enjoy the benefits of these advantages in the world economy they still face major challenges that could limit their growth potential; Along with their increase economic power, they also take a leading role in setting global priorities in world agenda in terms of environmental issues, energy policies and providing financial assistance; for instance BRICS have told to contribute at least 72 USD billion to IMF to help protect the global economy from Europe's deepening debt crisis (RT, 2010; 2012).They are also considered to have an intention to set up a development bank to mobilize resources for infrastructure and sustainable development projects in BRICS and other emerging economies and developing countries, to support the works of multilateral and regional financial institutions for global growth and development (Guardian, 2012) and increase in their IMF quota means that they have much more larger say at world table. On the other hand, as Christine Lagarde and also Rothkopf (2011) recently state that Turkey is regarded as a country to be listed in BRICS bloc and it is praised due to its role in IMF and recent economic outlook.

Therefore, emerging countries have not only capacity to make their domestic economies strong but also are ready to assume responsibilities for global economic stability. In that context, emerging economies are also expected to have prominent role in building and promoting KBE.

Table 4.Characteristics of Developed and Emerging Economies (Roztocki & Weistroffer,2011)

Business environment	Emerging economies	Developed economies
Laws &Regulations	Changing fast and unpredictably	Relatively slow and somewhat predictable changes in the regulatory environment
Governmental Control	Mostly strong and determined authorities	Mostly strong and stable authorities
Workforce characteristics	Low, but rising salaries, accompanied by high demand for highly qualified workers and high employee turnover	High salaries, flat demand for highly qualified workers, and low employee turnover
Economic conditions	Continuous and fast economic growth	Continuous but modest economic growth
Customer characteristics	Low per capita income, but a rising middle class with rapidly increasing consumer demands	High per capita income, but only modest growth in income

In addition to put exact definition on the terms of “emerging economies”, there is also various way to decide which countries should be counted as emerging economy.

According to Euromonitor classification (2010) emerging economies are composed by 25 countries including Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Kazakhstan, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, South Africa, Thailand, Turkey, the UAE, Ukraine, and Vietnam.

IMF (2010) mentions that emerging economies are those which are not included among the advanced economies and not eligible for Poverty Reduction and Growth Facility (PRGF) resources that support programs to improve living standards and provide sustainable economic conditions (IMF,1999). Under this description, countries in IMF's classification range from large emerging economies such as Brazil, China, India, Indonesia, Russia, South Africa, Thailand, Mexico ,Poland, Romania, Chile, Bulgaria, Turkey to small island economies such as Barbados, Bahamas.

Kplinger (2010) describes the world top ten emerging economies on the basis of their stock market value, Taiwan (USD 369 billion),Indonesia (USD 61 billion), Mexico (USD 141 billion),Brazil (USD 549 billion),Poland (USD 41billion),India (USD 243 billion),Turkey (USD 48 billion),South Korea (USD 413 billion.),China (USD 581 billion.) and Russia (USD 206 billion).

Apart from the general classifications introduced by various institutions such as FTSE group, Standard & Poor's, Goldman Sachs. There are well-known acronyms to mention about the group of emerging countries such BRICs (Jim O'Neill, 2001) and recently BRICS (S for South Africa).

However, as Goldstone (2011) mentions the notion of the BRICS is likely to be out of date in coming years and suggested a group of dynamic and democratic emerging economies "TIMBIs": Turkey, India, Mexico, Brazil, and Indonesia. These countries form more than just a cute acronym; TIMBIs are poised to benefit from making the jump to becoming creative, knowledge-driven economies. Goldstone (2011) has argued that economic growth in Russia and China would be hampered by shrinking working-aged populations, so India and Brazil should more accurately be placed with countries that boast growing economies and populations.

Moreover, other post-BRICS acronyms have been used in various ways; MIKT: Mexico, Indonesia, South Korea, Turkey (Jim O'Neill, 2006); other commonly used classification of emerging and developing economies include the BRICST (Brazil, Russia, India, China, and South Africa, Turkey), the Next Eleven (Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, Philippines, South Korea, Turkey and Vietnam).

Since the first publication of Goldman Sachs in 2003 “Dreaming with BRICs: Path to 2050”, BRICs countries along with S.Africa and Turkey have demonstrated much faster growth and development than it is actually assumed.

While most countries' economies were mired in the global financial crisis, China and India realized near double-digit economic growth rates in 2009 and 2010. Countries with the lowest initial GDP per capita of the five countries -China and India -experienced the greatest growth. Countries with the highest initial GDP per capita -Brazil, Russia, and South Africa -- experienced growth in 2010, after economic losses in 2009 (Gallup, 2012).

Emerging economies such as Brazil, Russia, India and China, which traditionally have played a big role in the global innovation landscape, have now begun to catch up in developing their own innovative capabilities and some have emerged as major players in certain technology intensive sectors like mobile communications, electronics and information technology. (OECD, 2010; Goldman Sachs, 2011).

Knowledge-Based Economy and BRICST

It is forecasted that BRICs economies are to be larger in size in context of GDP growth, income per capita in US dollar terms and currency movements than the G6 countries by 2040, according to recent revision (2007), this target can be achieved by 2032, faster than normally expected. BRICs start to be counted as important source of new global spending. For instance Russia's economy has displayed GDP per capita of $15.900 by the year of 2010 which accounts for 40% of developed markets' average and recently, BRICS as a group is to overtake the US until 2018, in addition to that, Brazil, China and Turkey will have incomes per capita similar to that of US today by 2050 (Goldman Sachs, 2011). At the end of year 2010, Turkey is the largest economy in Europe with 9.0 % GDP; in the second quarter of 2011, Turkey is the second largest economy in the world after China (9.5%) and again is the biggest one in Europe with 8.8% GDP in constant prices (TUIK, 2011).

Moreover, S.Africa, which became the official member of BRICs in 2011, on the other hand, is one of the largest countries as well as the largest economy on the African continent. According to longer term projections of Goldman Sachs (2003), S.Africa can grow at an average rate around 3.5% over the next 50 year although its economy would remain smaller than BRICs in that year.

So, these optimistic projections and exertive nature of BRICST countries demonstrate that it can be much more possible for these economies to transform into the KBE faster than developed countries and become an engine for growth in this new economic arena. In order to assess the position of BRICST, the developments on technology and innovation fields of BRICST countries to date can be taken into consideration.

South Africa

South Africa has taken remarkable steps in transformation to knowledge based economy by preparing science and technology related policies (DST 2008). Similar to the aim of European 2020 strategies, DST of S.Africa has set the target of reaching of 2% of GDP by 2018.While this target was 1% of GDP by 2008 which was never achieved S. Africa's GERD as a % of GDP amounted to 0.92% in the period of 2008 and 2009.

The Department of Science and Technology (DST), has worked on developing indicators to measure and monitor the development of a knowledge-based economy in South Africa. South Africa. Besides, far-reaching reforms, liberalization of domestic markets and development of open market economy allow S.Africa to progress rapidly in many areas including outsourcing services; e-security; biometrics and software development; and ICT product & services value chain (State of Victoria, 2007). S.Africa's dual economy status which composes the mix of developed and developing economy characteristics has been the major stimulus that provide necessary environment to introduce knowledge-based economy. For instance, R&D expenditures from business enterprises have risen in S.Africa; level of R&D funding abroad is 13.6 %, which is the highest of all non-OECD countries and business sector funds 45% of formal R&D and performs 58%.

These rates demonstrate that South Africa has an important platform of industrial R&D competence upon which to build (OECD, 2008). Existence of resource-based industries and related KIBS industry-research sector interactions as “focusing devices” for developing the knowledge infrastructure are also enhancing the advantage of S.Africa to transform into knowledge-based economy

However, there are some challenges that can prevent S. Africa from sustaining its competitive advantage such as shortage of high-skilled labor force in the country, internal rich-poor tension, strategy implementation capacity in the state’s part of the innovation system and poor quality schooling for many citizens (OECD,2007).

<u>China</u>

In China, where ICT market has reached the value of € 204.1 billion in 2010 (EITO, 2010), policy-makers are keen to boost the role of innovation in the country’s economic development so that the economy can eventually be transformed into a knowledge-intensive one, which is less dependent upon external markets (Schaaper, 2009). This goal is clearly envisaged in the country’s ‘Medium-to-Long Term Plan of National Science and Technology Development (2006–2020)’ announced in February 2006.This proposes that China can become an innovation-driven nation and it aims at raising the share of gross domestic expenditure in GDP (GERD/GDP ratio) from 1.54% (2008) to 2.5% by 2020 (UNESCO, 2010).

As World Bank (2001) and Ramesh (2012) have mentioned, strong ties to traditional values in education system and public institutions strong planned economy regime direct people only absorbing knowledge rather than creative thinking and innovative-oriented, therefore it is necessary for China to renovate its traditional economic structure in a way to educate for well-trained, innovation oriented people.

Brazil

In Brazil, which represents the 49.6% of Latin America IT market (USD 75 billion) government shows important effort to achieve to be information society? Beginning with the first report so called “Green Book” in 2004, many documents and projects (the next Brazilian revolution, ICT 2020: Transformation Strategies for Brazil, e-Brazil Project etc.) have been published in which Brazil explains its achievements in building an information society and conducting a wide range of e-government activities in education, health, public safety, justice, elections, legislation, public administration.

When looking at the IT market data for Brazil, the growth rate of the market has reached 21.3% by the end of 2009 and exports of software and services has accounted approximately U.S. $ 1.74 billion, an increase of 15.7% over 2009 (ABES, 2011). Under this context, a shared vision of a desired ICT-enabled future would give a more central role to the use of ICTs to realize Brazil’s goals and unlike other emerging countries in BRICST bloc, Brazil is able to bring innovative partnerships with the private sector and NGOs . (Knight, 2010). Many national companies such as Petrobras, Inpe and Embraer, Optoeletronica, which put efforts to develop innovation in agriculture, aerospace and energy, stand out as successful corporate and institutional leaders in highly complex and knowledge intensive projects involving.

In addition to these, in Brazil , investment in technological innovation comes mainly from the public sector about 55 % of the total, compared with about 30 % in the USA (WB, 2008). Developing the information society in Brazil has been the subject to the efforts of the Ministry of Science and Technology since 2000s and an institutional framework is created to develop e-government programs at the federal level in 2000 which aims at introducing more equitable society and more competitive KBE.

As a result of these efforts, Brazil's ICT market is able to achieve double size in the period of 2004-2008, which is higher than Russia, Turkey, India and S.Africa but remains below the market size of China, which accounts for USD 69.6 billion (ABINEE,2009). Besides, Brazil is expected to have most mature market by 2015 on the basis of internet penetration with the rate of 70 percent which will be the highest among Russia, India and Indonesia (BCG,2010).Table 5 below summarizes the size of ICT market in BRICST countries in 2008.While China holds the largest ICT market, S.Africa accounts only USD 7 billion ICT market.

Table 5. ICT Market Size (USD billion) of BRICST countries by 2008 (ABINEE 2009; *SOP 2011)

Countries	Brazil	Russia	India	China	S.Africa	Turkey *
Market Size	29.1	25.4	22	69.6	7.05	24.8

Despite these remarkable actions, main challenge is to design an innovation policy that induces innovation at productive system. (OECD, 2001; WB,2008). Brazil needs to complete its transition to a knowledge-based economy. One major structural obstacle arises from the combination of unequal income distribution and large pockets of poverty from which the country suffers. Also it is lack of science-based companies, a greater number of local firms linked to information-rich markets and committed to the acquisition and deployment of knowledge as well as international firms with major local R&D investments (OECD, 2001). On the other hand, structural weakness of Brazilian innovation stems from the fact that companies do not show interest in long term strategies because of uncertainty in business environment in Brazil.

Russia

The definite advantage of the innovation sphere in Russia remains the quality of its human capital, which generally rated by international experts higher than the overall level of innovative activity (38th according to the Global Innovation Index, e.g., by the quality of university education, 19th). Russia hosts many of the world's leading technology-based companies, as the aerospace and information and communication technology (ICT) sectors, for example, seek to access high skills at an internationally competitive price.

Like many other countries, Russia has sought to attract FDI through the establishment of various types of special economic zones and technology centers. In 2005, President Putin signed a decree on the creation of six special economic zones which four are to be focused on high technology and innovation (Ilyichyov,2005). In developing IT parks, innovation zones, and similar arrangements for the promotion of new technologies, Russia has followed the practice not only of India, but also other countries such as China where high-technology development zones have played a major role in the country's economic rise and Mexico, which has designed those areas designed to attract multinational companies and promote the development of IT outsourcing services (Horowitz, 2003).The other strengths of Russia that have made us to select this country as area of interest are : Long-standing scientific and engineering culture, Improved balance between co-operation and competition among the different components of the public research system, great number of would-be innovative entrepreneurs exists among the younger generations (OECD, 2011). Russia's higher education sector possesses significant S&T potential and long-standing research traditions. However, universities still play a minor role in new knowledge production: in 2008, they contributed just 6.7% of GERD, a figure that has remained fairly stable for the past two decades (UNESCO, 2010).

On the other hand, In Russia, key actors in the field of innovation—businesses directly transforming existing knowledge into products, services, and other economic benefits—remain underdeveloped (Gokhberg 2003; Kuznetsova & Roud 2011).Due to the strong bias towards the state support of traditional high-tech industries, Russia is called as ''high-technology myopia'' and the innovation is perceived as something related to technological phenomenon and ignore its impact on quality of life. (OECD, 2008).

Since post-2008 crisis period, modernization and innovation have been put forefront of Russian economic agenda in order to achieve its sustainable growth potential (OECD, 2011) which are improving innovation awareness and initiatives at the level of municipalities and regions. Boosting support for university research has become one of the most important strategic orientations of STI and education policies in Russia (Government of Russian Federation, 2009).

India

Unlike Brazil and Russia, the conditions to transform into knowledge-based economy is relevant and encouraging in India. Friedman (2005; 2010), presents India as a quintessential example of success in the knowledge economy. Far from being poorly paid sweatshop workers, Friedman portrays Indian knowledge workers as having cutting-edge skills and an ambitious outlook, able to compete with their counterparts in any part of the world.

As the second largest English-speaking population in the world, India offers global employers high-quality skills for a fraction of the cost of equivalent skills in the United States or Europe. Besides, KISs have seen a major upsurge in international trade beginning with Indian IT services exports (OECD, 2010a). In terms of KBE, however, the "brain drain" of technical talent to industrialized nations is viewed as a problem, channeling talent away from India (Khadria, 2001).

Turkey

ICT sector in Turkey has reached USD 24.88 billion by the end of 2008, which has experienced decrease during the global crisis and is able to 4.55% in 2010 in equivalent to USD 25.05 billion.

Turkey is in a relatively strong position to build its knowledge economy compared to other emerging countries mentioned above. Unlike the other countries, Turkey enjoys high level of young population which shapes innovation level and R&D activities of countries, the youth education level (percentage of the population between the ages 20-24, who have completed at least high school education) shows progress by years and it reached 57.6% as of 2010 (TURKSTAT, 2011).

Turkey is in the “preliminary” phase of transformation towards information society (SOP, 2006). However, Turkish authorities have already undertaken a set of initiatives to meet the challenges of the emerging global knowledge economy.

In that context , relations of Turkey with the EU throughout the various programs and plans such as the Lisbon Strategy, e Europe+ initiative, which aims at bringing modernization and reform in the economies of the candidate and accession countries in Europe , encouraging capacity building to establish information societies (EC, 2004), Turkey has a chance to define its national and international priorities in providing the environment for new economy.

Turkey has recently started e-Transformation Turkey Project which put a vision as “to be a country that has become a focal point in the production of science and technology, that uses information and technology as an effective tool, that produces more value with information-based decision-making processes and that is successful in global competition, with a high level of welfare” (SPO, 2006). The Ninth Development Plan (2011) has also been prepared with similar regard “Turkey, a country of information society, growing in stability, sharing more equitably, globally competitive and fully completed her coherence with the European Union”

The goals and objectives of innovation and ICT policies have been covered in various official reports in Turkey. Information Society Report (2010) has counted on seven strategic priorities:

- Provide ICT opportunity for all the citizens and encourage them to use ICT tools in their daily activities and business,
- Create competitive advantage to businesses through ICT,

- Implement public administration reform supported by ICT,
- Achieve globally competitive IT sector that is active as an international player,
- Promote competitive, widespread and affordable telecommunications infrastructure and services.

In the Ninth Development Plan (2011) these qualitative objectives listed above have been supported with qualitative objectives which are expected to be achieved by 2012-2013:

- GERD/GDP increased from 0.67% in 2002 to 2% in 2013,
- Number of full-time equivalent R&D personnel increased to 80 000 in 2013 (from 23 995 in 2002),
- Mobile telephone subscriber penetration rate rose from 64% to 90% between 2006-2013,
- Broadband subscriber penetration rate increased from 3.5% to 20% in the 2006-13 period,
- Internet user penetration rate rose to 20% from 2006 to 60% in 2013.

Supreme Council for Science and Technology in 2004 defined the main goals of the new science and technology strategy as increasing (a) the demand for R&D; (b) the number and quality of scientists, and vocational and technical staff; (c) the Gross Domestic Expenditures in R&D (GERD) as a percentage of GDP, has set two targets (a) To increase GERD/GDP ratio from 0.53% in 2002 to 2% by 2013 (b) To rise the number of full-time equivalent (FTE) researchers from 28,964 in 2002 to 150,000 by 2013.

Now, the challenge for Turkey is to increase levels of outputs from science and technology and to transform research results into innovation and viable business opportunities for the benefit of the society and economy. weaknesses in the ICT environment are the result mostly of restrictions that limit supply and raise costs. (WB 2004; SOP 2006)

The Ninth Development Plan (2007-2013) also highlights the weaknesses in university-industry links. The plan states that the weak links between knowledge producers and knowledge users hamper the transformation of R&D results into commercial values or lead to research activities which do not respond to the needs and demands of industry.

Having various policy bodies on innovation and R&D such as SCST (the Supreme Council of Science and Technology), TUBITAK (the Scientific and Technical Research Council of Turkey (operational arm of the Supreme Council), KOSGEB (the Small and Medium-Size Industry Development Organization),SPO (the State Planning Organization), Turkish has been considered to acquire an industry with significant innovative dynamism according to the result of Innopolicy survey (2009) conducted by European Commission.

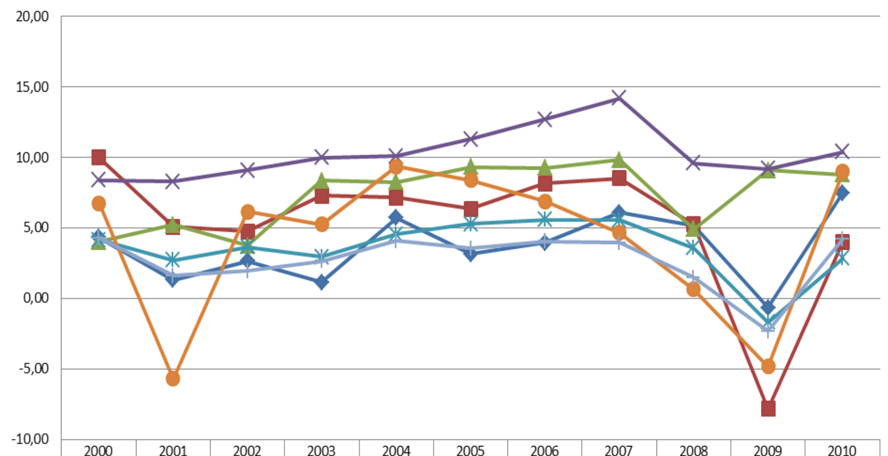
To sum up, this chapter has addressed main features of emerging markets that distinguish them from advanced countries. Along with the global KBE trends mentioned in chapter two, it is shown that BRICST countries are challenging the position of advanced countries in terms of transforming into new economy.

BRICST have already put KBE in their national agenda by defining national policies, long term goals on science and technology field. The main reason why we think that BRICST have both the potential to become important and reasonable chance of being knowledge-based markets and absorbing the opportunities that come with this economy based some common characteristics of each countries they share, although the political, social and economic dynamics of these countries are different from each other: (1) have rapid growth rate which is the line with the dynamic nature of ICT sector. (2) take advantage of evolving technologies and dealing with the economic crisis more successfully than advanced countries by focusing on their intangible sources, (3) embrace young and innovative human capital.

On the other hand, there are some obstacles that hinder the success of BRICST : (1) lack of technology infrastructure, (2) weak the education system that encourages innovation activities and improve the skills of people in producing and sharing knowledge, (3) lack of support for international FDI and private firms, (4) insufficient dissemination and application of knowledge and technology within the country. There are still some discrepancies between rural and urban areas in accessing to ICT tools and services. (5) lack of consistent economic and regulatory regimes.

It is well understood that economic indicators are not synonymous with welfare and not suited to catch all dimensions of economic growth, such as environmental or social concerns. However, consumption possibilities are an important aspect of welfare, and income growth usually raises sensitivity to environmental and social issues and KBE leads to an increase in the quantity and quality of the pool of knowledge available for economic production in any country. This in turn brings more productivity and, thus, economic growth (Chen & Dahlman, 2004). Moreover, the estimation of World Bank (2008) has shown that the higher the level of knowledge accumulation the higher the economic growth. So in these contexts, growth rate of GDP can provide useful insight to analyze the performance of countries in terms of establishing KBE.

One of the common macroeconomic indicator that is used for examine the impact of KBE on given country is annual percentage growth rate of GDP and as GDP per capita, the most widely accepted indicators.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	4,31	1,31	2,66	1,15	5,71	3,16	3,96	6,09	5,16	-0,64	7,49
Russia	10,00	5,09	4,74	7,30	7,18	6,38	8,15	8,54	5,25	-7,81	4,03
India	4,03	5,22	3,77	8,37	8,28	9,32	9,27	9,82	4,93	9,10	8,81
China	8,40	8,30	9,10	10,00	10,10	11,30	12,70	14,20	9,60	9,20	10,40
S.Africa	4,15	2,74	3,67	2,95	4,55	5,28	5,60	5,57	3,58	-1,68	2,84
Turkey	6,77	-5,70	6,16	5,27	9,36	8,40	6,89	4,67	0,66	-4,83	9,01
World	4,28	1,63	1,96	2,66	4,09	3,55	4,06	3,96	1,49	-2,33	4,21

Figure 7.Real GDP growth rates (%) from 2000 to 2010 ,(WB,2012)

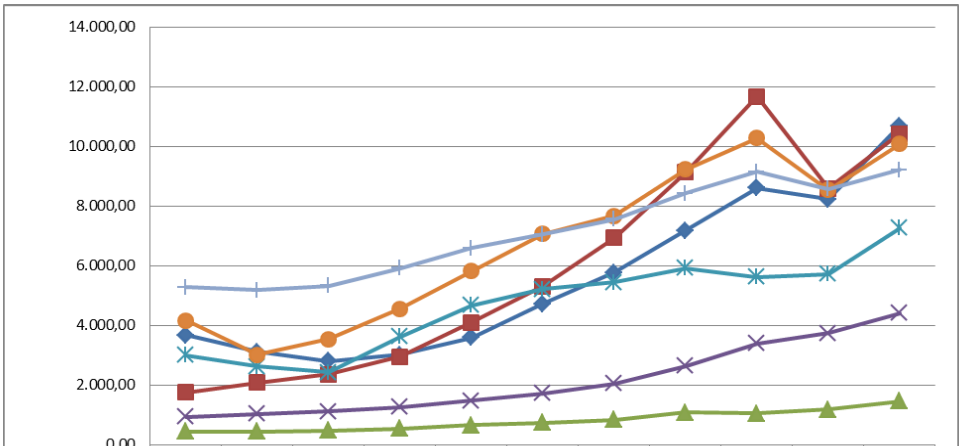
The figure 7 above displays the growth rate of BRICST with reference to world average from 2000-2010. Due to the global crisis in 2009, financial conditions have deteriorated for all economies. However, BRICST are able to more rapidly recover from this downturn than developed countries.For example; the growth rate of emerging countries jumped from -1.82% to 7.38 % in 2010,whereas in the same year growth rate of developed countries increased from -3.47% in 2009 to 2.56 % in 2010.

From 2000 to 2010, China has possessed the highest and sustainable growth rates. By 2007, China ranked among the four largest economies in the world in terms of total GDP. While the growth rates of Brazil, S.Africa, Russia, and Turkey have plummeted sharply in 2009, China displayed 9.20 % GDP growth followed by India in the same year. Due to superior performance of India and China, emerging Asia is forecasted to post strong growth of nearly 8% in 2011 (IMF, 2011).

In 2010, Brazil, Turkey, and Russia are the countries that recovered from the unstable phase most rapidly compared to China, India and S.Africa. Even though the global crisis of 2009 hit strongly the economies of Central and Eastern European (CEE) region, thanks to outstanding performance of Turkey, IMF has estimated the GDP growth of emerging countries in CEE region as about 6 percent for 2012.

South Africa, on the other hand, is showing the least growth but also it has least affected from the financial turmoil after China and India and Brazil in 2009 (decreased from 3.58 % in 2008 to -1.68%). Nonetheless, S.Africa has given significant progress in general; real GDP growth of South Africa has reached 2.95% in 2003 and is estimated 4.55% in 2004 and has amounted to 5.57 % before 2008. According to the Accelerated and Shared Growth Initiative for South Africa (ASGISA), a policy framework put forward in late 2005 by the S.Africa's government, the growth rate will be 6% between 2010 and 2014.According to latest report of IMF (2011), the growth rate for BRICST will be: Brazil and S.Africa will have 3.6 % , India 7.5%, Turkey 2.2% and Russia 4.1% real GDP in 2012. In short, in the year of economic turmoil all the countries have affected negatively, however, BRICST countries manage to grow with higher rate than the world average and advanced countries as well.

In terms of knowledge-based economy, GDP per capita which reflects average welfare of citizens in given country, is also significant indicator to find out to what extent countries can benefit from goods and services of information technology. The level of access to ICT can differ across income groups (Mocˇnik& Širec 2010) which also indicates the degree of digital divide in given country (Chinn &Fairle,2007).Moreover, it is confirmed that there is positive relationship between the use of technology and income across countries and within countries (OECD 2001; Quibria et al. 2003 ;Vu 2011). That is to say, the higher income of the nation, the higher share of ICT services in country's total development and GDP.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	3.696,15	3.129,76	2.812,33	3.041,68	3.609,88	4.743,26	5.793,40	7.197,03	8.627,99	8.251,06	10.710,07
Russia	1.775,14	2.100,74	2.375,16	2.976,14	4.108,57	5.337,07	6.946,88	9.146,42	11.700,22	8.614,67	10.439,64
India	452,97	462,82	483,66	563,19	668,30	761,97	857,21	1.104,59	1.066,69	1.192,08	1.474,98
China	949,18	1.041,64	1.135,45	1.273,64	1.490,38	1.731,13	2.069,34	2.651,26	3.413,59	3.748,93	4.428,46
S.Africa	3.019,95	2.638,16	2.439,99	3.647,70	4.695,04	5.234,58	5.468,30	5.930,07	5.641,76	5.733,04	7.275,34
Turkey	4.189,48	3.036,73	3.553,07	4.567,50	5.832,69	7.087,72	7.687,13	9.246,03	10.297,51	8.553,74	10.094,03
World	5.302,91	5.204,91	5.343,34	5.939,22	6.615,45	7.069,64	7.576,75	8.449,11	9.168,03	8.588,28	9.227,95

Figure 8. GDP per capita for BRICST 2000-2010 (WB, 2012)

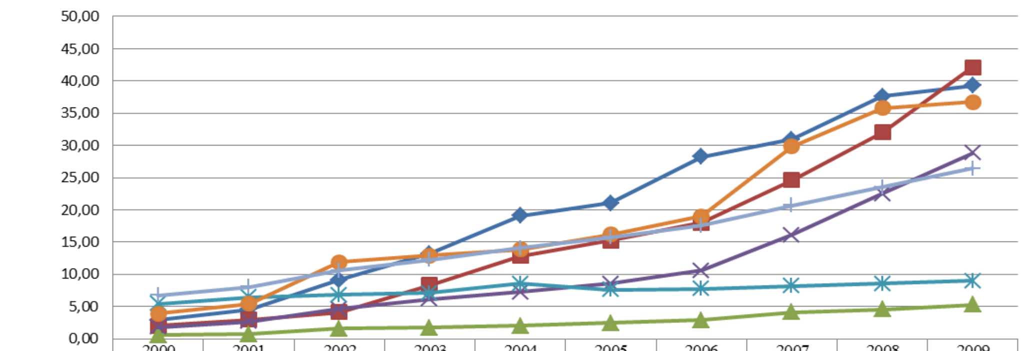
The data concerning GDP per capita is examined the year of 2002 was bounce point for BRICTS countries and their rates have continued to increase since then except for 2009 and if we exclude Brazil, it can be said that countries are showing similar progression.

In the context of data presented in figure 8, it is mentioned that increase in per capita is 50% in S.Africa, 29 % in Turkey and 25% in Russia from 2002 to 2003.India is the only country that displayed highest increase in crisis period (11% in 2008-2009) and Russia's per capita shrunk highest with the rate of -26.3% (from 11700 $ to 8164$).

Turkey has the highest GDP per capita among BRICS countries with average 6740.51$ per year between 2000-2010.According to recent projection of Goldman Sachs (2010), China and India will particularly experience fastest GDP per capita growth rates but BRICs will remain below those of developed countries.

ICT tools such as internet, mobile phone, personal computers and any other devices that enable individuals and business to reach technology, play an important role in achieving socio-economic development of BRICST countries. More and high-quality ICT infrastructure is necessary not only to create network societies-establish and maintain connections among citizens, organizations- but also attracts foreign investment, provides opportunities for innovative learning and education, which in return increases productivity and growth. As it has been stated in the G-8's Digital Opportunity Task Force Report (2001), ICT-enabler of development-when wisely applied, it brings various offers to narrow social and economic inequalities and support sustainable local wealth creation and thus help to achieve broader development goals.

The number of internet users is important factor in KBE in the sense that it demonstrates how new technologies have diffused throughout the economy and the Internet has also been at the heart of increasing of ICT investment, by making possible an increase in the quality and functionality of existing ICT (OECD, 2001 2010; 2011)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	2,87	4,52	9,14	13,20	19,07	21,03	28,21	30,94	37,60	39,30
Russia	1,98	2,95	4,13	8,30	12,86	15,23	18,03	24,63	31,98	42,09
India	0,54	0,68	1,58	1,74	2,04	2,47	2,90	4,09	4,54	5,31
China	1,78	2,65	4,62	6,17	7,25	8,58	10,60	16,13	22,50	28,84
S.Africa	5,45	6,44	6,81	7,12	8,57	7,63	7,75	8,22	8,58	8,96
Turkey	3,93	5,42	11,89	12,89	13,85	16,15	19,04	29,86	35,82	36,76
World	6,73	8,05	10,55	12,24	14,06	15,76	17,54	20,66	23,48	26,42

Figure 9.Internet users (per 100 people) in the world and BRICST from 2000 to 2009 (WB,2012)

According to Euro Monitor (2011), the number of internet users in emerging economies grew by 177 % between 2005 and 2010 and reached 954 million people compared to 26.7% increase in advanced economies during the same period. Also, it was estimated that these countries would grow by annual average rate of 9.8% between 2011-2020 and reach 2.2 billion by the end of that period.

When we focus on our selected economies, the figure 9 demonstrates their rapid progress on internet usage. Between 2001-2002, internet users in Brazil (102.1%), India (133.2%) and Turkey (119.3%) increased by more than 100 % .In average, Turkey (18,56) has the highest number of internet users per 100 people after Brazil (20,58). Russia (16,21), on the other hand, is shows the most stable rise between 2000-2009 due to the fact that price of broadband access is cheaper in Russia than other BRICST. Russia is one of the first to adopt the Internet.

India is starting from a very low base (2,58 average users per 100 people) and as the graph above shows, India lags behind in internet usage among the other countries. After its prominent rise with more than 100%, it was unable to follow the similar trend with Brazil, Russia and Turkey.

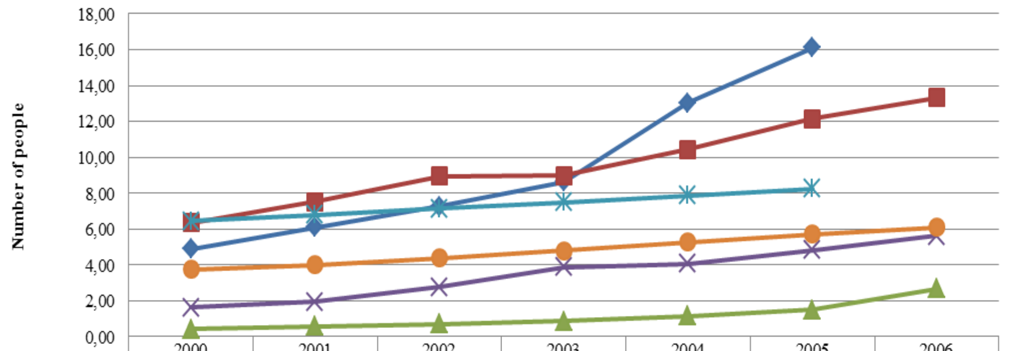
However, India is expected to see the fastest growth in internet users between 2011-2020, with a rate of 22.1 % per year (Euromonitor,2011).Indian Government has also moved towards ''information age'' and ''convergence'' by announcing enabling policies toward development with the goal of ''Internet for All''

In terms of South Africa, it has more internet users per 100 people than India. But, on the other hand, poor educational standards as well as the very high access cost to ICT prevailing in the country, South Africa ranks below among the other emerging countries. In addition government readiness weak with little success in promoting ICT (WEF, 2011).These can be reasons behind the low rate of internet usage in S.Africa.

Number of internet users in China is showing relatively stable pattern until 2006 and after that it reaches 16,13 per 100 people with nearly 52.17 % increase. According to BCG report (2010), between 2007-2009 China's current 384 million internet users represent only 28% of China's population. Although China has a great number of Internet users and a fast expansion speed, the overall penetration of the Internet is still quite lower.

Number of internet users doubled over the last five years. Growth rate for emerging countries are high which is largely driven by China, India, Brazil and Russia while the mobile subscription has saturated in developed countries. Emerging countries have also showed rapid increase with a rate of 20% which so called mobile miracle (ITU, 2011).

Together with internet, the level of development in ICT is an significant factor in the diffusion of internet however, another prerequisite is personal computers (per 100 people) which refers to the number of computers designed to be used by a single individual and is an indicator of personal computer penetration and use of new technology for information processing (WB, 2004).



	2000	2001	2002	2003	2004	2005	2006
Brazil	4,88	6,11	7,26	8,62	13,05	16,12	
Russia	6,34	7,53	8,94	8,99	10,43	12,15	13,33
India	0,44	0,57	0,70	0,86	1,17	1,50	2,69
China	1,63	1,96	2,76	3,89	4,06	4,84	5,61
S.Africa	6,46	6,81	7,14	7,50	7,88	8,25	
Turkey	3,76	4,00	4,39	4,81	5,27	5,72	6,10

Figure 10.Personal computers (per 100 people) in BRICST from 2000 to 2006 (WB, 2012)

When looking at the average for each country between 200-2007 by referring to data presented in figure 10, Russia and Brazil perform the best with rapid increase for each year. As it was observed in the previous indicators, Russia (8.46) and Brazil (7.01) have also highest numbers of PC per 100 people on average. This can be interpreted that the more internet users per 100 people the more PC owners in Brazil and Russia or vice versa. However, the fact about Brazil is that fixed-line broadband is much expensive-average 27$ per month and only 12 million Brazilians can provide fixed-line whereas 9 million of those use dial-up. This means that only one third PC owners have an internet connection (BCG, 2010).

Although there are less than four PC for every 100 people in India (1,39) and China (3,09), which are less than that of S.Africa (5,51) and Turkey (4,26), because of the high population density in these countries, Forrester has estimated (2007) that nearly 500 million new PCs will be in use in China alone and India will add another 157 million by 2015. Whereas the same rate is about 277 million for US , 96 million for Japan and 97 million for Western Europe.

Along with the modernization of ICT infrastructure, development of innovation capability is also required in order to achieve successful transition to knowledge based economy. One of the way to understand how a country performs in terms of achieving knowledge-economy is to look at amount of human capital they put into. Because one of the four pillars of knowledge-based economy is effective innovation system of firms, universities and other organizations that can follow up knowledge revolution, tap into the growing stock of global knowledge and adapt it to local needs (World Bank 2008 ; Chen& Dalhman 2005). Some research has also been conducted on innovations and R&D that lead to new technologies, ultimately resulting in increases in output per capita (Lederman &Maloney 2003; Wong et.al 2005). The application of knowledge in areas such as entrepreneurship and innovation, R&D, software and product design, and in people's education and skill levels, is now being recognized as one of the key sources of growth in the global economy (Chen& Dahlman, 2005).

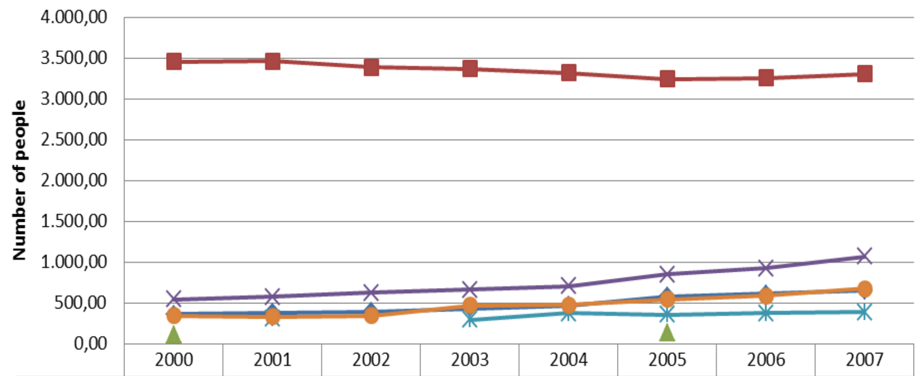
One of the way to understand how a country performs in terms of achieving knowledge-economy is to look at amount of human capital they put into.

It is observed from the figure 11 that Russia has the highest level of R&D personnel (3304,72 per million people) of all the other emerging countries; total number of people in Brazil, China, S.Africa and Turkey (2801,05 per million people) stay below that of Russia in 2007. Also, in terms of absolute number of R&D personnel, Russia is counted among the world leaders after USA and Japan (UNESCO, 2010). It is the fact that apart from the energy sector, Russia has a comparative advantage human capital intensive sector (Algieri&Calabria 2006; OECD 2007).The main is that Russian government provides suitable environment for innovation and R&D studies such as developing legislation system, governmental support to regional innovation development agencies, increasing availability of financial resources all of which lead Russian economy to more innovative direction (Cooper,2006).

In the period of 2004-2005 number of R&D personal increased most 24% in Brazil, in China among the same period 20 % and in Turkey the highest rate is approximately 34.2% in the period of 2002-2003 and show similar trend with Brazil in general. But in case of Russia the maximum rate of increase is only 1.43% between 2006 and 2007. Although GERD/GDP of South Africa is higher than Turkey, it has lowest number of R&D personnel among other countries if we exclude India due to lack of data.

The overall growth pattern of R&D personal prevailed low. The main reasons-as many studies (ie; Indjikian& Siegel 2005; Gryczka 2010; Fu et al. 2011; Kaartemo 2009) and international institutions such as WB, OECD, UNESCO have indicated-are: high level corruption, problems with intellectual property protection, gross income inequality between rural and urban areas, all of which hinder the increase in the number of R&D personnel in BRICS countries excluding Turkey and

S.Africa. Thus, these are the common obstacles BRICS countries need to tackle immediately in order to have successful knowledge based economy.

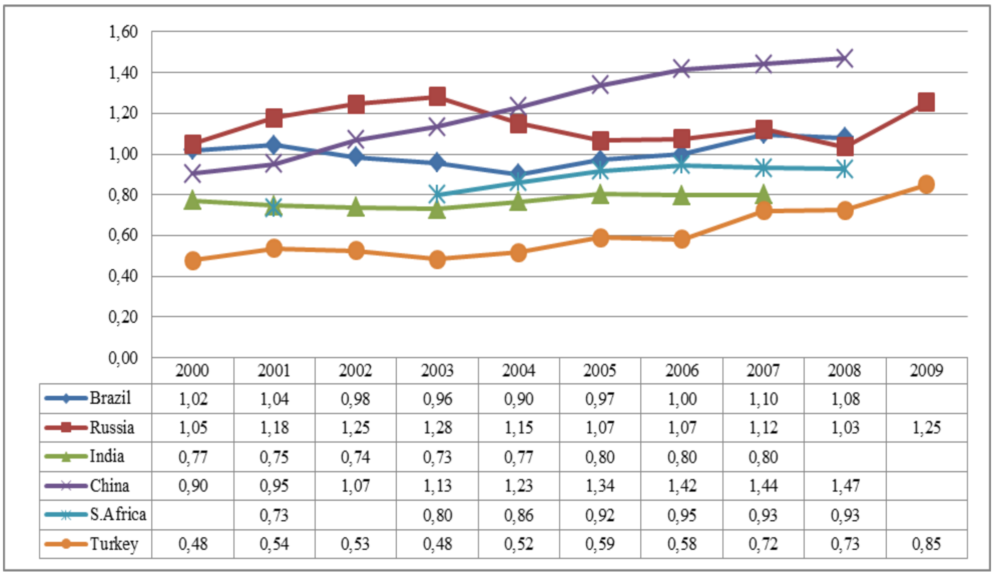


	2000	2001	2002	2003	2004	2005	2006	2007
Brazil	367,46	383,69	400,87	436,83	472,81	588,04	620,06	656,86
Russia	3.452,79	3.463,25	3.384,80	3.371,25	3.320,13	3.244,94	3.257,95	3.304,72
India	111,20					136,94		
China	548,61	581,76	630,28	665,75	710,50	852,50	926,58	1.070,94
S.Africa		311,45		301,63	377,33	359,93	381,85	392,90
Turkey	347,32	336,60	350,81	471,08	482,22	549,94	591,83	680,35

Figure 11.Number of R&D personnel in BRICST from 2000 to 2010

Lastly, Gross domestic expenditure on research and development (GERD) which is total intramural expenditure on research and development performed on the national territory during a given period, The world spent nearly 1.7% of GDP to R&D in 2007 and this rate has remained stable since 2002 whereas in China it has climbed by 50% since 2002 to 1.54% and its ratio has exceed all the other countries by 2008 with 1,47 %.This demonstrates that China not only contributes to global GDP with high growth rates but also enriches the global GERD. Along with China, large emerging developing countries such as Brazil, India, Mexico and South Africa are also spending more on R&D than before (UNESCO, 2010).

According to figure 12, in the period of 2002-2008, GERD in Brazil has increased by just 10%, from 0.98% to 1.09% of GDP. Over the same the federal government announced plans to raise the GERD/GDP ratio to 1.5% by 2010 (MCTI, 2007).Turkey spends least of GDP on R&D among the other countries. But when we consider its performance only, GERD /GDP has increased more than 75 % (0.48 % in 2000 and 0.85% in 2009). TUBITAK (2009) is estimated that Turkey's GERD/GDP ratio is to nearly rise from 0.53% in 2002 to 2.0% by 2013.South Africa stands as third country after Russia and China with high GERD/GDP ratio (0.93% in 2009).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	1,02	1,04	0,98	0,96	0,90	0,97	1,00	1,10	1,08	
Russia	1,05	1,18	1,25	1,28	1,15	1,07	1,07	1,12	1,03	1,25
India	0,77	0,75	0,74	0,73	0,77	0,80	0,80	0,80		
China	0,90	0,95	1,07	1,13	1,23	1,34	1,42	1,44	1,47	
S.Africa		0,73		0,80	0,86	0,92	0,95	0,93	0,93	
Turkey	0,48	0,54	0,53	0,48	0,52	0,59	0,58	0,72	0,73	0,85

Figure 12: GERD (% of GDP) in BRICST from 2000 to 2010 (WB, 2012)

Although Russia seems to display closer trend to China, Russia's ERD/GDP ratio of 1.03% (2008), this is lower than in 2007 (1.12%) and from 2000 to 2009, it has volatile ratio. India's GERD has also risen only slightly between 2000 and 2007, from 0.77% to 0.80% of GDP, despite to the fact that it was aimed at increasing India's overall GERD from 0.73% of GDP in 2003 to 2.0 % of GDP by the end of 2007 according to Tenth Five-Year Plan.

CHAPTER IV

KNOWLEDGE BASED ECONOMY INDICATORS

Since KBE can be defined in various ways, it is hard to measure and describe common methodologies, measurement indices in context of science, technology and innovation.

Traditional economic indicators such as GDP growth (annual %), trade in services (% of GDP), Foreign direct investment, net inflows (BoP, current US$) are not sufficient due to the fact they might fail to recognize economic performance beyond the aggregate value of goods and services. Knowledge itself is difficult component to quantify and calculate its market value. Unlike other economic inputs (land ,labor), knowledge has no fixed capacity, it shows more rapid change in that sense it tends to be obsolete in a short period of time.

According to OECD (1996) the main reasons that cause difficulties in measuring knowledge are:

(a) There are no stable formula for translating inputs into knowledge creation into outputs of knowledge.

(b) There are no knowledge accounts analogous to the traditional national accounts.

(c) Knowledge lacks a systematic price system.

(d)New knowledge creation is not necessarily a net addition to the stock of knowledge.

Therefore, analyzing the relation between knowledge and economic performance can be challenging task in current economic context.

The first attempt for the development of a framework in order to interpret of data relating to science, technology and innovation has been made by OECD. It has prepared manuals for measuring knowledge inputs mostly emphasis on input measures of R&D expenditures and human resources, aimed at informing policy makers about the scope and limitations of innovation activities and allow countries to conduct international comparisons on knowledge based economy. Oslo Manual summarizes new theories regarding innovation and making its worldwide application possible for the measurement of innovation (Carvalho,2006). Thus, a more direct measurement of innovation is made possible (Archibugi,1988; Tether,2001).

Under the light of this manual, the first tool to identify innovation and benchmark innovation performance between sectors and countries has been made by the introduction of European Community Innovation Survey (CIS) which was developed in 1992 with collaboration of European commission and OECD and it has been widely used since then. The first version was limited to innovation activities of manufacturing sector within particular countries. With its updated versions CIS II (1994), CIS III (1999) and CIS IV (2001),CIS 2006 and CIS 2008.It embraces telecommunication and services sectors by expanding the number of countries conducting their innovation assessment with CIS. For instance, in Turkey CIS is used by minor changes in its general format. However, CIS has been criticized in the sense that it approaches the definition of innovation in narrower perspective and therefore it prevents the generation of obtained results (Carvalho, 2006). Secondly, CIS is more concerned about the measurement of inputs and outputs within a particular firm rather than dynamics that create the innovation and therefore it is claimed to be unreliable tool to collect information about the dynamics and the actual process of innovation (Salazar & Holbrook, 2003).

Table 6.List of OECD Manuals (OECD,1996)

Knowledge Economy Indicators	Manuals
R&D expenditures	Frascati Manual (1993)
Technology balance of payments	TBP Manual 1990
Innovation	Oslo Manual 1992 (revised in 2005)
Patent	Patent Manual 1994
Human Resources	Canberra Manual 1995

Following these developments, OECD has formed Science and Technology Scoreboard that was first introduced in 1999 and since then it serves as generally-accepted framework including indicators which measure innovative performance and other related outputs of knowledge-based economy (i.e. investment in intangibles, the weight of knowledge-based industries across countries, the role of ICT and expenditures on science and technology) and with its recent version, it allows policy makers to understand the trends in KBE and make comparisons among OECD and major non-OECD countries particularly Brazil, Russia, India, Indonesia, China and South Africa by using over 180 indicators.

Along with OECD, many other institutions such as UNESCO, World Bank, ITU, Eurostat and United Nations have introduced a range of indicators are widely use to analyze country's potential for knowledge-based economy. Since it is not feasible to rely on one single method or indicator to assess and conceptualize the knowledge asset, various of measurement tools are available in the literature allow us to benchmark the performance of countries in terms of their capabilities and efficiency in transforming into KBE. The following sections cover the review of some popular indices developed by international institutions and scholars.

World Bank's Knowledge Assessment Methodology and Scorecards

One of the earliest experiment in development of indices for the new economy has been made by World Bank through launching a project entitled "Knowledge for Development" (K4D) which aims at not only providing a standard assessment of countries' readiness for knowledge economy, that is called Knowledge Assessment Methodology (KAM), but also identifying sectors or specific areas where policy makers may need to pay more attention for future investments as well as opportunities for making the transition to the knowledge economy and encouraging economists to combine global and local knowledge in order to accentuate comparative advantages (World Bank, 2008).

Comparisons in the KAM are made on the basis of 83 structural and qualitative variables that serve as proxies for the four knowledge economy pillars (table 7) and 140 countries can be compared which include most of the OECD countries and 100 developing countries.

According to KAM framework, a country's economic and institutional regime must provide incentives for the efficient use of existing and new knowledge through educating its people and enabling them to create and share knowledge. In order to fulfill this requirements, information infrastructure is needed to promote the effective communication and processing of information and the education system is expected to be capable of assimilating and adopting knowledge to local needs and creating new technology.

Table 7.Four Pillars of Knowledge Assessment Measurement (WB,2012)

Pillars	Indicators
Economic and institutional regime	Tariff and non-tariff barriers Regulatory quality • Rule of law
Education and skill of population	• Adult literacy rate • Gross secondary enrollment rate • Gross tertiary enrollment rate
Information infrastructure	Telephones per 1,000 people • Computers per 1,000 people • Internet users per 1.000 people
Innovation system	• Royalty payments and receipts, US$ per person • Technical journal articles per million people • Patents granted to nationals by the U.S. Patent and Trademark Office per million people

Through KAM, Knowledge Economy Index (KEI) has been derived to present a broad measure of general level of preparedness of countries for the knowledge economy. The KEI which is prepared as average of the normalized values of those indicators, from 0 to 10 (close to 10 implies relatively good development of the four knowledge),summarizes each country's performance on variables it corresponds in the four knowledge economy pillars and serves as the indication of overall potential for knowledge development in a given country. Besides the combination of last three pillars have brought the Knowledge Index (figure 13).

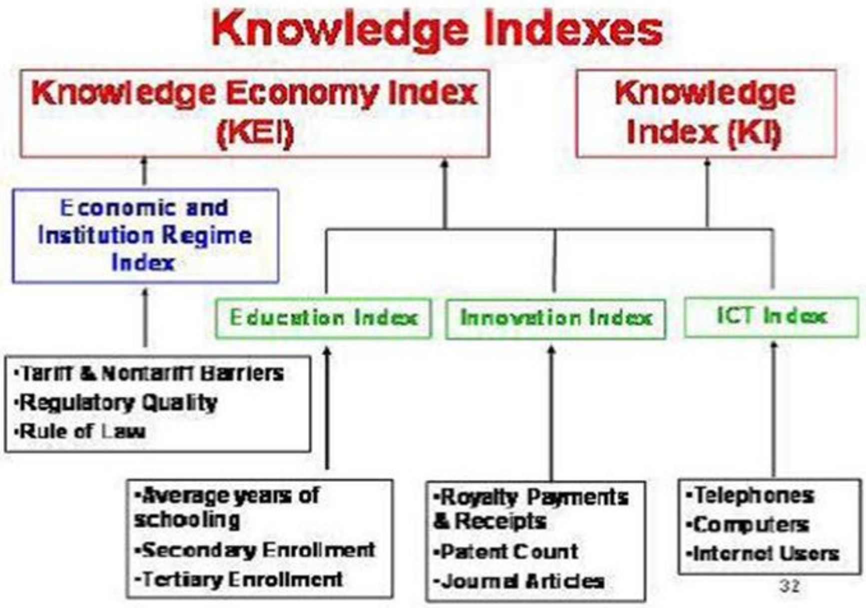


Figure 13.World Bank knowledge indexes framework (WB,2012)

According to KEI (2012), Sweden is ranked as the most advanced knowledge economy followed by Denmark, Finland and Netherlands , all of which have also possessed the highest scores for other sub-indices. United States falls behind these countries and Its KEI has fallen from 1st place in 1995 to 12th position in the current 2012 ranking.

Although they still have lower scores compared to other countries, BRICST countries show higher improvement in their position. Russia has climbed 3 positions and India has risen 4 positions compared Brazil while China moved up 18 positions to come in second in the list of gainers in KEI rankings .On the other side, Turkey has obtained 12 position in general score and 35 position in innovation rank in the period of 1995-2008 (WB, 2008).Within BRICST countries, Turkey have the higher economic incentive regime index which indicates the business environment for innovation and technology activities is much more suitable than other emerging countries in the table. The EIR is Brazil's weakest pillar mainly because of relatively high trade barriers. KEI of India falls 6 spots to 110 in the 2012 KEI rankings. In terms of innovation index, China, Russia, India, Turkey and Brazil display highest change in their position from 1995 to 2012.

Table 8. Knowledge Economy Index (KEI) —Top Counties and BRICST in 2012 (WB,2012)

Rank	Countries	KEI	KI	Economic Incentive Regime	Innovation	Education	ICT
1	Sweden	9.43	9.38	9.58	9.74	8.92	9.49
2	Finland	9.33	9.22	9.65	9.66	8.77	9.22
3	Denmark	9.16	9.00	9.63	9.49	8.63	8.88
4	Netherlands	9.11	9.22	8.79	9.46	8.75	9.45
5	Norway	9.11	8.99	9.47	9.01	9.43	8.53
6	New Zealand	8.97	8.93	9.09	8.66	9.81	8.30
7	Canada	8.92	8.72	9.52	9.32	8.61	8.23
8	Germany	8.90	8.83	9.10	9.11	8.20	9.17
9	Australia	8.88	8.98	8.56	8.92	9.71	8.32
10	Switzerland	8.87	8.65	9.54	9.86	6.90	9.20
11	Ireland	8.86	8.73	9.26	9.11	8.87	8.21
12	United States	8.77	8.89	8.41	9.46	8.70	8.51
13	Taiwan, China	8.77	9.10	7.77	9.38	8.87	9.06
14	United Kingdom	8.76	8.61	9.20	9.12	7.27	9.45
22	Japan	8.28	8.53	7.55	9.08	8.43	8.07
23	Singapore	8.26	7.79	9.66	9.49	5.09	8.78
55	Russian Federation	5.78	6.96	2.23	6.93	6.79	7.16
60	Brazil	5.58	6.05	4.17	6.31	5.61	6.24
67	South Africa	5.21	5.11	5.49	6.89	4.87	3.58
69	Turkey	5.16	4.81	6.19	5.83	4.11	4.50
84	China	4.37	4.57	3.79	5.99	3.93	3.79
110	India	3.06	2.89	3.57	4.50	2.26	1.90

World Bank (2008) mentions that correlation between accumulation of knowledge, which is indicated by KEI, and economic development is high (87 %). So, it is assumed that countries with high KEI scores, display high level of economic development or vice versa. Statistically significant causal relationship between the level of knowledge accumulation and future economic growth has also been confirmed (one unit increase in the KEI score or 13 position in the rankings leads to an increase of 0.49 % points in economic growth. The estimation of World Bank confirms the growing presence of knowledge in economic growth process.

ICT Development Index (IDI)

The ITU (2009) presents the ICT Development Index (IDI) to benchmark information society developments which go through different stages by taking into consideration technology convergence and the emergence of new technologies (ITU, 2009). The IDI is a composite index made up of eleven different indicators, grouped into three sub-indices as shown below: ICT infrastructure and access (sub-index access), ICT use and intensity of use (sub-index use), and the capacity to use ICTs effectively (sub-index skills). Table 9 summarizes the components of IDI.

Table 9.ICT Development Index (IDI) Sub-Indicators (ITU,2009)

Sub-Indicators and their weights on the IDI	Indicators
ICT access (40%)	1. Fixed telephone lines per 100 inhabitants 2. Mobile cellular telephone subscriptions per 100 inhabitants 3. International Internet bandwidth (bit/s) per Internet user 4. Proportion of households with a computer 5. Proportion of households with Internet access at home
ICT use (40%)	6. Internet users per 100 inhabitants 7. Fixed broadband Internet subscribers per 100 inhabitants 8. Mobile broadband subscribers per 100 inhabitants
ICT skills (20%)	9. Adult literacy rate 10. Secondary gross enrolment ratio 11. Tertiary gross enrolment ratio

A country's transformation to information society can be achieved through following three-stages: ICT readiness (level of networked infrastructure and access to ICTs), (2) ICT intensity (level of ICT usage in society), (3) ICT impact (outcome of effective ICT use). In that sense, how country can achieve this transformation process depends on its ability to combine the ICT sub-indexes listed above. Therefore, high score for IDI index can be interpreted as an remarkable success factor for country's position in KBE.

Similar to the results of KAM, the top countries according to IDI are from Europe particularly Nordic states, Sweden Iceland, Denmark, Finland and Asia. The reason why most of the European countries in general have similar performance is based on the fact they are required to follow common set of policies in order to achieve national Europe 2020 targets. In terms of Asia, as we have seen, they are main ICT-technology exporters in the world.

Korea-holds highest mobile broadband penetration worldwide (90%)- and Sweden-90 % of its population use internet- are described as the best performers due to the fact that they exhibit high values in indicators both absolute and relative terms and therefore, they are able to make ICT as the engine of economic growth (ITU, 2009).

The position of United States, Japan and most of European countries i.e. Switzerland, United Kingdom, Germany, Hungary, France, Belgium remains stable. Emerging countries have shown little or no improvement as well. However, countries' performance vary from each other when looking into sub-indices. For instance; Russia has lost 2 positions in IDI ranking moving from 49th to 47th.But it is able to improve its performance in ICT access and use. Brazil shows improvement in its IDI value because of the changes in its access sub-index.

IT industry competitiveness index (IT-CI)

Parallel to KEI of World Bank, IT industry competitiveness index (IT-CI) by Economic Intelligence Unit (2009),which allows to compare countries according to their possession of the conditions that are necessary to support a strong IT industry, is based on six categories of indicators (table 10) and composes both qualitative assessment (scored on a 1 (least)-5 (most) basis) and qualitative indicators which are normalized through the population and the composite score for each country is also based on an index range of 0 to 100 (the highest and best possible score).

Table 10.Dimensions of IT Industry Competitiveness Index (IT-CI) (EIU,2009)

Categories	Weights
1.Overall business environment	10%
2. IT infrastructure	20%
3.Human Capital	20%
4.Legal Environment	10%
5.R&D Environment	25%
6. Support for IT industry development	15%

IT industry index 2011 scores United States remains the world's most conducive environment for the development and growth of IT firms and is followed by Finland, Singapore, Sweden and United Kingdom.

BRICST countries have maintained slow but steady performance. Turkey has reached the position of 41st in the world (46th in 2009) This increase comes from the improvement in human capital and the R&D environment. In this country bloc, it holds the best business environment for IT firms. China improved one position (38th in 2012 ; 39th in 2009) due to improvements in its business environment, IT infrastructure and IT human capital scores (EIU,2012). Russia (46th) has fallen back several places due mainly to a decline in scores for R&D environment however compared to BRICST countries, it displays strong IT infrastructure and Human capital .In China and India, the legal environment for intellectual property rights are expected to be improving.

Technology Achievement Index (TAI)

Different from other indices mentioned above, Technology Achievement index (TAI) which is originally developed in 2002 by Desai and others provides how well a country is creating and diffusing technology and building a human capacity in order to encourage them to participate in the technological innovations of new global economy. This index measures achievement effort or inputs. It is not a measure of which country is leading in global technology development, but rather focuses on how well the country is involved in creating and using technology (UNDP,2001). It is useful index in the sense that it allows countries to assess their relative technology readiness in comparison with their competitors for participation in the global knowledge based economy (Nasir et.al, 2009).

TAI which consists of four dimensions of technological capacity (table 8), only gives a rough summary of a society's technological achievements due to the difficulty of capturing whole potential of countries to contribute innovation and technology. Moreover, its first publication, TAI-02, was limited to rankings of 72 countries whereas the recent study in 2009 (TAI-09) has covered 91 countries.

Table 11.Dimensions of Technology Achievement Index (Desai et al.,2002)

TAI sub-index	Indicators
Creation of technology (TC index)	Patents granted per capita Receipts of royalty and license fees from abroad per capita
Diffusion of recent innovation (DRI index)	Internet hosts per capita High- and medium-technology exports as a share of all exports
Diffusion of old innovations (DOI index)	Telephones per capita (mainline and cellular combined) Electricity consumption per capita
Development of Human skills (DHS index)	Mean years of schooling Gross enrolment ratio at tertiary level in science, mathematics and engineering

The TAI is the simple average of these four dimension indices and its value has ranged from 0.744 for Finland to 0.066 for Mozambique. Based on the general TAI score, countries are categorized into four groups, Leaders (TAI above 0.5), Potential leaders (0.35–0.49), Dynamic adopters (0.20–0.34), Marginalized (below 0.20), all of which reflect countries at different levels of development. The results given below has been derived from the TAI-09 calculations (Table 12)

Table 12.Country Groups Under TAI (Desai et.al 2002; Nasir et.al 2009)

Categories	Features	Countries
Leaders (TAI above 0.5)	They have remarkable technological innovation. and high achievements in technology creation, diffusion and skills	Korea, Finland, Sweden dominates the top of the list followed by Singapore, Japan, Netherlands, Luxembourg, UK, US, Canada, Norway, N.Zealand, Ireland, Australia, Germany ,France ,Iceland, Estonia respectively.
Potential leaders (TAI 0.35–0.49)	They invest on high levels of human skills but show less innovation	Most of the European Countries (Spain, Italy, Czech Republic, Greece, Portugal, Bulgaria, Slovenia, Poland),Hong Kong, Argentina, Malaysia, Mexico, Chile
Dynamic adopters (TAI 0.20–0.34)	They hold important high-technology industries but the diffusion of old inventions is slow and incomplete	Lebanon,Brazil,China,S.Africa,Iran,Guyama,Jordan,Pakistan,Colombia, Turkey,Tunisa,Algeria, India
Marginalized (TAI< 0.20)	Technology diffusion and human skill are insufficient, Most people do not benefit from the diffusion of old technology	Kenya,Ghana,Senegal,Nepal ,Sudan Mozambique

Nasir et.al (2009) has analyzed this index to see whether any changes have occurred in the position of countries from 2000 to 2009 and obtained the following results: Sweden, Japan, Iceland, Norway, USA, UK, France, Germany, Japan have maintained their top positions with minor shifts; Korea has moved up in TAI ranking from 9th to 1st position and Canada, Germany, Slovenia, Greece, Cyprus, Poland, Romania and China are able to improve their ranking.

Singapore has moved up from 8th to 4th position with better performance in technology creation and diffusion of recent innovations. Germany has jumped from 16th to 13th position, due to the improvement in diffusion of recent innovations and development of human skills. China, on the other hand, has improved in terms of technology creation and diffusion of old technologies, moving from 47th to 41st position. While, based on TAI-02, Turkey together with some other countries have not been included in the rankings because of lack of data, TAI-09 calculation provides Turkey to be listed as dynamic adopter. Whereas Russia include neither of the TAI lists (Table 12) .Brazil is second country dynamic leaders group where Lebanon is the top country.

Table 13.TAI Scores of Top Five Countries and BRICST (Nasir et.al 2009)

Rank	Country	TAI-09
1	Korea	0.765
2	Finland	0.677
3	Sweden	0.661
4	Singapore	0.642
5	Japan	0.630
8	USA	0.607

Table 13.continued.

Rank	Country	TAI-09
53	Brazil	0.335
54	China	0.334
55	S.Africa	0.326
64	Turkey	0.312
81	India	0.215

Table 13 above shows the ranking of advanced and emerging countries in terms of TAI-09 scores.Korea,which holds the first position in accordance with its success by realizing the highest scores in all the sub-dimension of TAI,particularly technology creation and diffusion of recent innovations.However, BRICST countries are listed in the behind those countries even though they realize the similar achivements in sub-indices.In general framework, emerging countries are again displayed in lower positions compared to developed countries.

E-readiness Index (ERI)

E-Readiness Index (or digital economy ranking) which is firstly introduced by Economic Intelligence Unit in 2000, also reflects level of a country's capability to participate in the knowledge-based economy and puts emphasize on the ICT infrastructure but different from TAI, it considers how consumers, businesses and governments benefit from ICT and serves as a guideline for companies and individuals who are willing to invest or trade with a country which has remarkable qualification in terms of ICT.

E-readiness index pays special attention on increasing role of technology in political arena and ads the concept of “e-participation” in its scoring in which 38 indicators and 81 sub-indicators are weighted according to their assumed importance as influencing factors and seventy countries are ranked on 1(least) -10 (best) basis.The sub-categories under ERI and their weights in total score are defined as given in table 14.

Table 14.E-readiness Index (ERI) Sub-Categories and Weights (EIU, 2010)

Categories	Weights
1.Connectivity and technology infrastructure	10%
2. Business environment	20%
3.Social and cultural environment	20%
4.Legal environment	10%
5.Government policy and vision	25%
6. Consumer and business adaptation	15%

According to table 15,the top performers in the 2010 digital economy rankings are Sweden (1st) and Denmark (2nd) which demonstrates high degree of connectivity, high quality of business and legal environments and the existence of sound public policy on ICT. When concentrating on each sub-indices of ERI, in all indices, North American continent dominate the highest scores with Scandinavian countries.

The position of BRICST countries remain stable in a year but according to EIU (2009; 2010) emerging countries are the ones that are able to achieve rapid increase in their score whereas developed countries manage to protect their position on the top of the list even though there is little or no improvement in their scores. Also, it is emphasized that innovative practices and applications are being conceived and put in practice in the emerging world faster than in the developed world. The emerging markets are assumed to be new source of innovation as well.

Table 15.E-readiness Index Rankings for Developed Countries and BRICST between 2009-2010 (EIU,2010)

2010 rank	2009 rank	County	2010 scores	2009 scores
1	2	Sweden	8,49	8,67
2	1	Denmark	8,41	4,87
3	5	United States	8,41	8,60
4	10	Finland	8,36	8,30
5	3	Netherlands	8,36	8,64
6	4	Norway	8,24	8,62
7	8	H.Kong	8,22	8,33
8	7	Singapore	8,22	8,35
9	6	Australia	8,21	8,45
10	11	N.Zealand	8,07	8,21
42	42	Brazil	5,27	5,42
70	70	Russia	3,97	3,98
58	58	India	4,11	4,17
56	56	China	4,28	4,33
40	40	South Africa	5,61	5,68
43	43	Turkey	5,24	5,34

Although some differences are observed, EIU (2010) claims that the digital divide is narrowing between developed and emerging countries because of the increased attention to fast-growing emerging markets by global businesses who search for technology investments and ability of these countries to use ICT tools as a platform for building capacity in education and services.

Networked Readiness Index (NRI)

Alternative to ERI, Networked Readiness Index (NRI) (WEF, 2011) in the same manner demonstrates the capacity of a country to benefit from new technologies in its competitiveness strategies allows private and public stakeholders to evaluate competitive strengths and weaknesses in national networked readiness scope.

The underlying principles of NRI are established on the fact that the country's general environment for innovation bolsters successful use of ICT in which collaborative effort of government, business and individuals are expected to reach optimal networked readiness and that in return leads to increasing interest through ICT usage. In that context, NRI includes three sub-indices with a total of nine pillars as follows (Table 16):

Table 16.The Networked Readiness Framework (WEF,2011)

Sub-Index	Pillars
Environment Index	Market Environment; Political Regulatory Environment;Infrastructure Environment
Readiness Index	Individual readiness;Business readiness Government readiness
Usage Index	Individual usage; Business usage; Government usage

In order to capture all possible relevant dimensions of economies' networked readiness, NRI is measured through quantitative data (45% of all variables) collected by international organizations and remaining part captures the effect of more qualitative data of the Executive Opinion Survey which covers over 15,000 business leaders in all the economies. The results of 2010 NRI address same countries on the top of its list like the result of E-readiness index.

Sweden, US, Denmark and Finland possess best ICT readiness and usage with strong education system where the collaboration with industries and private firms are encouraged in order to increase innovation capacity of the economy. These countries are followed by Asian countries particularly Singapore, Taiwan and Korea. Among the BRICST countries, only China (16th) and India (33rd) are listed on top 50 countries whereas Brazil (59th), Russia (68th) , S.Africa (79th), Turkey (81st) stay behind them. However, China is argued to provide widespread ICT usage among business sectors rather than individuals also have difficulties for individuals and firms to start business because of legal constraints and tax burdens. In similar vein, India has poor ICT infrastructures which prevents benefiting from technology easily (WEF,2011). These drawbacks can hinder India and China to hold their current rank in coming years.

Lisbon Scores

Under the context of latest Lisbon Strategy (2008) which provides a benchmarking for European member and non-EU countries' (Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Macedonia, Montenegro, Serbia, Turkey and Ukraine) relative performances in meeting the Lisbon goals as well as member countries position relative to USA and East Asian emerging economies such as Hong Kong Japan, Korea, Singapore,Taiwan and China.

The overall Lisbon scores of each country is calculated as an unweighted average of the individual scores in the eight dimensions (WEF, 2010) based on the data obtained though the WEF's Executive Opinion Survey which is conducted with business leaders from more than 130 countries,which provides data for a variety of qualitative issue :

(1) Information society, (2) R&D, (3) Liberalization, (4) Network industries (telecommunication, utilities &transport),(5) Financial services,(6) Enterprise environment (business start-up environment, regulatory environment), (7) Social inclusion (returning people to workforce, upgrading skills, modernizing social protection, (8) Sustainable development.

The results have shown that EU-27 outperforms the US and East Asia,only in the sustainable development dimension, but the overall EU27 score (4.81) remains behind both those of the United States (5.27) and East Asia (5.28) the largest gap in the area of innovation and R&D.

Within European countries, the Nordic region dominates the rankings, with Sweden holding the leading position for followed by Finland and Denmark. These countries do particularly well as a group in the areas of developing an information society, innovation and R&D, social inclusion and sustainable development.

In case of Turkey, (figure 14), which is ranked 4th, has some strengths and weaknesses compared to other non-EU countries. Turkey is ranked 1st out of all countries in the figure 14 with high extent of liberalization, with the economy characterized by high levels of competition. Financial services are also relatively well developed, ranked second behind Montenegro out of the 11 countries and ahead of EU members such as Latvia and Romania. However, Turkey's competitiveness is held back by its performance in a number of other areas. It has not yet developed an information society that is sufficiently supportive of productivity enhancements, and measures of innovation and R&D remain below EU standards.

	Final Index		Subindexes															
			Information Society		Innovation and R&D		Liberalization		Network Industries		Financial Services		Enterprise Environment		Social Inclusion		Sustainable Development	
Economy	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Montenegro	1	4.19	2	3.95	3	3.32	2	4.34	2	4.60	1	4.74	6	4.32	2	4.28	2	3.94
Croatia	2	4.18	1	4.04	2	3.36	5	3.85	1	5.23	3	4.34	7	4.16	7	3.72	1	4.70
Azerbaijan	3	4.02	4	3.67	4	3.26	3	4.15	6	4.16	4	4.13	2	4.68	1	4.50	4	3.57
Turkey	4	3.85	5	3.61	5	3.24	1	4.39	3	4.38	2	4.39	5	4.46	10	3.19	9	3.12
Macedonia, FYR	5	3.79	3	3.86	7	2.93	4	3.95	5	4.16	5	4.08	3	4.58	9	3.39	6	3.33
Georgia	6	3.78	6	3.35	9	2.79	6	3.82	8	3.93	7	3.69	1	5.01	6	3.77	3	3.89
Ukraine	7	3.62	9	3.04	1	3.59	10	3.48	4	4.32	11	3.22	9	4.08	4	3.89	5	3.33
Serbia	8	3.51	7	3.29	6	2.95	8	3.66	9	3.83	8	3.68	10	4.01	8	3.45	7	3.19
Armenia	9	3.50	11	2.70	8	2.82	7	3.74	7	3.94	6	3.88	8	4.15	5	3.79	10	2.98
Albania	10	3.47	8	3.13	11	2.52	9	3.65	11	3.46	9	3.41	4	4.48	3	3.94	8	3.13
Bosnia and Herzegovina	11	3.07	10	2.86	10	2.54	11	3.43	10	3.73	10	3.32	11	3.28	11	2.69	11	2.73

Figure 14.Rankings and scores of non-EU eastern European countries (WEF,2011)

In general, Lisbon scores indicates that the EU has problems in terms of less strengthening network,industries,public-private partnership,the development of financial services and increasing social inclusion which are necessary channels to transform into information society and obtain the benefits of KBE.

Europe Innovation Union Scorecard (IUS)

Under the agenda of Europe 2020, which aims at achieving,

(1) smart growth through education (encouraging people to learn, study and improve their skills); research& innovation (creating new products/services that generate growth and jobs and help address social challenges) ; digital society (using information and communication technologies)

(2) sustainable growth through building a more competitive low-carbon economy that makes efficient, sustainable use of resources , capitalizing on Europe's leadership in developing new green technologies and production methods ,improving the business environment, in particular for SMEs, helping consumers make well-informed choices.

(3) inclusive growth through raising Europe’s employment rate, helping people of all ages anticipate and manage change through investment in skills & training, modernizing labor markets and welfare systems and ensuring the benefits of growth for parts of the EU,

The European Commission has created indicators to support Research & Innovation (R&I) policy making at three different levels:

Headline indicators for the highest political level, which are emphasized through Europe 2020 strategy indicators. In order to assess the results towards carrying out innovation union, European Council brings two headline indicators: (a) the R&D investment target (investing 3% of GDP on research and innovation) and (b) Innovation Union Scoreboard .

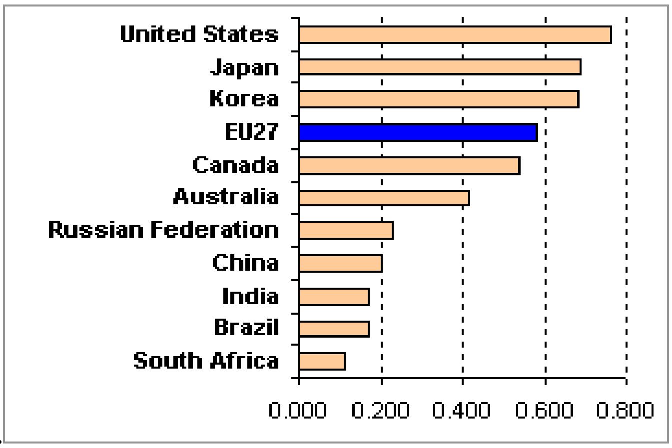
Innovation Union Scorecard (IUS)-revised and updated version of European Innovation Scoreboard (EIS) in 2010- has been developed in order to monitor the implementation of the Europe 2020 Innovation Union flagship by benchmarking innovation performance of the EU27 Member States as well as Croatia, Iceland, the Former Yugoslav Republic of Macedonia, Norway, Serbia, Switzerland and Turkey in related to their relative strengths and weaknesses of their research and innovation systems. It compromises 3 main types of indicators and 8 innovation dimensions, capturing in total 25 different indicator (Table 17)

Table 17. Components of Innovation Union Scorecard (IUS) (EC, 2010)

ENABLERS	Human resources	1.1.1 New doctorate graduates 1.1.2 Population completed tertiary education 1.1.3 Youth with upper secondary level education
	Open, excellent and attractive research systems	1.2.1 International scientific co-publications 1.2.2 Scientific publications among top 10% most cited 1.2.3 Non-EU doctorate students
	Finance and support	1.3.1 Public R&D expenditure 1.3.2 Venture capital
FIRM ACTIVITIES	Firm investments	2.1.1 Business R&D expenditure 2.1.2 Non-R&D innovation expenditure
	Linkages & entrepreneurship	2.2.1 SMEs innovating in-house 2.2.2 Innovative SMEs collaborating with others 2.2.3 Public-private co-publications
	Intellectual Assets	2.3.1 PCT patent applications 2.3.2 PCT patent applications in societal challenges 2.3.3 Community trademarks 2.3.4 Community designs
OUTPUTS	Innovators	3.1.1 SMEs introducing product or process innovations 3.1.2 SMEs introducing marketing/organizational innovations
	Economic effects	3.2.1 Employment in knowledge-intensive activities 3.2.2 Medium and high-tech product exports 3.2.3 Knowledge-intensive services exports 3.2.4 Sales of new to market and new to firm innovations 3.2.5 License and patent revenues from abroad

Comprehensive set of indicators used for in-depth economic analysis published analytical studies especially for expert use (EC, 2011).These indicators provide an evidence-based overview of progress towards the realization of the Innovation Union and the European Research Area of progress on the six axes of the ERA Green Paper.

When performance of EU-27 countries are compared to other countries and country groups over 5 year period (2005-2010), it is seen that EU-27 performs better than BRICS countries but remains behind the US, Japan and South Korea. The US is performing better than the EU27 in terms of education, R&D expenditure in the business sector. Only dimension that Russia is accounted more successful than EU-27 and other emerging countries is human resources component. While China decreases it gap against EU-27 in tertiary education, international co-publications, R&D expenditure in the public sector and all other components under intellectual asset are far behind in China, India, Brazil and S.Africa compared to EU-27.



.

Figure 15.EU-27 Innovation performance compared to main competitors in 2010 (EC,2010)

Along with these findings, European countries have grouped according to their overall innovation performance :

Innovation leaders: Switzerland, Denmark, Finland, Germany and Sweden

Innovation followers: Austria, Belgium, Cyprus, Estonia, France, Ireland, Luxembourg, Netherlands, Slovenia and the UK

Moderate innovators: Czech Republic, Greece, Hungary, Italy, Malta, Poland, Portugal, Slovakia, Spain, Turkey.

Modest innovators: Bulgaria, Latvia, Lithuania and Romania.

Among countries included in IUS, Turkey is regarded as one of the modest innovators and its relative strength is defined as open and attractive research system, finance and support, innovators and economic effects with high growth performance human resources. The table 18 gives the current performance of candidate countries.Although most of its scores are close to or below of average EU-27, the significant dimensions in which Turkey surpasses candidate countries are entrepreneurship and innovators. For instance, in-house innovation activities of SMEs and innovative production and services of these enterprises in Turkey are the highest among given countries. These results demonstrate the innovation capability of Turkey which mostly relies on the activities of SMEs.

Table 18.Current Innovation performance of European Union Candidate Countries for selected indicators (EC,2010)

	EU27	Croatia	Turkey	Iceland	Serbia	Macedonia
ENABLERS						
Human resources						
1.1.1 New doctorate graduates	1,5	0,9	0,3	0,7	0,5	0,4
1.1.2 Population completed tertiary education	33,6	22,6	15,5	40,9	20,5	17,1
Finance and support						
1.3.1 Public R&D expenditure	0,76	0,41	0,51	1,10	0,78	0,14
FIRM ACTIVITIES						
Firm investments						
2.1.1 Business R&D expenditure	1,23	0,32	0,34	1,64	0,13	0,04
2.1.2 Non-R&D innovation expenditure	0,71	0,86	0,16	N/A	0,80	0,90
Linkages & entrepreneurship						
2.2.1 SMEs innovating in-house	30,31	25,60	28,18	N/A	27,83	11,30
2.2.2 Innovative SMEs collaborating with others	11,16	11,88	5,28	14,05	3,50	9,60
2.2.3 Public-private co-publications	36,2	17,7	1,7	126,2	4,2	N/A
Intellectual Assets						
2.3.3 Community trademarks	5,59	0,44	0,35	5,46	0,56	0,24
2.3.4 Community designs	4,77	0,14	0,36	0,93	0,00	0,03
OUTPUTS						
Innovators						
3.1.1 SMEs introducing product or process innovations	34,18	31,48	29,52	N/A	18,32	39,20

Table 18.continued

	EU27	Croatia	Turkey	Iceland	Serbia	Macedonia
Economic effects						
3.2.1 Employment in knowledge-intensive activities	13,50	9,90	4,80	18,10	12,32	10,60
3.2.2 Medium and high-tech product exports	48,23	45,17	38,61	16,70	26,08	53,43
3.2.3 Knowledge-intensive services exports	48,13	14,01	18,83	53,00	45,20	29,35
3.2.4 Sales of new to market and new to firm innovations	13,26	14,41	15,82	12,69	10,01	9,90

The overview of Turkey given in the table 18, indicates the need for collaboration between various actors involved in the innovation system ranging from private firms to public authorities, in the sense that these actors help improve the national innovation system and capability but also they promote the role of KBE among the socities by taking innovative activities and introducing policies on science and technology field.

Global Innovation Index (GII)

Global Innovation Index (GII), which was launched by (INSEAD) in 2007, aims at finding metrics and approaches to better capture innovation in society and go beyond the traditional measures of innovation such as the number of PhDs, research articles produced etc.

It builds around the previous innovation measurement tools : The Boston Consulting Group/National Association of Manufacturers Index (2009), European IUS, The Global Competitiveness Index (GCI) of the World Economic Forum, The Global Innovation Index of the Economist Intelligence Unit.

(GII) relies on two sub-indices, the Innovation Input Sub-Index and the Innovation Output Sub-Index, each built around pillars. Five input pillars for national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. Two output pillars for innovation outputs: (6) Scientific outputs and (7) Creative outputs. Each pillar is divided into sub-pillars and each sub-pillar is composed of individual indicators. Sub-pillar scores are calculated as the weighted average of individual indicators; pillar scores are calculated as the simple average of the sub-pillar scores.

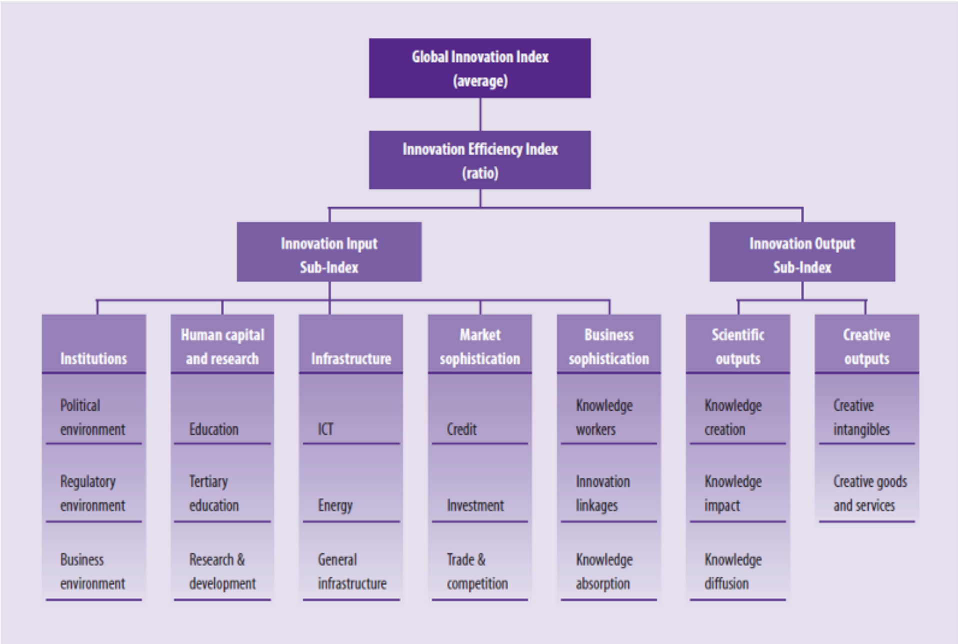


Figure 16.Global innovation index (GII) framework (INSEAD, 2011)

GII model includes 125 countries that represent 93.2% of the world's population and 98.0% of the world's GDP (in current US dollars) and provides a ranking in terms of innovation Input Sub-Index which is the simple average of the first five pillars scores: Singapore, Hong Kong, Switzerland, Ireland, Sweden, Finland, Denmark, Canada, Luxembourg, UK and US .Regional leaders are Singapore (1st), Switzerland (3rd), Canada (8th), Israel (20th), Chile (36th), South Africa (40th), and India (87th).

Position of emerging countries among them are : S.Africa (40th), China (43rd), Russia (59th), Brazil (68th), Turkey (80th), India (87th), Korea (17th) and Malaysia (27th).

The Innovation Efficiency Index is the ratio of the Output Sub- Index over the Input Sub-Index. The countries are divided according to the income groups they belong to IEI with high income : Sweden, Hungary, Switzerland, Netherlands, Germany, Qatar, Israel, Korea, United States of America, Estonia; IEI upper-middle income: Brazil, Argentina, Venezuela, Serbia, Iran, Lebanon, Turkey, Romania ,Russia; IEI lower middle income: Côte d'Ivoire , Nigeria, China, Pakistan, Moldova, India, Jordan ,Vietnam.

Indices mentioned above have stood as a reference point for many authors in the literature to develop their own indicators and indices.

Relating to TAI and UNIDO's Industrial Performance Scoreboard, Archibugi and Coco (2004) carry out ArCo index that focuses on technology capabilities of developed and developing countries has been built on three main dimensions with eight sub-indices (Table 19):

Table 19 : Components of ArCo Index (Archibugi&Coco,2004)

Dimensions	Sub-Index	Indicators
1.Creation of technology	Patent index Articles index.	1.a Patents granted at the USPTO by country per million people 1.b. Scientific articles by country per million people
2.Technological infrastructures	Internet index, Telephony index Electricity index.	2.a Internet users by country per million people 2.b. Fxed and mobile telephone lines by country per million people 2.c. Electricity consumption by country per million people

Table 19.continued

Dimensions	Sub-Index	Indicators
3.Development of human skills	3.a.tertiary index 3.b.schooling index 3.c.literacy index	3.a. gross tertiary science and engineering enrolment by country 3.b. mean years of schooling by country 3.c. adult literacy rate by country

By taking the means of three main categories, countries are divided into four main groups according to their overall ArCo Index score.

Leaders (ranking from 1 to 25): Nordic countries, United States, Asian countries (Hong Kong, Korea, Taiwan, Singapore) and some of the European countries are listed in this group

Potential leaders (from 26 to 50); invest in the formation of human skills and technological infrastructures but achieve little innovation: Central and East European Countries, Greece, Russia, Argentina, Chile and Arab Emirates

Latecomers (from 51 to 111): Central and South American countries (Venezuela, Mexico, Colombia, Brazil, Paraguay and Bolivia), Malaysia, Thailand, China, India, Indonesia, Turkey.

Marginalized (from 112 to 162): Many African countries fall within this grouping where the low technological level is associated to the very low income level.

Indices and indicators mentioned in this chapter are commonly used at national level and they measure the performance of many developed and developing countries in terms of KBE. But these measurement tools have not existed in the literature without some debates about their efficiency and reliability on assessing the countries' situation.

Malhotra (2003) reveals its concern about the validity of KAM project by saying that there is a problem of validity in the sense that it is difficult to understand what KAM is really measuring. For instance it is unclear whether ICT index is reliable and valid proxy for effective utilization for real performance outcomes of countries. Besides, as we have seen from the indices above, there are overlapping components are included in each measures and it is difficult to distinguish whether these methods are tied to validity requirements. He has discussed that international institutions can develop more reliable methods and give more interest on social and human capital of KBE. Moreover it is claimed that there is a need for clarification on the measurement of KBE because of continuing dichotomy between KBE and industrial/agricultural economy (Malhotra 2003; Powell 2004). Beyhan et.al (2009) explain that any tool that assess innovation in developing countries must consider the specific features of these countries. The main conclusion of this chapter is that most of the tools for measuring the capabilities and performance of countries in accumulating knowledge and contributing their economies through innovation and technology are not reliable in the sense that they ignore the dynamics of country's economic, social and political spheres. Therefore, single county or group of country analysis (G7, EU-27, Next-Eleven, and BRICST) can provide much persuasive look on KBE settings.

CHAPTER V

LITERATURE REVIEW

In this chapter, the role of KBE components on macro and micro level economic conditions are reviewed. Firstly, the theory of endogenous growth has been defined. As it is given in the literature, the relationship between ICT and economic growth is explained. Then empirical studies on KBE from developed countries, emerging markets and Turkey are presented.

Endogenous Growth Theory

The contribution of factors of knowledge based economy to national economic growth has been well established in the economic literature since the introduction of " New growth theory" reflects the attempt to understand the role of knowledge and technology in driving productivity and economic growth. In that framework, studies have been conducted both theoretically (Solow, 1956; Romer, 1986) and empirically (Mansfield, 1972; Nadiri, 1993).

Very early studies on knowledge based economy have focused on the efficiency of the R&D process .Schumpeter (1947) has conceptualized innovation and assessed its impact on the economy. He mentions that whenever an economy or industry has come across with changes in the environment , it adapts itself through increasing its human capital and expanding current activities –"adaptive response" or through developing new ways of doing actions that is innovation –"creative response". After that, neoclassical endogenous growth theories by Solow (1956), Romer (1990) and Segerstrom (1991) have analyzed the impact of technological change to economic growth. At another level, Nelson (1982) has understood the importance of R&D in technological change, and examined the interaction of knowledge and R&D efficiency.

It is expected that production of ICT goods can increase economic growth in two ways (Pohjola 2001; Wong 2001): (1) it can directly contributes GDP and job creation. Because global demand for this goods is growing faster than the demand for other goods, (2) it can indirectly raise level and growth of labor productivity, because production of ICT goods requires the implementation of advanced manufacturing process which induce higher labor productivity than other sectors.

Until 1990s, there have been found no relationship between ICT investment and productivity at macro and micro level (Strassmann 1990; Loveman 1994; Berndt & Morrison, 1995; Brynjolfsson, 1996). This is explained through the fact that the amount of IT capital can be too small for its effect to be detected in large scale studies (Schreyer, 2001). Also, according to Pohjola (2001), decrease in the price of new capital goods can lead to increase in economic growth but if it takes time to absorb this new technology, this can be related to prolonged decline in productivity. So, slow diffusion of information technology can be one of the reason for the negative correlation between IT investment and productivity (Kraemer& Dedrick, 2001). This conclusion have brought the concept of productivity paradox of Solow (1987). Productivity does not seem to show any impact from the information technology. This term refers the discrepancy between intensive ICT investment after

1970s and absence of positive effects of ICT diffusion on productivity and economic growth in the US.

However, when the diffusion and impact of ICT are actualized ,its impact can be contradictory as well. For instance, even if countries have similar rates of ICT investment or diffusion, this necessarily means that ICT has a comparable effect on performance. For instance, the average ICT intensity of fast-growing and slow-growing countries does not seem to be significantly different (OECD, 1999). Again, ICT networks continue to diffuse throughout the OECD area, even during the period of slower growth. However, large differences in technologies appear both between and within OECD countries (OECD, 2003)

This complex nature of KBE components has led many scholars to find alternative methods and approaches in order to measure the impact of the factor of KBE to economic growth and productivity.

(a)Growth accounting model provides a simple and consistent method which can be used as a starting point to identify the contribution of the various inputs to aggregate growth and thus to derive the relative importance of ICT to economic growth. According to this theory, a sizable share of the observed growth in output can be explained by the growth of the primary factors of production, i.e. capital and labor. The remainder that cannot be explained by the growth of capital and labor could be attributed to a 'residual' known as the Solow residual. Wu (2011) also introduced regional growth accounting model to explore the role of innovation in China's economic growth by using regional level of data. The impact of ICT in the neoclassical growth accounting framework is theoretically based on the idea that an increase in ICT capital deepening (i.e. more ICT investment per employed labor input) is triggered by rapidly falling IT prices. The key critique of the growth accounting method is in not explicitly accounting for the underlying causes of growth. Rather, it allows for the quantification of the proximate sources of growth in a systematic and consistent neoclassical framework.

A number of researchers developed growth accounting into a well-tested approach to quantify the ICT contribution to economic and productivity growth (van Ark et al. 2003; Jorgenson& Stiroh 2000; Yousefi, 2011)

(b) Greenwood, Hercowitz, and Krusell (1997) – is based on dynamic general equilibrium (DGE) models which do not work on historical decompositions of aggregate growth as the growth accounting approach does, but instead, quantify the contribution to growth of specific technological change (Kiley 2001; Rodríguez& Torres 2008)

(c) One of the generally accepted structural model in measuring the relationship among R&D, innovation and productivity have been developed by Cre´pon, Duguet and Mairesse (1998), subsequently referred to as CDM-that is knowledge inputs (R&D or other innovation activities) are expected to generate some knowledge output (innovation), which in turn is expected to have a direct impact on economic performance (labor productivity).

This model have been used many scholar who analyze this relationship on developed and developing countries such as on OECD countries (Mohnen et.al 2006) , Brazil (Goedhuys 2007), Chile (Benavente 2006), Malaysia (Hegde and Shapira 2007).

There are abundance of studies that are conducted on KBE ranging from the micro-level analysis at firm or industrial level to macro-level analysis at country level.

When looking at the firm-level studies, they show that the use of ICT may help efficient firms gain market share at the cost of less productive firms, raising overall productivity. In addition, the use of ICT may help firms expand their product range, customize ,the services offered, or respond better to demand, i.e. to innovate. Moreover, ICT may help reduce inventories or help firms integrate activities throughout the value chain. These studies also show that ICT is part of a broader range of changes that help enhance performance. The impacts of ICT depend on complementary investments, e.g. in appropriate skills, and on organizational changes, such as new strategies, new business processes and new organizational structures.

Innovation and R&D activities at firm level are important in the sense that they lead creation of new products and but they also contribute general stock of knowledge which brings innovation(Cukurcayir, 2008). Firm-level studies are able to demonstrate the positive productivity contributions of computers in the 1990s (Lehr& Lichtenberg 1999; Brynjolfsson & Hitt, 2003; Hegde & Shapira 2007).

Recently, Rodríguez (2012) estimates how real output, employment, labor productivity in EU-15 countries and the USA have been affected by the ICT investment at industrial level by using panel-vector autoregression model. Grouping the industries as ICT intensive and less ICT intensive, he concludes that both types respond the ICT investment in the same manner in most of the countries from EU area even though there are some quantitative differences between the two industry and the EU-15 countries considered. But all in all, the result indicates that ICT investment has positive impact on economies through giving rise to larger growth in real output, employment, and labor productivity at the industrial level.

On the hand, studies involving developed countries have mostly concentrated on the US economy which becomes the subject of empirical examination in the literature. These studies have found positive relationship between information technology investment and various economic performance indicators in US at economy and firm level.

Greenwood et al. (1997; 2000) report that approximately 60% of the US postwar productivity growth can be attributed to investment-specific technological change. Likewise, Jorgenson and Stiroh (2000), Oliner and Sichel (2000, 2003), Jorgenson (2001), Pakko (2002), Jorgenson et.al (2003) and Martinez et.al (2010) conclude that ICT contributes to faster gross domestic product (GDP) and labor productivity growth in the US

Finally, many scholars in knowledge based economy literature (Shreyer 2000; Colecchia& Shreyer 2001; Pilat & Lee 2001; Cette et.al 2005; van Ark et.al 2008) show that the level of the diffusion of ICT differs greatly across the main industrialized countries while the USA has the highest diffusion among all. Apart from the studies that analyze the US, many scholars have confirmed the positive contribution of ICT on macroeconomic performance of other countries as well such as Australia (Parham et. al 2001; Simon& Wardrop 2001; Gretton et.al 2004), Canada (Armstrong et al. 2002; Khan& Santos, 2002; Carlaw&Kosempel 2004) Belgium, (Kegels et al. 2002), Finland (Jalava &Pohjola, 2002),Korea (Kim, 2002)

Netherlands (Van der Wiel, 2002),France (Cette et al,2002), UK (Oulton 2002; Bakhshi& Larsen 2005), Japan (Miyagawa et al. 2002;Motohashi 2002) Greece (Antonopoulos &Sakellaris, 2009), G7 countries (Slavatore,2003), OECD countries (Motohashi 1997; Schreyer 2000; Colecchia&Schreyer 2002),EU countries (Ark et.al 2003; Piatkowski 2006; Dimelis &Papaioannou 2011) and cross-country studies covering both developed and developing countries (Dewan & Kraemer 2000; Pohjola 2001; Kooshki&Ismail 2011).

When we look at aggregate-level evidence, Schreyer (2000), for example, has examined the contribution of ICT-producing sectors to output growth across seven OECD countries for the period to 1996. He has found that technical progress leads to a rapid improvement in the price-performance ratio of ICT capital goods and reduced the user cost of ICT capital goods relative to other types of assets. As a consequence, there has been significant substitution of ICT capital for other types of capital and overall, the contribution of ICT capital to output and labor productivity growth has been significant and rising in relative terms. In Canada, the United Kingdom and the United States, ICT equipment contributed about half of fixed capital's contribution to output growth. In France, Germany and Japan, its contribution has been somewhat smaller

Oliner and Sichel (2000) and the Council of Economic Advisors (2000) find the ICT-producing industry making a much smaller contribution to overall MFP growth. Shinozaki (1999) shows that IT makes a smaller contribution to growth in Japan than in the United States. This appears linked to a slower rate of introduction, with Japanese companies mainly adopting technologies already shown to be effective in the United States, and to a lower volume of investment in ICT. A study for Canada finds that the impact on labor productivity growth of IT investment and of international R&D spillovers linked to import of IT goods is large (Gera et al. 1999). Another study for Canada attributes much of the Canada-US productivity gap in manufacturing to the performance of two sectors, machinery and electronic products, both of which are important producers of IT products (Gu and Ho, 2000)

Technological capabilities of emerging and developing countries is one of the important features in transforming to KBE due to the fact that absorbing knowledge and technology produced in advanced countries through foreign trade and applying these intangible assets into their domestic production spur faster growth in total factor productivity (Coe et al. 1997). Moreover , Xu (2000) and Frantzen (2000), Fleisher et.al (2010) have found that in the absence of adequate human capital, technology spillovers may simply be unfeasible. In similar vein, international technology diffusion through foreign trade does not provide direct contribution to recipient country which needs to have absorptive capacity' (Cohen and Levinthal,1989; Griffith et al., 2003; Narula& Dunning, 2000) of countries cover a complex network of interconnected actors and institutions as emphasized in the literature on systems of innovation (Freeman,1987; Lundvall, 1992; Nelson, 1993; Breschi and Lissoni, 2001).Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host countries Besides this absorptive capacity might be affected by education because technology imports boost productivity only when an economy has reached a sufficiently high level of educational attainment or local R&D efforts that can allow for the efficient use of the imported technology (Mingyong et.al, 2006).

Availability of human capital for technological enhancement and economic growth studies (Mateus 2005; Pereira & St Aubyn 2009; Teixeiraa & Fortuna 2010) indicate that human capital is crucial to enable the FDI spillovers that underpin economic growth. However, low levels of schooling and qualifications represent one of the most serious obstacles to the development of the country. But as Corley et.al (2002) mention human capital is difficult to proxy at the industry level and aggregate measures such as R&D scientists and engineers and enrolment rates may not capture the industry dynamics

Parallel to the content of studies mentioned above, Castellacci (2002) analyses productivity rate differences between countries by using kaldorian idea of cumulative causation- bases on a process of interaction between growth of demand and growth of productivity, which is developed through two distinct causal sequences- and technology gap approach, which indicates that the growth rate differential in a country relies on its capability to absorb knowledge spillover from abroad. Under the assumption of technology gap-approach, it is required from the countries to invest in indigenous capabilities, capital equipment, infrastructure, etc. Otherwise, they are more likely to fall behind the technology leaders rather than catching up with them (Verspagen 1991; Fagerberg 1994). Technology-gap and cumulative causation mechanisms simultaneously determine the rate of growth of productivity, output and knowledge stock for the follower country. Under this theoretical framework, Castellacci (2002) tries to explain technological activities and productivity for 26 OECD countries from 1991 to 1999 by using cluster analysis and taking the indicators of average annual rate of growth of labor productivity, the human capital and the knowledge stock at the beginning of the period and the increases in the knowledge stock over time. Overall analysis in his study, four main clusters with different features have been formed:

Table 20.Country Clusters Based on the Study of Fulvio Castellacci, (2000)

Clusters	Countries	Features
A	Austria, Canada, Czech Republic, Greece, Italy, New Zealand, Australia, Belgium, Spain	initial technology-gap, slow knowledge stock growth, average human capital ,different productivity level
B	Turkey and Portugal	fast convergence in productivity, very high initial technological distance from the leaders, slow increases in the knowledge stock, human capital below average. partial slow technological catching up and economic convergence
C	Hungary, Poland	Similar to those in cluster B plus they grow much faster than the leader
D	Ireland, Korea	process of catching-up much faster than any others above average level of human capital
E	Denmark, Finland, Norway, Netherlands	Less technological distance from the leaders productivity performances are rather heterogeneous
F	US, Japan, France, Germany, UK, Sweden Switzerland	Already very close to the technological frontier Technological catching-up faster High level of human capital

Each country is assigned to different clusters based on the technology gap they have,the extent of human capital,productivity levels at country level and countries' ability to catch up technological developments occurred in other countries.

At another study, Raffo et al. (2008) also analyze the relation between innovation and economic performance in Europe and Latin American countries by using firm level data and they find that the impact of innovation activities stronger on European than Brazil and Argentina due to the fact that in these emerging countries, there is lack of connection between academic and industry field , which in turn prevent the establishment of innovation networks and companies are reluctant to invest in R&D activities unless emerging countries have sufficiently large market for transferring knowledge and technology.

Another area of interest that can be taken under KBE studies is the link between innovation, economic growth, income level and social capital. It is assumed that high level of social capital may provide a suitable environment for implementing policies to foster economic growth and boost innovation which is one of the important factors to transform into knowledge based societies (Akcomak &Weel, 2009)

Akcomak and Weel (2009) claim that social capital increases per capita income growth through promoting innovation. They take 102 regions in the EU-14 (excluding Luxembourg), they estimate innovation output and social capital by using patent applications as dependent variable and in addition to that regression model is used in order to find out the impact of historical institutions and investment on social capital which in turn brings innovation. Their empirical analysis shows that social capital stimulates innovation in selected region. As Archhibugi and Coco (2005) have already confirmed, this study indicates the fragmentation within the European region in terms of knowledge collaboration and level of contribution to science&technology and innovation activities.

Yousefi (2011) analysis the possible effect of labor, ICT and non-ICT capital on economic growth in developed and developing countries in the period of 2000-2006, ICT makes significant contribution to economic growth for high and upper-middle income groups but fails to contribute to the growth of the lower middle income group countries.

Recently Vu (2011), who has conducted three separate empirical analysis of ICT as a source of growth for 120 countries in the period of 1996-2005. He has concluded that ICT can affect growth via 3 different ways: (i) fostering technology diffusion and innovation; (ii) enhancing the quality of decision-making by firms and households; (iii) increasing demand and reducing production costs, which together raises the output level According to his empirical analysis growth in the period of 1996-2005 have experienced structural change and increase sharply.First exercises how that growth in 1996–2005 improved , the traditional cross-country regression methodology to identify association between ICT penetration and growth and lastly Generalized Method of Moment (GMM), panel data analysis to observe the same relationship mentioned previously.

Along with the positive contribution of ICT on economic performance in developed countries, ICT diffusion and utilization have been cited as the essential factors that enabled developing countries such as China and India to improve their competitive advantage and expand their economies (Udo et al., 2008).

Early studies that analyze the relationship between ICT and economic growth in emerging markets mostly have been conducted on Asian countries. One of the reason behind this fact is that in the period of 1985-1995, the compound annual growth rate of global IT market is the highest in Asia Pacific Region (18.9 %) (OECD, 1997) where Hong Kong, Singapore, South Korea and Taiwan account for 12% of electronics industry in the world (Mansell &Wehn,1998) and ICT goods has hold 44% of manufacturing value added in Singapore in 1994. Also the source of growth in East Asia depends on productivity growth which results from the learning, entrepreneurship and innovation. Moreover, these countries do not only adopt foreign technologies but also develop indigenous technologies (Mahmooda & Singh, 2003).

Kreamer and Dedrick (2001) claim that emerging countries like China, India, Taiwan, S.Korea and Philippines has successful established their IT industry in 1980s and reaped the benefits from computers production in global market whereas Brazil and Mexico showed little success compared to other emerging countries in their study. In his book, Pohjola (2001) summaries the results of some of the authors in the table below (Niinien 1998; Jeong et al. 1997; Wong 2001) which help us to understand how significant the impact of one of the ICT component on growth rate.

The contribution of computer hardware to economic growth in Finland, S.Korea and Singapore is larger than United States and S.Korea itself accounts the largest growth rate of computer among the given countries .In addition to that, during the first half of 1990s, the contribution of capital deepening in ICT sector to labor productivity is significant in many countries Hong Kong, Singapore, Korea and Philippines (IMF, 2003).

As it is shown in the table 21, the time period the authors have collected data and analyzed these countries address the financial crisis of 1990s and Asian Crisis in 1997.This leads to conclude that Asian economies were able to recover from financial crisis of 1990s by spending on ICT sector (Pohjola, 2001). As Tan and Hooy (2007) have indicated, even though they are small in size, emerging countries in Asia such as the ones mentioned above, hold high level and development and efficiently exploit their knowledge inputs to develop knowledge economy when compared with large economic giants such as the US and Japan. As a result, Tan and Hooy (2007) claim that most of these emerging countries are likely to perform another ‘Asian miracle’ as alternative means of growth, one of which is to take ride towards KBE.

Table 21.Contribution of Computer Hardware to the Growth of Gross Domestic Products in Four Countries in Selected Time Periods (Pohjola,2001)

		Computer Hardware	
	GDP growth rate	Growth Contribution	Growth Rate
US 1980-1992	2,3	0,20	26,5
US 1996-98	4,2	0,35	37,3
Finland 1983-1996	2,4	0,38	24,7
Finland 1991-96	0,5	0,33	15,8
S.Korea 1980-1995	7,9	2,54	39,1
S.Korea 1990-95	7,5	2,71	42,7
Singapore 1977-1997	7,8	1,46	34,2

This remarkable framework that emphasizes the growing role of ICT and knowledge in emerging countries leads many scholars to give particular attention on the role of KBE on these countries.

According to Wong (1997), the rapid development of ICT goods industry and high level informatization in Singapore is related to investment on infrastructure and human resources; effective policy coordination among various institutions and most importantly knowledge-based economy related policies of the government, which in turn make Singapore to obtain much higher level of knowledge economy than other Asian economies such as Taiwan and Hong Kong. Under the same context, Wong (2001a), this time conducts empirical study in order to assess the linkages among the growth of ICT production and rapid diffusion and adaptation of ICT on the economic growth of Singapore by both doing macroeconomic level and firm level analysis at the same time. In macroeconomic level study in which Cobb-Douglas production function is applied and the condition of IT capital and non-IT capital is separately taken, he has found out that there is significant excess returns from IT-capital than non IT-capital and claimed that Singapore's performance is closer to that of developed countries than developing countries. In the firm level study, intensity of IT usage positive but differential impacts on firms performance. Wong (2001b) has also discussed in another article whether Asian countries are remaining slow to adapt ICT in comparison to non-Asian countries and assess the ICT adaption gap between Asian and Non-Asian as well as within Asian countries by using regression model over the period of 1994-1998. It is observed that Asian countries exhibit lower levels of penetration than it is expected from their level of economic development. Within the Asian countries, only Japan and four Asian newly industrialized economies (NIEs) are better off exploiting the use of ICT.

Addition to these results, in his study, where positive impact of ICT on Taiwan's economy has been confirmed, Wang (1999) mentions that this positive contribution cannot be achieved unless national information infrastructure that supports ICT adoption and applications is established. According to Avgerou (1998), economic growth of ICT lies in homogenization of economic structure and business practice as well as mobilizing investment for IT and providing appropriate economic policies, otherwise adapting best practices of developed countries in order to reap the benefits of new technologies never brings any competitive advantage in global economy. So with this finding, it is suggested that governments and policy makers should consider the extent to which organizational and economic changes are to be required to accompany technological innovation .However, the suggestion that developing countries need to accompany ICT innovation with the adoption of economic and organizational forms from advanced industries cannot be generalized due to the fact that there is no proven 'best practice' or best policy. There is no unique path for changes that need to be implemented in order to facilitate achievement of economic benefits from ICT diffusion and secondly, adopting economic mechanisms and organizational practices from the post-industrial world.

Jeong et al. (2001) has conducted a study to measure the aggregate impact of ICT on the economic growth of Korea from 1980 to 1995 by using growth accounting model. Their result have showed that all ICT components, that is ICT capital and labor, contribute around 16.2 % during 1981 and 1985, when oil shocks hindered the economic growth of Korea; 29.9% between 1986-1990, period of Asian crisis, and 49.3% during 1991-1995, in general more than 30% of increase in output between 1980-1995 came from the ICT sector and its annual growth. Moreover, IT-capital stock reached to 3.0 % in 1995 whereas this rate id 0.08% in 1980 and 0.8% in 1990. Similar results are also found for Singapore’s economy in the period of 1977-1997 (Wong, 2001). He has demonstrated in his macroeconomic estimation that ratio of IT capital stock to total capital stock increased from 0.1 % in 1980 to 1.5% in 1990 and 3.9% in 1997. In addition, it is figured out that IT-capital contribution to total GDP growth in Singapore (18.7%) was quite close that of Finland (19.7 %) and higher than that of US (15.5%).Besides, Kanamori and Motohashi (2006) have showed that GDP growth of Japan and Korea stems from IT producing sectors since the late 1990s and IT output growth contributes in Korea’s economy more than in Japan’s economy.

Kim (2002) confirms the positive role of IT on economic growth and productivity in Korea and argue that IT and knowledge capital are the main sources of economic performance of Korea and tries to prove this hypothesis by using growth-accounting methodology and data for 1971-2000 interval.Depending on both the significant contribution of IT to economic growth in the past and the upward trend in magnitude of that contribution according to results of his empirical work.

Complaining about the lack of studies that try to estimate the economic impacts of ICT revolution in post-communist economies, Piatkowski (2003) delineates the contribution of ICT to economic growth in Poland. In order to quantify results of those impacts, he employs an extended growth-accounting methodology by using data covering the period of 1995-2000. Piatkowski (2003) in his empirical analysis reveals that the average contribution of ICT capital to Polish economic growth in the period of 1995-2000 was 0.47 percentage points which correspond to 8.9 percentage of average output growth. Piatkowski (2003) shows that this ICT contribution to economic growth in Poland is much smaller compared to experiences of the EU and the US.

Study of Lederman and Maloney (2003) have shown that there is positive correlation between R&D expenditures and level of GDP per capita. However, this cannot be achieved unless financial depth, protection of intellectual property rights, government capacity to mobilize resources, and the quality of research institutions are provided. It has been proven that Taiwan, Korea, Finland, Israel, China and India are displayed high R&D expenditure while enjoying high level of development

Mahmood and Singh (2003) measure extent of innovation capabilities of NICs (Taiwan, South Korea, Hong Kong and Singapore) in relation to other emerging economies in Asia (India, China, Indonesia, Malaysia and Thailand) and in Latin America (Mexico, Brazil, Argentina, Chile and Venezuela) by using patent data in the years between 1970-1999. In their sector-level analysis , 33 sectors are categorized as "fast-growing", "medium-growing" and "slow-growing" and in order to find out the sectors that are capable of dealing with scientific and technological activities. Besides, "relative technological advantage" (RTA) index that measures the relative distribution of a country's inventive activity in each field and $\chi 2$ index that examines how patenting activities are distributed in given countries are used. The results a rise in technological capability over time in East Asian economies which do not specialize in any mature sectors where the developed countries might not compete in anymore. However county differences are significant. Taiwan, South Korea, Hong Kong and Singapore have much higher patenting than all other emerging countries given. But, Taiwan and South Korea, whose success comes from innovation by domestic firms are assumed to be better than Hong Kong and Singapore in innovation capability. South Korea is making rapid transition from a scale-intensive phase to a technology-intensive phase of development (Bell &Pavitt,1993). India and China stay behind these countries in patenting.

Pappanoui (2004) in his study looks into the innovation effects of foreign direct investment (FDI) and Information and Communication Technologies (ICT) on productivity growth of selected developed (some countries of EU ,US, Canada ,Hong Kong, Israel) and developing countries (China, India, Turkey, South Africa, Poland, Hungary, Romania and some Latin and East Asian countries) in 1993-2001 by using panel data analysis. He reaches the result that innovation effect from FDI is positive and significant for all selected countries while contradictory results are found for ICT and interaction effects of FDI between developed and developing countries. Indjikian and Siegel (2005) have also demonstrated that there is a positive relationship between IT and economic performance by reviewing various researches on this subject, they indicated that changes in workforce as well as organizational structure related with IT improvements would help firms to implement IT more effectively. Furthermore, it is claimed that developing countries could increase the probability of catching up to more advanced countries through well-targeted investment in IT and Internet-related technologies.IT investment and internet would generate high social returns, in this way households and businesses could access IT related goods easily, thus developing countries would obtain important opportunity to improve even perform above the advanced countries in global market. Sustainable economic development of developed countries such as Japan depends on technology innovation which integrates traditional resources (natural ,financial and human) with economic growth (Kondo&Watanabe,2003). On the other hand the speed of convergence in BRICs mostly comes from traditional resources which provide 54 % of Total Factor Productivity (TFP) contribution to GDP in 2004 and with respect to this study Yao et.al (2009) have approved that BRIC's sustainable development also comes from technology innovation ,whereby effective utilization of their potential resources.

Ženko et.al (2004) have presented detailed innovation and technology framework of Slovenia and discussed to what extent Slovenia is prepared to be a member of European Union in the context of knowledge-based economy. Their semi-structured survey with 129 publicly listed on the Ljubljana Stock Exchange reveals the view that the innovation environment is not very promising due to the fact that the number of inventions patented and trademarks registered, either national or international is low for all the firms in the survey. Besides, little interest is shown in obtaining already available funds for innovation, low satisfaction with tax rules and regulations, ISO standards are less important and quality control has low priority

Breitenbach et al. (2005) complain that even though there are lots of efforts to evaluate the role of ICT in economic growth and development throughout the world there is no such a study for South Africa. As a toe-hold, they analyze the impact of ICT on South African economy by utilizing a time series regression analysis with the data that belongs to the period of 1975 to 2002. However, their empirical analyses seem a bit weak due to both several oversimplifications as well as limited number of data points. According to the results, a statistically significant relationship between ICT and GDP is proved. Thus, authors conclude that ICT is an important factor for economic growth of South Africa but they do not refrain from suggesting testing the magnitude of that relationship with a broader set of data.

Fedderke (2005) analyses the growth in TFP due to infrastructure in South Africa using sector specific data to examine impact on TFP growth of the quality and quantity of human capital. On the other hand, aggregate data is used to analyze the interaction between social infrastructure and human capital. His regression results reveal that human capital has a direct effect on output. However, the weight of the impact depends on the quality rather than on the quantity of human capital. Secondly, the formation of human capital is itself dependent on social infrastructure.

Kanamori and Motohashi (2006) focused on the role of IT on economic growth in Japan and Korea from 1985 to 2004. In both countries, the information technology industry is an important source of economic and productivity growth from the output side. In addition, active IT investments are supposed to lead to substantial IT capital service contribution to economic growth from the input side.

Diez and Kiese (2006) has conducted industry-level analysis to search the breadth and efficiency of innovative activities in Singapore, Malaysia and Bangkok by focusing on the innovation capabilities of the manufacturing firms in the survey regions, their propensity to cooperate with external partners in the innovation process, as well as the scales of these cooperation linkages comparison to 11 European Regions. It has been concluded that firms in Singapore, Malaysia and Bangkok are more relying on cooperation with external partners than the firms (90% respondent firms' intensive cooperation relationships with at least one partner). According Diez&Kiese (2006) and Foss (1998), this addresses the lack of resources in these firms necessary to conduct innovation activities which are insufficient in Asian countries when compared with Europe. innovating firms collaborate with local partners, or 'leapfrog' the neighboring regions of South East Asia to work with technologically advanced partners in North America, Europe or Japan.

The rising role of innovation in China has attracted the interest of many scholars (Ao & Fulginiti 2003; Fu 2005; Wu 2000; Wu 2008; Zheng & Hu 2006; Zheng et al. 2008). At the regional level it is shown that innovation makes a positive contribution to TFP growth in China.

Wei and Liu (2006) find the positive impacts of R&D activities on productivity performance at the firm level. Their finding is consistent with the observations at the sector level by Wu (2006; 2009) who showed that R&D contribution to productivity growth in manufacturing is statistically significant. Some authors also provided evidence using cross-regional data (Kuo &Yang, 2008).Others focused on firms within particular regions (Hu& Jefferson 2004).

Wu (2011), on the other hand, discusses the factors that enhance innovation in China. The regional level analysis though regional growth accounting model has showed that innovation has positive effect on economic growth in Chinese regions. An increase in R&D intensity by 0.1% would lead to an increase in innovation by 0.89% and subsequently economic growth by 0.08%.Moreover, infrastructure development, the degree of economic reform, government spending, foreign capital and human capital endowment also play a role in affecting China's innovation and economic growth

Success of Indian knowledge workers with overall economic performance have taken attention of many authors in their studies (Baker &Kriplani, 2004; Friedman, 2004; De Jonquières, 2005; Pink, 2004). Udo &Edoho (2001) who have noted that India has developed IT sector and used its own satellites to reach rural areas.

According to Radhakrishnan (2007), to launch into a knowledge economy provides countries the benefits of economic integration without investing heavily on traditional industrial development and Ireland, Finland and S.Korea are role models for leapfrogging on the knowledge-based economy. In his article, he tried to gain a perspective on the experiences of individuals engaged in the knowledge-economy by conducting interview with IT workers in India in 2004-2005 with more political approach. Several respondents told that IT was a widening gap between the rich and poor and it became less feasible for Indian citizens who are not knowledge professionals to make a living on technology-focused capitals like Bangalore and in general, India has intervened knowledge workers, who are trained with the ideals of adaptability and flexibility in India's work setting, to take part in economic activities in most of its region. Idea of knowledge economy and hiring practices based on castece-system leads immense pressure for the development of KBE (Radhakrishnan, 2007)

In addition to this conclusion, Radhakrishnan (2007) has also developed a counter argument against the effect of World Bank Project “Knowledge for Development” (K4D) which indicates knowledge as something available and free for all people as such hinder the class position of the skilled global experts who are engaged in the knowledge economy and making an elite project appear broad-based and democratic. K4D discourse also narrowly describes proper actions in order to present technology, expertise and IT infrastructure to developing countries. In that context, he claims that instead of successfully creating a new middle class, emphasis on K4D and new economy has had an effect of producing an elite with economic strength unless the problem was remedied through educational intervention and set of policies of the government.

Another area of study that is conducted under knowledge-based economy literature is the relationship between innovation and productivity. The earlier studies have been made on developed countries starting with Cre´pon et.al (1998) (the CDM model) which is referred by many scholars who analyze the same relations (Loof et al. 2003 Janz et al. 2004; Griffith et al.2006)

Benavente (2006) uses CDM model to study innovation and firm performance in Chile. He introduces four dependent variables ,each of which is estimated by different methods: Non-zero research (Probit); (2) research expenditures per employee (Tobit); (3) Innovation intensity (Intensity) and (4) value added per employee per employee (productivity).The results indicate that research and innovative activities are related with firm size and market power. Also, technological opportunities do play a major role in research activities. However, in the short run the effect of both innovation and research expenditure are irrelevant for the firms in Chile. Roud (2007) used the CDM model for Russia. His results are similar to the previous findings of studies on Western European countries plus innovative activities in firms in Russia were constrained by a lack of finances and somewhat by a lack of human resources. Vahter (2006) has analyzed the Estonian CIS3 data without a CDM model, but by regressing total factor productivity on various variables (such as firm size, industry and location dummies). He found that there is a statistically significant productivity premium for firms with product or process innovation in the year 2000.When the productivity in Estonia has been analyzed by CDM model together with CIS3 and CIS4 surveys for 1998–2000 and 2002–2004 (Masso & Vahter,2008), this time product rather than process innovation have significant impact on productivity. This time series analysis has led (Masso & Vahter,2008) to conclude that the significance of process or product innovation varies across different periods, either because these periods are characterized by different stages of economic development or are from different stages in the economic cycle.

Apart from the studies mentioned above, Raffo et.al (2007) has implemented cross-county analysis at international level by using micro-level data to compare innovation and productivity links among European (France, Spain, Switzerland) and Latin American (Argentina, Brazil, Mexico) countries. They find that Latin countries

are more successful in transforming innovation into economic performance. Second, there is the factor of strong fragmentation within emerging countries concerning regulations and institutions affecting investments and performances (Goedhuys et al. 2006).Differences between national systems of innovation in emerging countries are the result of potential economic crisis and different science and technology policies. For example ,time period of the data set of innovation surveys used by the scholar in analyzing Latin American countries is ranged from 1990s to 2000,which include two severe financial crisis in that region.

Ramlan, et al. (2007) has considered whether there is significant impact of ICT on economic growth of Malaysia in the period of 1966-2005 by following growth accounting model and what they find is that investment on telecommunications affects the economic growth in Malaysia significantly. They also prove that approximately one tenth of the growth in human capital productivity is due to ICT during the selected years and claim ICT as core player in Malaysian human development.

Tan and Hooy (2007) measure knowledge-based development in the emerging (China, Malaysia, Philippines and Thailand) and developed countries (United States, Finland, Japan, Korea and Singapore) as well as possible knowledge gaps between East Asian emerging countries by using Data Envelopment Analysis (DEA) and radar chart. They conclude that according to radar chart method, there is a knowledge gap between developed and Asian emerging countries. However, DEA revealed that even though developed countries (US and Japan) use more resources and accumulated more knowledge, small countries with high level of development (Malaysia, Singapore, South Korea and Finland) are more efficient in achieving knowledge-based economy. Besides, Tan and Hooy (2007) claim that East Asian countries are configuring themselves towards new economy and Malaysia , Korea and Singapore can be taken as a evidence of a knowledge economy convergence in the East Asian region since they are strategically important (neighbors with China and Japan) and economically interconnected with US and EU.

Thomas and Sharma (2008) have measured the relative efficiency of the R&D process among developed and four developing countries (India, China, Russia and Hungary) by using Data Envelopment Analysis (DEA) under CRS as well as VRS framework in which patents granted to residents was taken as output and gross domestic expenditure on R&D and the number of researchers as inputs. According to the findings, Japan, Korea and China are efficient under CRS whereas India, China and Hungary are found technically efficient nations under VSR and US is the only country with decreasing returns to scale. Therefore, Thomas and Sharma (2008) indicate that some developing nations can be taken as benchmarks due to their efficient use of R&D sources.

Fu (2008) has looked at the impact of foreign direct investment (FDI) on the development of regional innovation capabilities in China's provinces and cities by using panel data set over the 1998-2004 period. His study has showed that regional innovation capacity as well as efficiency is positively affected by FDI, but the degree of impact depends on the absorptive capacity-the ability of region to identify and exploit information from environment- and the complementary assets. In this term, coastal region of China, which had abundant of R&D staff top universities and research institutes, could more benefit from attracting technology-intensive FDI and achieve fast regional economic growth compared to inland provinces which do not have any experience such innovation accumulation.

In another study, Motohashi and Yuan (2008) have a analyzed the role of innovation factors- that are IT and R&D-on the productivity performance of manufacturing firms in China for the years between 1995 and 2003. TFP index- defines the relative productivity of each firm in each industry, country, and firm size- is used as dependent variable; IT intensity in capital stock and the share of R&D employment in total employment (RD intensity in employment) are taken as independent variable. Unlike the conventional IT capital stock (computer, communications equipment and software, hardware), they include IT-controlled production facilities. Their regression analysis has revealed that IT intensity, are positively correlated with firm-level productivity growth and there is a learning effect associated with IT and R&D investments, so that excessive firm-level dynamics may not be a good thing for achieving innovation-driven productivity growth

Cheng et.al (2009) assess knowledge-readiness of Malaysia which demonstrates its ambitious on achieving knowledge-based economy by preparing "Knowledge-based Economy Master Plan" in 2002 and the "Knowledge Content in Key Economic Sectors in Malaysia" report in 2005 in order to identify key economic sectors which are more likely to integrate into knowledge-intensive activities. They develop Individual Readiness Index which shows the awareness (Awareness Index (AI)),involvement (Involvement Index (II)) and contribution of people Contribution Index (CI) on KBE study, it can be concluded that Malaysians are currently aware of what is going on in the knowledge-based economy, but are not taking enough action to participate and contribute to the development of the new economy.

Katz (2009) explains the macroeconomic impact of broadband technology on employment and productivity in Latin America. This means that considering the direct relationship between economic development and broadband in Latin America, there are regions that already suffer from a deficiency in broadband coverage. The largest share of this gap is concentrated in Venezuela (50%) and Brazil (20%). the region seriously lags in penetration when considering the needs emerging from the economy.

Yunwei et al. (2009) have measured the technology innovation ability in China based on the eight economic regions in the time period of 1999-2004 .Their results have demonstrated that the patent application particularly in the fields of medical or veterinary science which holds high technical innovation capability have increased in China. Although regional differences have been observed in terms of patent application, it has been claimed that the more R&D expenditures, the more innovation activities and output of patents applications. Hu and Mathews (2005), and Gu and Lundvall (2006), Li (2009) claim that increasing disparity in innovation performance between Chinese regions can be eliminated by government support, the constitution of the R&D performers, and the regional industry-specific innovation environment. Apart from these, recently, Mu and Fun (2011) in their article, suggest a theoretical framework to narrow the difference between the concept of National Innovation Capacity (NIC) which describes as the ability of a nation to produce and commercialize a flow of innovative technology and establish a strong connection between common national innovation infrastructure and the environment for innovation in a nation’s industrial clusters (Furman et al., 2002), and policies to establish this capacity in China. What they offer is that NIC can be achieved by diversified stakeholders of innovation such as scientists, technologists, engineers, entrepreneurs, organizations and in that sense, Chinese government should observe and analyze the dynamic process of innovation in key industries, strategic emerging industries, and modern service industries together with social development.

Mocˇnik and Širec (2010) have taken more specific perspective on the information technology and its economic effect. In this cross-county study (cover 160 countries including BRICST) They try to measure the intensity of internet use in terms of ICT and some socio-economic indicators such as investment, international trade, educational and population distribution by using factor analysis. The most significant impact on Internet use is found on the ICT infrastructure followed by educational capability ,income distribution, and investment and international trade. It is confirmed that the impact of each variable would differ across countries, however, the study does not provide specific results for BRICTS countries as well as for the others.

Gryczka (2010) has conducted descriptive analysis on the selected time series of 1990-2008 to examine the role of BRIC countries in new economy. He has anticipated that along with developed countries such as US, Japan and Germany ,some developing countries especially China-leading merchandise exporter with knowledge intensive business services and India-attracting investment on computer and information services turn into critical players on post industrial economies which is called as creative industries.

Ramesh (2010) mentions that China's transformation to knowledge economy has achieved through four processes: (a) Knowledge creation in Coastal region of China which is facilitated by Foreign Direct Investment , (b) Accumulation of knowledge through Technology Parks and Special Economic Zones (SEZ's) which provide knowledge transfer from foreign MNCs to China, (c) incentivisation of research which encourages interaction among universities, research institutes and SME's, (d) reform of education system which is claimed to make little or no contribution to KBE in China due to the fact that Chinese education system is rooted on Confucian tradition that constraint students to be more innovative thinkers and develop new ideas.

Filippetti and Peyrache (2011) have explored the technological capabilities of set of countries including BRICST over the period of 1995-2007 in order to understand pre-conditions for countries to generate and manage technical change. They have introduced Global Capabilities Indicator (GloCap), which was developed by using three dimensions (Business innovation, knowledge skill and infrastructure) and with this indicator, selected countries are categorized into four different groups. According to their findings, three BRICST countries-Brazil, South Africa and India are categorized as unbalanced-catch up group which means that these countries show significant performance in closing their distances from Technological Capability Frontier (TCF) but they are not good at improving the composition of their technological capabilities. Whereas, China, Turkey, Mexico along with Estonia and Lithuania have displayed a balanced catch-up process, they have managed both the expansion of technological capability as well as achievement of balance between business innovation, knowledge skill and infrastructure. In short, overall results have proven how advanced countries-North America, Western Europe and Japan lagged behind in terms of technological capability.

Gokhberg and Kuznetsova (2011) present the development of innovation activities and policies in Russia by comparing the conditions before and after 2008 global financial crisis, They mention that Russia holds a complex and weak innovation system due to unfavorable market conditions, the low efficiency of the NIS, moreover the key actors in the field of innovation—businesses directly transforming existing knowledge into products, services, and other economic benefits—remain underdeveloped (Gokhberg, 2003), in spite of these drawbacks, as it is indicated by many institutions and scholars (Cooper 2005; OECD; WEF; UNESCO) the main strength of Russia in terms of KBE is high quality of human capital. Whereas, it holds one of the most powerful S&T potentials in the world, 44th in terms of this potential's level (Global Innovation Index, 2011).The discrepancy between targeted actions defined in the planning reports and actual innovation practices in the market hinder the innovation transformation of Russia. What they suggest is that revision, and rational combination of various tools which are differentiated for various business agents, industries, regional clusters, as well as for different types of innovating companies.

Kooshki and Ismail (2011) have assessed the external effects of ICT on economic growth on newly industrialized countries (NICs) including Mexico, Brazil, China, India, South Korea, Malaysia, Singapore, Philippines, Thailand and Turkey between 1990-2008 by using endogenous production growth model and in order to see differences among countries, they have grouped the countries as OECD countries (Mexico, South Korea and Turkey), ASEAN members (Malaysia, Singapore, Philippines and Thailand) and BRIC countries excluding Russia. Results showed that ICT has a positive and significant impact on GDP growth in NICs as a whole. In addition this effect in each subdivision is also significantly positive. Accordingly each 1% increase in the ICT investment would result in 5, 2, 11 and 3% increase in the GDP growth respectively in NICs, BRICs, and OECD and ASEAN countries.

Moreover, Fu and Pietrobelli (2011) explain that indigenous innovation and its diffusion are the main motives for technological capability building which brings technological change and catching up in emerging countries which are able to establish their own modern industries through technology acquisition via international trade and investment. However, because of differences in local social-economic as well as technological conditions in emerging and developing countries can hinder benefiting from foreign technology diffusion and cause widening of North-South technology gap. Therefore, what they suggest is that South–South trade and FDI can help adaptation of foreign technology and the acceleration of technological learning and capabilities building.

Finally, Samoilenkoa and Brysonb (2011) have questioned the role of ICT investment on total factor productivity (TFP) in transition economies (TEs) in the period of 1993-2002. Their research model is composed of five dimensions that are used to explore their impact on TFP under five hypotheses which are looking at the relationship between (a) ICT capitalization and productivity, (b) ICT utilization and ICT capitalization (c) ICT diffusion and ICT capitalization. (d) ICT diffusion and health of the economy (e) ICT diffusion and the militarization of the economy. Taking group of 18 TEs in Europe and the former Soviet Union, the authors have categorized these countries as leaders and followers regarding to their performance in five dimensions given above.

Under the context of emerging countries, it is important to mention about the studies that specially conduct on Turkey.The majority of studies conducted in Turkey have been mainly focused on firm and industry level analysis of KBE factors.

Ongan-Baskaya and Erdil (2003) have analyzed the contribution of electronic commerce (e-commerce) to macroeconomic performance of Turkey and some OECD countries. They aim at finding out whether e-commerce together with technological change have significant linkages to economic growth, trade balance, and investment and R&D expenditures. By using the data of total manufacturing industry of OECD countries for the period of 1970-1997 under two OLS models and panel data estimations, it has been found out that while in the short-run technological change causes unemployment, in the long-run this can provide benefits. However this result cannot be generalized due to the lack of empirical studies that observe the similar relationship. Besides, this study has shown that link between technological change and international trade is weaker than the other variables . But in general technological change has effect on the economy of both industrialized and developing countries. Ongan-Baskaya and Erdil (2003) claim the existence of country level differences in OECD countries due to their performance on technology change variables and e-commerce usage, however they do not mention county specific analysis or suggestions.

Serdar (2003) has applied system dynamics model, which is described as method for qualitative description, exploration and analysis of complex systems in terms of their process, information, organizational boundaries (Wolstenholme, 1990) and to analyze the interaction between technology improvement and national technology policies in Turkey and provide a tool for strategic S&T policy makers. Under this framework, he has established influence diagram which maps the complicated linkages among these policy actors and in addition to interview with experts and literature survey, he defines the area of concentration zones for policy making: a) Free Technology Zones, b) Fusion-Diffusion and Transfer of Technology,c) Academia-Government, d) R&D Expenditures,e) Technological Capability of Turkey) National Innovation System (NIS), g) Product-Process Development, h) Technology Improvement. What he suggests is that Turkey should pay special attention on increase of number of risk capital firms,high / low technology export ratio, number of firms cooperating with University-Industry Research Centers (USAMs), number of USAMs, article/instructor ratio, education level, both private and government R&D expenditures, technology effect on GNP in order to achieve national technology improvement.

Pazaroglu and Gurler (2007) have analyzed the relationship between telecommunications infrastructure and economic growth and productivity on 30 countries which are member and candidate countries of European Union between 1990 and 2004.Their fixed panel data analysis in which real GDP has been taken as an dependent variable, public spending (as % of GDP), fixed investment (as % of GDP), total import-export, telecommunication access per 1000 people, personal computers per 1000 people and telecommunication investment as returns to scale have been chosen as independent variables. The results indicate that for all selected countries, the effect of telecommunication infrastructure on economic growth is significant. Particularly, the increase in infrastructure investment has more effective on the economic growth of countries such as Denmark, Estonia, Holland, in addition the economic growth of Turkey, which in context of ICT investment, only remains behind those of Ireland and Poland.

Adacay (2007)on the other hand, has studied on comparison between Turkey and European countries, by using the indicators of R&D intensity (R&D spending /GPD), number of R&D personnel, number of scientific journal published (per million people), high technology export, number of patents application, and ICT spending (million US $). He concludes that Turkey, in general, performs below the European countries because of insufficient resource allocation on the field of science and technology and its fragmented innovation system. Although Turkey has prepared many strategic vision plans and defined long term goals to move towards new economy, it is unable to achieve them unless Turkey makes necessary investment on infrastructure and human capital.

Oktay and Kaynak (2007) have also made comparison of Turkey and EU-27 countries to measure the relationship between knowledge input and output variables through canonical correlation. They have chosen the variables on the basis of World Bank 's KAM method.ICT spending, public and business R&D spending ,number of graduate students from science&engineering field, Human Development Index, public education spending (% of GDP) are taken as input variables while high-technology export as a share of GDP, number of patents registered to USPO, cellular subscription per 100 people, internet users per 100 people and percentage of business with internet access are taken as knowledge output. What they have found is that the correlation between the knowledge economy input and output indicators of the European Union with Turkey is high.

Along with the studies below, industrial level innovation capabilities is taken attention under KBE literature. Because industrial clusters (IC) which are assumed to be important source innovation are also another area of interest in literature. Emphasis on understanding the linkages among industrial cluster and external economies, knowledge transfer, skills and learning among firms in geographical proximities has been mentioned with the theory of Alfred Marshall (1980).Repeated interactions among these clusters can boost significant learning and innovation. Their ability to coordinate devices for resource development and knowledge diffusion, in turn, presents new combination of skill and knowledge for given area (Lundvall,1985).So in that context, ICs work as a catalyzer of innovation at regional level in a country (Isaksen,1996; De Propris,2002).

Ozkanli et.al (2008) make empirical analysis on intra and inter industry district (ID) and firm relationship in order to determine innovation capabilities of firm and map out prospective ID innovation policies in Turkey. Taking Ankara One Industrial District in Sincan as research sample, they have conducted survey with 207 firms operating mostly in metal (38.16%) and machinery& equipment (13.53%) industry in 2005. The results disclose that inter firm relations and collaborations among these firms are one of the source of innovation capacity in Turkey. Besides, Ankara District displays some structural problems due to mismatch between technology used and skill of labor, financial constraints and hosting firms, most of which have no interaction with global market. Similar to this study, Irena (2010) examines the inter-firm and firm-university linkages among actors located in METU Techno-park and Bilkent Cyber-park. Through the questionnaires and interviews conducted with the representatives of the techno-parks' management, it has been understood that these techno-parks put their efforts towards stimulating technological innovation and generation of scientific collaboration and economic productivity. Results also reveal that there is a certain extent of firm-university relationships and low level of inter-firm interactions. Because most of the firms in techno-parks do not aware of the benefits that they can obtain through inter-firm network, which is a problem that can be solved by fostering and encouraging networking among those firms

Beyhan et al.(2009) focus on the reliability of Community of Innovation Survey (CIS) from the perspective of Turkey. Comparing the discrepancies the Oslo manual (2005) and the CIS applied by TUIK in the period of 2004-2006, They find out that CIS of TUIK remains insufficient in terms of coverage of marketing and organizational innovation sections together with the lack of questions dealing with networking among firms, duration of relationship, proximity, trust, developers and users of innovation.Moreover, Oslo manual includes five main factors hampering innovation namely, cost, knowledge, market, institutional, and other factors whereas CIS includes only four of these and leaves out the institutional factors such as the lack of infrastructure, poor IPR, regulations, standards and taxing. Therefore exclusion of some critical factors can prevent the policy makers or interest actors measuring the real innovation capacity in Turkey.

Yeloglu (2009) provides much detailed comparison settings for Turkey than the one Adacay (2007) has resulted via conducting empirical research with hierarchical cluster analysis which enables grouping similar items from a large set of data and building hierarchy among these clusters.Yeloglu (2009) tries to measure to what extent Turkey exhibits similarity to North European and OECD countries in terms of progression towards to KBE in the period of 1995-1999. Under the five knowledge economy variables which are selected from OECD's variables for knowledge economy measurement (1) production, (2) employment, (3) wages and salaries, (4) value addition, (5) number of established firms, it is concluded that in comparison to OECD countries, Turkey shows resemblance to North European countries in terms of changes in those variables and its level of progression towards KBE remains below that of OECD countries.

Yapraklı and Saglam (2010) who claim that ICT has positive effect in the short and long run.IT investments are also the main reason for the increased growth rates of total factor productivity. However, as concluded by previously mentioned studies, the main requirements to benefit from information technology are ICT infrastructure and capacity to absorb knowledge. According to Saatcioglu and Ozmen (2010) finance of innovation as well as problems with raw materials perception of innovation is risky affected all the barriers in front of innovation process in Turkey.

Isik (2010) has discussed the ICT's impact on economic growth in Turkey from the period of 1980-2009. In order to determine causality relationship between these two factors in the short and the long term, he has used autoregressive distributed lag (ARDL) approach to cointegration and error correction models. As a result, it is confirmed positive relationship in short run and negative relationship in the long run between economic growth and information technology investment which is also the reason behind the increased growth rates of total factor productivity in selected period in Turkey.

Isik and Kilinc (2011) provide another comparative analysis among OECD, EU-27, Japan, US, Turkey, Greece, China and Brazil in order to see role of innovation and R&D on regional development in Turkey. Using R&D spending, the number of patent and intellectual property applications high technology exports ,the number of researchers and entrepreneurs as innovation indicators. They reach the conclusion that Turkey, Greece and Brazil display performance below the world average in most of these indicators. For instance in the period of 1998-2008, the number of researcher and volume of high technology export in Turkey remains below the average of OECD while show similar performance with Russia and Greece. Nevertheless, Turkey is in advantageous position for regional development due to increasing number of entrepreneurs and young population, suitable environment for making innovative activities. In order to eliminate the drawbacks such as discrepancies among the regions in terms of economic, social and infrastructure tools, insufficient use of resources etc. Turkey is expected to: (a) improve R&D environment and technology infrastructure and provide incentives for patent and trademarks (b) increase investment for human, financial and any other knowledge-based resources, (d) encourage the collaboration among universities, firms, industries, SMEs and any other actors who directly or indirectly contribute innovation activities in Turkey.

Different from the studies above, Bascavusoglu-Moreau and Colakoglu (2011) concentrate on the effect of changes in SME policies, which was introduced in 1990s in order to provide funds and credits to small businesses that have experienced a lack of demand, innovation decision and activities in Turkey. Using firm-level survey conducted on 45.000 SMEs, innovative capabilities of firms are assessed in terms of their innovation efforts, innovation decision and innovative intensity and dividing the sector of firms as high-tech (firms with more than one patent) and as low- tech (firms with one or no patent), they conclude that R&D investments, educational level of the employees, outsourcing, use technology intensive production processes and ICT also are highly associated factors of innovative efforts. Moreover, industrial diversity has a negative effect at the beginning of innovative capacity building and institutional environment, particularly the human capital and public investment at the regional are claimed to play important role for innovation efforts.

The recent study in the context of Turkey and KBE (Karagol& Erdil, 2012) has discussed the effects of ICT revolution (rather than ICT usage as it is the case for most of the studies mentioned in literature part) on economic growth in Turkey and other OECD member countries by performing panel data analyses for thirty OECD member countries for 1999-2008 period as well as time series analyses for only Turkey by using data between 1980 and 2009. The aggregate output is taken as dependent variable while capital and labor as independent variables together with two other explanatory variables namely ICT usage and ICT production, which are used to analyze change in output (GDP) with the changes in capital, labor, ICT usage and ICT production which is the only indicator that is unavailable for Turkey's analysis due to lack of data. Overall results show that in the case of OECD countries capital, labor, ICT usage and ICT production variables demonstrate positive impact on the economic growth. Due to some methodological difficulties and insufficiency of critical mass regarding ICT area and complementary physical and social infrastructures in Turkey, they cannot find any significant relationship between ICT and economic growth for Turkish case.

In sum, following the Schumpeterian idea of innovation as a major force of economic dynamics, many scholars put important interest in developing new growth theories- reflects the attempt to understand the role of knowledge and technology in driving productivity and economic growth (OECD,1996)- to explain the forces that drive long-term economic growth.

Based on the literature review, it can be said that most of the studies that deal with KBE have focused on measuring the link between ICT and macroeconomic performance in a given country. However the exact nature of relationship vary between industries and countries. It can be reasonable to assume that policy environment and ICT infrastructure together with qualified human capital are basic requirements to successful establishment of KBE and reap its benefits through economic growth. Besides, as it is explained above, there are some variances among BRICST countries, therefore in this study aim is to assess the impact of the determinants of KBE on macroeconomic performance of BRICST countries over the period of 2000-2010; and to understand the capability of these countries in the process of transformation of their economic structures towards this new economy.

Overall conclusion is that investment infrastructure, innovation and education are keys to economic development in new age economy. Evidence on the impact of ICT investment on growth performance emerges from a variety of studies. First, aggregate-level studies provide evidence of the accumulation of ICT capital and of its contribution to output and labor productivity growth. The impact of ICT investment on economic growth is commonly regarded as a main driver of the new economy. Second, industry and firm-level evidence shows the impact of ICT on business performance in more detail. Lastly, the economies emerging countries are more positively affected from the factors of KBE than that of advanced countries.

CHAPTER VI

METHODOLOGY AND DATA

In this study, OLS regression model is employed to empirically assess the impact of KBE factors on macroeconomic performance for six emerging countries, Brazil, Russia, India, China, Turkey and South Africa over the period of 2000-2010.

In the review of existing literature the relationship between ICT and economic growth in developed and emerging countries are strongly emphasized and we see that technology infrastructure, education and human capital and innovation are important elements that are needed to be improved in the new economy .In that context, firstly, model in this study has been developed by categorizing the determinants of knowledge economy factors as; Education level (EL), Information and Communication Technology (ICT) and Potential for Innovation (PI) .

$$EP = f(EL,ICT,PI) \quad (1)$$

The model is adjusted to test the impact of the determinants of knowledge economy factors economic growth as follows:

$$EP_{it} = \beta_0 + \beta_1 \, ALR_{it-1} + \beta_2 SE_{it-1} + \beta_3 LEB_{it-1} + \beta_4 \, TMP_{i\,t-1} + \beta_5 MPP_{it-1} + \beta_6 \, INU_{it-1} + \beta_7 \, CMP_{it-1} + \beta_8 RDP_{it-1} + \beta_9 SJAP_{it-1} + \beta_{10} \, GERD_{it-1} + \varepsilon_{it} \quad (2)$$

where subscript i denotes countries and t represents time period.

The annual data for six countries are used for the period between 2000-2010. All variables are in natural logarithms. GDP, GDP per capita (GPDPC) and economic growth rate (GRW) are considered as alternative dependent variables in the model. Independent variables are the major determinants for KBE as they are presented in Table 22.

Table 22. Determinants of KBE achievement

Determinant	Proxy Variable	Definition	Source	Effect
Education	Adult Literacy Rate (ALR)	The proportion of the adult population aged 15 years and over which is literate.	WB	+
	Secondary Enrollment (% gross) (SE)	The ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education	WB	+
	Life Expectancy at birth (LEB)	Life expectancy at birth, total (years)	WB	+
Information and Communication Technology (ICT)	Fixed telephone lines (TMP)	Fixed telephone lines (per 100 people)	WB	+
	Mobile Phones per 100people (MPP)	subscriptions to a public mobile telephone service using cellular technology per 100 people	UN	+
	Internet Users per 100 people (INU)	Internet users are people with access to the worldwide network.	WB	+
	Personal Computers per 100 people (CMP)	The number of Personal Computers (including PCs, laptops, notebooks) which measures the number of computers installed in a country is divided by the country's population and multiplied by 100.	MDGI	+
Potential for Innovation	Number of R&D personnel (RDP)	Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned. Postgraduate PhD students engaged in R&D are included.	WB	+
	Scientific and Technical Journal Articles (SJAP)	Scientific and technical journal articles refer to the number of scientific and engineering articles published in the biology, chemistry, mathematics, clinical medicine etc.	WB	+
	Gross Domestic Expenditures on Research and Development (GERD)	Total domestic intramural expenditure on R&D during a given period as a percentage of the GDP	UNESCO	+

In era of rapid technological changes, enrollment and literacy rates are important contributors for economic development of countries. Literacy is also fundamental barrier to participate in knowledge societies. Cohen and Soto (2007) show that increased level of education has a substantial impact on productivity growth. Accumulation of educated people can affect country's ability to innovate, benefit from ICT and catch-up with advanced countries. Besides, when considering developing countries, education can provide economic freedom for the citizens. Shirazi et.al (2010) find out that in Middle East countries namely Bahrain, Iran, Jordan, with high level of educational attainment obtains greater benefit from ICT and expansion of ICT infrastructure together with education have positive impact on economic freedom. Therefore, we expect that the effect of adult literacy rate on economic performance of emerging countries is to be positive.

In addition, the expected sign of coefficient for secondary enrollment is also positive due to the fact that secondary level education aims at achieving lifelong learning and human development through subject or skill-oriented instructions. Therefore, in countries where the secondary enrollment level is high, people are able to understand, use and integrate knowledge from various resources, be more capable of handling ICT tools and as a result they can increase their intellectual capital, involve more in innovative activities and contribute the economic growth and welfare.

In terms of relationship between life expectancy at birth (LEB) and economic growth, there are some contradictory findings in the literature. On one hand, some studies have shown that LEB has positive effect and is significant predictor of economic growth (Bhargava et al. 2001; Jayachandran & Lleras-Muney 2008;

Lorentzen et al. 2008). On the other hand, Acemoglu and Johnson, (2007) show that LEB has little or no effect on total GDP, More importantly, GDP per capita and GDP per working age population show relative declines as large increases in life expectancy trigger faster population growth. Radelet et al. (1997) measure a non-linear relationship between LEB and economic growth in Asian countries and the results indicate that high level of LEB probably can enhance economic growth by increasing the supply of and productivity of labor. However, this positive effect diminishes and brings negative impact on aggregate growth and economic welfare as life expectancy continues to increase which means that retired age population lives longer, consumes more out of their life time savings and reluctant to contribute the economy by joining any workforce. Apart from these claims, Cervellati and Sunde (2009) explain that the causal effect of life expectancy on income per capita is likely to differ systematically during the different phases of economic and demographic development whereas according to Kelley and Schmidt (1995) population growth is not all good or all bad for economic growth but both elements coexist. In spite of these ambiguous results in previous studies, the expected sign of LEB is assumed to be positive in our analysis.

ICT indicators are assumed to have positive signs based on various studies that have been mentioned in the literature review (Kooshki &Ismail 2011; Yoo 2003; Kanamori &Motohashi 2006; Pazaroglu& Gurler 2007). It is expected that internet users in selected countries bring positive contribution on the economic growth as well as welfare of the citizens. Several studies have already demonstrated similar results in the literature. According to Freund & Weinhold (2004), internet has a positive effect on bilateral trade and foreign direct investment, respectively. By using panel data with 207 countries from 1991 to 2000, Yi and Choi (2009) find evidence that internet plays a positive and significant role in economic growth after investment ratio, government consumption ratio, and inflation are used as control variables in the growth equation.

Broadband infrastructure such as fixed telephone line and mobile phone subscription boost economic growth, because broadband networks act as channel for providing different services such as PSTN, VoIP ,videophones, high-speed internet and other multimedia services (online games, video streaming).Internet, PC, cell phone, main telephone, and broadband are generally considered the most important determinants of international disparities in ICT with the potential to promote economic growth and human development (Dewan & Riggins, 2005). These ICT indicators have been used to describe the speed of technological adoption and the availability of physical resources that allow access to the digital economy and stimulate its social and economic development (Corrocher & Ordanini, 2002).

As people can easily search and reach to necessary information any time, transaction cost decreases; these services can cultivate the capabilities of labor force as well as the profit of related industries, in return broadband network positively affect the economic growth and welfare of the countries. Sridhar and Sridhar (2004) show that there is a significant impact of cellular services on national output. Another study (Madden& Savage, 1998) conducted on transitional economies in Central and Eastern Europe exhibits that telecommunication investment, especially when measured by main telephone lines, is related to economic growth and the improvement in the telecommunication infrastructure can improve the link between aggregate investment and growth. In addition to these, Datta and Agarwal (2004);

Lehr et al.(2006) also conduct similar studies in which they demonstrate the positive contribution of broadband infrastructure in economic level.

However, the majority of studies of computers and productivity that have been published have turned up little evidence of positive impact (Berndt &Morrison, 1994; Loveman 1994). Doms and Lewis (2005) have found that some areas adopt computers much more intensively than others and demonstrated that areas which were computer intensive in 1990 are also the areas that enjoy faster real wage growth for college-educated workers and, to a lesser degree, for workers with less than a college education.

The number of personnel employed in R&D activities and the total amount of expenditure on R&D are included as explanatory variables in the model. The R&D process is essentially a knowledge generation process where resources like scientists, engineers, technicians, research equipment are employed to create new knowledge. Because of this relationship, the effect of R&D expenditure and R&D personnel number on economic performance is assumed to be positive.

The correlation among the available data is tested and the variables with $r>0.6$ are eliminated with stepwise analysis. High correlation (0.70) between ALR and SE is seen as it is expected. As people complete their secondary education, it is natural to have higher literacy rate in the society. TMP is also correlated with ALR (0.72) and LEB (0.69). MPP (0.93) and INU (0.86) are highly correlated with GDP PER CAPITA, indicating that the use of mobile phones and internet increase with higher GDP per capita. A parallel trend is seen for INU and MPP. Their correlation rate is (0.77), showing that people prefers mobile lines for accessing internet. CMP and SE has a correlation rate of 0.79, which shows that people start using more personal computers as their education level rises. RDP has correlation with ALR (0.78) and TMP (0.70). GRW is correlated SJAP (0.67) and GERD (0.62), indicating a positive relation between economic growth and expenditure on R&D as well as number of journal articles.

There are two main obstacles in conducting empirical research on emerging countries : (1) the limited availability of reliable time series data (Hoskisson et.al 2000; Samoilenko & Bryson,2011) and the lack of clear consensus for the definition of emerging, developing, and transition economies in the literature (Samoilenko, 2008). In this study, some variables such as patent application granted by USPTO (per million people) and technicians in R&D (per million people) are eliminated due to the lack of consistent data. On the other hand, the countries in the sample are clearly perceived as emerging markets.

Table 23. Correlations Among Variables Used in Panel Data Analysis

	GDP	GDPPC	GRW	ALR	SE	LEB	TMP	MPP	INU	CMP	RDP	SJAP	GERD
GDP	100.000	-.20370	.63953	.16098	-.19151	.42300	.17268	-.09899	.11487	.03254	.64536	.96897	.96443
GDPPC		1.00000	-.19368	.55685	.57329	.18474	.54985	.92626	.85510	.55206	.48950	-.33620	-.37834
GRW			1.00000	-.08378	-.42255	.14045	-.07999	-.06997	-.06741	-.22523	.29355	.66961	.61899
ALR				1.00000	.70462	.28010	.72751	.56071	.48545	.53140	.78191	.05138	.11317
SE					1.00000	.08204	.51338	.51969	.49247	.78838	.37101	-.33976	-.26028
LEB						1.00000	.68593	-.00433	.43622	.09242	.55304	.37172	.32423
TMP							1.00000	.43915	.55572	.34451	.70468	.11946	.10245
MPP								1.00000	.76920	.54596	.51362	-.21306	-.25040
INU									1.00000	.66422	.63559	-.03566	-.09029
CMP										1.00000	.41928	-.16265	-.11671
RDP											1.00000	.54752	.54989
SJAP												1.00000	.98504
GERD													1.00000

Based on the correlation findings, the variables in the model are reduced with stepwise analysis and the base model is obtained as follows.

$$EP_{it} = \beta_0 + \beta_1 \, SE_{it-1} + \beta_2 \, TMP_{i\,t-1} + \beta_3 \, MPP_{it-1} + \beta_4 \, CMP_{it-1} + \beta_5 \, RDP_{it} + \beta_6 \, GERD_{it-1} + \varepsilon_{it} \quad (3)$$

The econometric model analyses the impact of KBE indicators on economic performance for the BRICST countries with the available data for the period of 2000 and 2010 to test the following hypotheses.

Hypothesis 1: Knowledge-based economy indicators improve economic performance of the BRICST countries.

Hypothesis 2: Economic performance is positively related with education level indicators in the BRICST countries.

Hypothesis 3: ICT infrastructure enhances economic performance in the BRICST countries.

Hypothesis 4: Innovation potential stimulates economic performance in the BRICT countries.

CHAPTER VII

EMPIRICAL FINDINGS

The impact of KBE determinants on economic growth is analyzed by employing Ordinary Least Square (OLS) Model. As a first step, the sensitivity of fundamental factors such as education level, ICT and innovation potential are tested individually and simultaneously. Since the findings for individual factors are found to be statistically not significant, it is not presented in this study. However, the simultaneous effect as it is presented as Model 1 is found to be significant. As a second step, the sensitivity of economic performance is considered and alternative dependent variables, GDP, GDPPC (GDP per capita), GRW (economic growth rate), are run against explanatory variables. The empirical results for GDP PER CAPITA and GRW are found to be consistent and statically sign, respectively. As a third step, high values for some pairwise correlations among independent variables are taken into account. Highly correlated variables are dropped from the initial model and the base model (Equation 3) is obtained. Two versions of the models are run with different dependent variables to determine the best identification for the impact of knowledge-based economy on economic performance.

The econometric estimation of OLS Model for dependent variable, GRW, for the period 2000-2010 is presented in Table 24.

Table 24. OLS Model with Economic Growth as the Dependent Variable

	Model I	Model II	Model III	Model IV	Model V	Model VI
Constant	-4335.13	923.962	-	-	-	-
	(-0.903)	(0.435)				
LnALR	970,990	-	-	-	-	-
	(1,221)					
LnSE	.09470646	0.088	0.0840	0.0349	0.095	0.132
	(0.880)	(0.820)	(0.787)	(0.344)	(0.900)	(1.282)
LnLEB	138.881	-218.249	-6..444	-106.401	-	-
	(0.230)	(-0.411)	(-0.158)	(-0.265)		
LnTMP	-149.401	45.197	-	8.020	20.260	13,997
	(-0.800)	(0.463)		(0.086)	(0.267)	(0.198)
LnMPP	-98.409	-89.184	-79.026	-	-72.661	-71.420
	(-1.291)	(-1.170)	(-1.090)		(-1.131)	(-1.434)
LnINU	50.285	20.509	11.245	-	-8,128	-
	(0.463)	(0.193)	(0.108)		(-0.102)	
LnCMP	33.853	62.455	804.096	-12,426	80.347	47.935
	(0.361)	(0.684)	(0.979)	(-0.195)	(1.008)	(0.634)
LnRDP	-0.441*	-0.400	-0.332	-0.259	-0.344	-0.290
	(-1.722)	(-1.569)	(-1.607)	(-1.174)	(-1.605)	(-1,379)
LnSJAP	0.163*	0.131	0.128	0.119	0.128	-
	(1.62)	(1.471)	(1.451)	(1,340)	(1.452)	
Ln GERD	0.072	0.056	0.065	0.088	0.048	0.088
	(0.633)	(0.494)	(0.587)	(0.811)	(0.437)	(0.824)
Adjusted R-Squared	.138E-01	.522E-02	.189E-01	-.239E-02	.197E-01	.177E-01
R-squared	0.17	0.14	0.14	.010	0.14	0.11
Est.Autocor. of e(i,t)	-0.238	-0.211	-0.200	-0149	-0.204	-0.198
F [.,.]	1.09	1.04	1.16	0.98	1.16	1.20
Log likelihood	-455.89	-456.77	-456.89	-458,183	-456.87	-458.07

Parameters are statistically different from zero at the 1, 5 and 10% confidence level in a two-tailed t test. t-statistics and ***, ** and * denote significance levels, respectively.

When the impact of KBE factors is tested against economic growth rate, the coefficients have inconsistent signs. In addition, most of them are not statistically significant even at 10% confidence level. The R-square values are also low, indicating weak explanation of explanatory variables. As an alternative approach, GDP per capita is utilized as the dependent variable and the empirical results are presented in Table 25.

Table 25. OLS Model with GDP per Capita as the Dependent Variable

	Model I	Model II	Model III	Model IV	Model V	Model VI
Constant	22.375***	12.231***	8.315***	6.005***	5.920 ***	5.788***
	(3.862)	(4,671)	(3.682)	(25.915)	(27.773)	(29.572)
LnALR	-1.873*	-	-	-	-	-
	(-1.951)					
LnSE	0.0001	0.0001	0.0001	0.0004***	0.0002	0.0002
	(1.030)	(1.096)	(0.823)	(2.850)	(1.427)	(1.267)
LnLEB	-2.270***	-1.581**	-0.515	-	-	-
	(-3.112)	(-2.417)	(0.958)			
LnTMP	0.690***	0.315**	-	0.301***	0.134	0.188*
	(3.064)	(2.620)		(2.809)	(1.370)	(2.056)
LnMPP	0.162*	0.144	0.215**	-	0.264***	0.335***
	(1.768)	(1.545)	(2.286)		(3.187)	(5.187)
LnINU	0.296**	0.353**	0.288	-	0.146	-
	(2.257)	(2.699)	(2.139)		(1.417)	
LnCMP	0.242**	0.187	0.312***	0.712***	0.317***	0.363***
	(2.141)	(1,667)	(2.924)	(8.058)	(3.079)	(3.705)
LnRDP	0.0003	0.0002	0.0007 **	0.0001	0.0006**	0.0006**
	(0.894)	(0.629)	(2.506)	(0.472)	(2.161)	(2.180)
LnSJAP	-0.0001	-0.0006	-0.00009	-0.00005	-0.00008	-
	(-1.121)	(-0.582)	(-0.742)	(-0.329)	(-0.766)	
Ln GERD	-0.00003	-0.00002	0.00006	-0.0002	-0.00006	-0.0001
	(-0.238)	(-0.014)	(0.423)	(-1.457)	(-0.392)	(-0.792)
Adjusted R-Squared	0.87	0.86	0.84	0.78	0.85	0.85
R-squared	0.89	0.88	0.87	0.80	0.87	0.863
Est.Autocor. of e(i,t)	0.763	0.795	0.789	0.798	0.802	0.811
F [.,.]	44.17	46.34	46.49	39.64	47.37	62.06
Log likelihood	-12.401	-14,609	-18.42	-31.71	-17.88	-19.37

Parameters are statistically different from zero at the 1, 5 and 10% confidence level in a two-tailed t test.
t-statistics and ***, ** and * denote significance levels, respectively.

The empirical results of GDP PER CAPITA as the dependent variable improve significantly. First of all, the explanatory power of the models, R-square, increases significantly, ranging between 0.80 and 0.89. This shows that indicators of KBE have a strong effect on the variation in GDP per capita. In addition, the adjusted R^2 also improves for all models with GDP per capita as the dependent variable. The calculated F values in all versions of estimations are higher than the one percent critical value from F Table.

The coefficients measure magnitude of the effect coming from explanatory variables of KBE on economic performance variables on GDP per capita which is defined as an indicator of economic growth. The effect of SE on GDP per capita is positive in all versions as it is expected and statistically significant at 1% confidence level in Model IV.

Surprisingly, LEB, life expectancy at birth, has a negative impact on GDP per capita in this sample. It is significant at 1% and 5% confidence levels in Model I Model II, respectively. The negative relationship can be due to characteristics of the countries in the sample. They have high population rates and relatively low life expectancy at birth compared to developed countries. Life expectancy at birth is defined as the average number of years a person born in a given country would live if mortality at each age remains constant in the future. LEB is also perceived as an indicator that reflects the quality of healthcare in the countries. In the sample, the ranking of the BRICST countries for according to life expectancy at birth by the United Nations is as follows: China is 80th with 73 years; Brazil is 91st with 72.4 years; Turkey is 98th with 71.8 years; Russia is 112th with 70.3 years; India is 139th with 64.7years and S. Africa is 178th with 49.3 years. India and S. Africa are below the world average which is 67.2. Especially, high poverty levels in India and HIV/AIDS infections levels in S. Africa could be the main factors contributing to low life expectancy rates.

Empirical findings in the literature are also contradictory. Some studies have shown that LEB has positive effect and is significant predictor of economic growth

(Bhargava et al. 2001; Jayachandran & Lleras-Muney 2008; Lorentzen et al. 2008) while some studies demonstrate little or no effect on total GDP and GDP per capita (Acemoglu &Johnson, 2007; Radelet et al., 1997; Sunde, 2009; Kelley and Schmidt, 1995).

The explanatory variables of TMP, MPP, INU, CMP and RDP have expected positive effect on GDP per capita as it is expected. Though, they show difference in terms of significance. The impact of ICT infrastructure indicators which are defined as fixed telephone lines, TMP, mobile phones, MPP, internet users, INU and number of personal computers, CMP, on GDP per capita are found to be significant in many versions of the model in the sample for the period of 2000-2010. This shows that as ICT infrastructure improves economic performance through enhancement of people’s skill and capability and chain effect of value-added created trough technology diffusion in other sectors.

In order to determine the base model, the correlated explanatory variables are eliminated from Model I. ALR is correlated with SE, TMP and RDP; LEB is correlated with TMP; INU is correlated with MPP and CMP. Therefore, ALR, LEB, INU and SJAB are not included in the base model. The R-square of the base model is 0.85 with a F-value of 62. The impact of SE on GDP per capita is positive but it is not significant. However, the impact of TMP, MPP, CMP and RDP on GDP per capita are positive and statistically significant for the BRICST countries, supporting many empirical studies in the literature.

Internet, PC, cell phone, main telephone, and broadband are generally considered the most important determinants to promote economic growth and human development (Dewan & Riggins, 2005). Broadband networks act as channels in access to the digital economy and help the pace of technological adoption that stimulates social and economic development (Corrocher & Ordanini, 2002). Therefore, empirical findings about the impact of ICT infrastructure on economic performance are in the parallel of the studies by Sridhar and Sridhar (2004), Madden& Savage (1998), Datta and Agarwal (2004), and Lehr et al. (2006).

The impact of R&D personnel number (RDP) on economic performance is found to be positive in all versions of the model and it is significant at 5% confidence level in the base model. Economic performance is positively affected from knowledge generation process with well equipped human resources like scientists, engineers and technicians for the given sample. However, the sign of coefficient for R&D expenditure is negative but insignificant. Human capital in the process of knowledge generation is much more important determinant for economic performance in the BRICST countries.

In summary, OLS approach is used to determine the impact of knowledge-based economy on economic performance for a group of emerging countries, Brazil, Russia, India, China, S. Africa and Turkey for the period of 2000-2010. Main findings are as follows:

- Empirical results reveal a significant impact of knowledge-based economy indicators on GDP per capita rather than economic growth rate.
- The coefficient of secondary education on GDP per capita is always positive, indicating that secondary enrollment level boosts economic performance in the BRICST countries. As the secondary enrollment level increases, people are able to understand, use and integrate knowledge from various resources, be more capable of handling ICT tools and as a result they can increase their

intellectual capital, involve more in innovative activities and contribute the economic performance and welfare (GDP per capita).

- ICT indicators such as fixed telephone, mobile phone and personal computer are found to be important infrastructure channels that affect GDP per capita positively in the BRICST countries.

- The number of R&D personnel as indicator for innovation potential has positive influence on GDP per capita while the negative impact exists with respect to R&D expenditures. Accumulation of educated people in R&D can affect country's ability to innovate, benefit from ICT and enhance economic performance.

- Expansion of ICT infrastructure together with educated R&D personnel has positive impact on economic performance.

CHAPTER VIII

CONCLUSION

Recent financial crisis and remarkable presence of ICT market has increased attention to KBE as an viable option in terms of providing solution to global macroeconomic problems. Many countries around the world have already developed policies and target short and long term objectives to realize the requirements of KBE that are put forward by World Bank's Knowledge Assessment Methodology: (1) establishing economic institutional regimes in a way to (2) realize a successful education system that encourage innovative thinking , (3) providing necessary infrastructure to allow diffusion of technology and innovation in the market as a result increase the efficiency of countries' innovation system.

This broad topic in new global agenda bring particular interest of various actors towards KBE with the question in the mind that whether KBE can be new engine for the economic growth in national and global market and how we can benefit from its outcomes. The abundance of study conducted on KBE have shown that ICT increases economic and productivity growth both developed and developing countries through technology innovation and accumulation of knowledge with effective utilization of potential resource. In this context, emerging countries particularly the BRICST are viewed as having enough capacity to make transition from a scale-intensive production process to technology intensive phase of development.

This study focuses on set of components of KBE and their impact on economic performance in BRICST countries over the period 2000-2010. Overall results show that determinants of KBE do not display significant influence on GDP and GDP growth rate as economic performance indicators in the BRICST countries. However, they have significant impact on GDP per capita.

The empirical findings are in line with the results in empirical studies in the literature. Although we expect that LEB makes positive effect on economic performance, the empirical findings for LEB confirm the findings of Acemoglu and Johnson (2007) who find no impact of LEB on economic growth. The coefficient of secondary education on GDP per capita is always positive, indicating that secondary enrollment level boosts economic performance in the BRICST countries. Moreover, ICT indicators such as fixed telephone, mobile phone and personal computer are found to be important infrastructure channels that affect GDP per capita positively in the BRICST countries in parallel to the findings of Sridhar and Sridhar (2004), Madden& Savage (1998), Datta and Agarwal (2004), and Lehr et al. (2006).

As indicators for innovation potential, the number of R&D personnel has positive influence on GDP per capita while the negative impact exists with respect to R&D expenditures. Therefore, as the secondary enrollment level and accumulation of educated people in R&D increase, country's ability to innovate and benefit from ICT improves and boosts economic performance. The intellectual capital is vital for integrating knowledge from various resources, handling ICT tools enhancing innovative activities and contributing economic performance and welfare of the society.

The BRICST countries have remarkable position in terms of international ICT trade and manufacturing, however, there is still need for creating appropriate business and legal environment to boost innovation activities and economic performance. Efficient and problem-oriented set of policies can be helpful to deal with these particular problems

Policy Recommendations

Propositions for policy makers in BRICST countries can be summarized as follows:

- Invest on ICT infrastructure

The first drawback has to be dealt with is to provide necessary infrastructure and services in every part of the countries. This constitutes the first step towards establishing KBE and transform into information society where people use and share knowledge and improve accumulation of knowledge capital.

Numerous projects such as Internet kiosks, cyber cafés, and multipurpose community telecenters have been launched in emerging nations to offer ordinary people a chance to get online. Although the PCs mobile phone and internet users has increased more than advanced there are still restriction of internet particularly in China and India government strict control on using these tools is still a problem to be solved. Since the issue of lack of necessary infrastructure can be observed in rural parts, in order to complement growing technology diffusion process governments of BRICST countries should provide coordination with local governments through giving higher priority to technology dissemination schemes: engineering, research and productivity centers .

- Promote high education and skills for ICT usage

The Internet is less attractive to people with limited education. Improvement in literacy and technological skills which means the ability to use ICT tools, understand and respond coming messages plays an important role. Taking steps toward further reform of the education system, it is vital to start with a nationwide evaluation of students' literacy based on knowledge economy requirements. It is necessary to establish regulations that facilitate integration of the private sector into the formal education system and exploit opportunities for a learning grid based on information communication and technologies.

- Increase Public Awareness on KBE

Even if the GDP per capita is high and technology infrastructure has already been established, people may still remain reluctant to use ICT tools due to the lack of understanding the importance of these matters. In that context, policies are required in order to promote technology skills by regulatory policies and put technology education and skill improvement forefront of the agenda.

The recommendations that are proposed may lead to changes in the role of the government, the development of a dynamic private sector, and the establishment of a clear rule of law. But implementation of these policies can vary according to dynamics of each BRICST country. For example, in some countries, it might be crucial to establish proper price policies for telecommunication services or telecommunication investment policy, whereas in others they should focus on affirming effective education. The data show that people in BRICST countries prefer connecting to the internet by using mobile phone but this trends depends on the income level of people in that country. For example, internet users in India stay at the lowest level comparing to other countries in BRICST bloc. Because households in India desire to adopt the internet only in the case that its benefits does not exceed its costs.

Existing studies in the literature have focused on a group of countries, especially the developed countries. Therefore the empirical results are very sensitive to the selected sample and the selected time period. The aim of this study is to examine the impact of knowledge-based economy indicators on economic performance for a group of leading emerging countries in the 2000s. From a policy perspective, the evidence suggests that expansion of ICT infrastructure together with educated R&D personnel are the major determinants of GDP per capita defined as economic performance in the BRICST countries.

This study contributes to the literature by: (1) being one of the first studies covering leading emerging economies, BRICST countries where there exists a large discrepancy between economic and technological development levels; (2) investigating a period where improvement in ICT infrastructure reached peak levels in the 2000s. The policies above are not difficult to implement however it takes a long period to realize its effect on GDP per capita, because since the knowledge is dynamic in nature its adaptation cost into economy becomes much higher than traditional industrial products.

For future studies, much remains to be done. This approach can be tested for the group of countries that have similar characteristics of those BRICST, as well as advanced countries to compare to what degree the determinants of KBE is significant in developed and emerging economies. Moreover, by taking the county specific conditions into account, it is possible to analyze whether country size and development status matter in accumulation of knowledge in order to realize KBE. Therefore, many research opportunities exist in comparing groups of emerging/developing countries at different phases of the technological process. Many policy-oriented studies can be conducted to design proper R&D policies for a group of similar countries, as well as case studies for specific countries, by taking into account local characteristics. Technological and digital divide should be considered, and global policies to eliminate this divide should be investigated.

REFERENCES

Acemoglu, D.& Johson, S.(2007). Disease and development: the effect of life expectancy on economic growth. Journal of Political Economy, 115(6), 925-985.

Adacay, R.F.(2007).A comparison between Turkey and European Union in the perspective of basic indicators related to information economics. Journal of Social Science, Dumlupınar University,19 ,185-204

Akcomak ,S.& Weel, B.(2010).Social capital, innovation and growth: Evidence from Europe, European Economic Review. 53,544–567.

Ayanso,A., Cho, D.I. & Lertwachara, K. (2010).The digital divide: global and regional ICT leaders and followers.Information Technology for Development, 6(4), 304-319.

Antonopoulos, C.& Sakellaris, P.(2009). The contribution of information and communication technology investments to Greek economic growth: An analytical growth accounting framework. Information Economics and Policy,21,171–191.

Apak, D.(2005).E-government applications and methodologies: Turkey on the e-government way. Science and Technology Policies Research Center (STPS),Middle East Technical University (METU),Working Paper,1-37.

Archibugi, D.& Coco, A.(2004). A new indicator of technological capabilities for developed and developing countries (ArCo).World Development,32(4), 629–654.

Archibugi, D.& Coco, A.(2005). Is Europe becoming the most dynamic knowledge economy in the world?.JCMS,43(3),433–59.

Archibugi, D., Denni, M. & Filippetti, A.(2009). The technological capabilities of nations: The state of the art of synthetic indicators. Technological Forecasting & Social Change,76,917–931.

Arnold, D.J., & Quelch, J.A. (1998). New strategies in emerging markets. Sloan Management Review, 40(1),7–20.

Asian Development Bank .(2007). Moving toward knowledge-based economies: Asian experiences, Philippines.

Avgerou, C. (1998). How can IT enable economic growth in developing countries?, Information Technology for Development, 8(1), 15-28.

Banerjee, P.M.(2011).From information technology to bioinformatics: evolution of technological capabilities in India. Technological Forecasting & Social Change, 1-11.

Bascavusoglu-Moreau, E.& Colakoglu, M.(2011). Impact of SME policies on innovation capabilities: The Turkish case. METU Working paper, 1-26.

Bassanini, A., Scarpetta, S.& Visco, I. (2000). Knowledge, technology and economic growth: recent evidence from OECD Countries. Working papers, 32,1-39.

Benavente, J.M. (2006). The role of research and innovation in promoting productivity in Chile. Economics of Innovation and New Technology,15(4), 301-315.

Berndt, E. R. and Morrison, C.J.(1995) High-tech capital formation and economic performance in U.S. manufacturing industries: an exploratory analysis. Journal of Econometrics, 65,9-43.

Beyhan, B., Dayar, E.& Fındık, D. (2009).Comments and critics on the discrepancies between the Oslo manual and the community innovation surveys in developed and developing countries, METU Working Paper,1-11.

Bilbao- Osorio, B.&Rodriguez-Pose, A. (2004). From R&D to Innovation and Economic Growth in the EU, 35(4), 434-455.

Bhargava, A., Jamison, D. T., Lau, L. J.& Murray, C. J. L. (2001) Modeling the effects of health on economic growth, Journal of Health Economics, 20(3),423–440.

Blankley,W.O.& Booyens, I.(2010).Building a knowledge economy in South Africa. South African Journal of Science, 106 (11),1-6.

Boisot, M.H.(1998).Knowledge assets :securing competitive advantage in the information economy. New York, Oxford University Press.

Boston Consulting Group (2010). The internet's new billion:digital consumers in Brazil, Russia, India, China, Indonesia. Boston, USA.

Brynjolfsson, E. & Hitt, L.M. (2003).Computing productivity:firm-level evidence. The Review of Economics and Statistics, 85(4), 793–808

Brynjolfsson, E.&Yang, S. (1996). Information technology and productivity:a review of the literature. Advances in Computers,43,179-215.

Brazilian Electrical and Electronics Industry Association (ABINEE) (2009).Accessed from: http://www.abinee.org.br/abinee/decon/decon10.htm

Cakar, S., Bukulmez, E., Cakmakci, M.A.& Ureyen, R.(2009). Technology and economic development,3rd International Conference on Innovation, Technology and Knowledge Economics, Ankara.

Castellacci, F.(2002): Technology gap and cumulative growth: models and outcomes, International Review of Applied Economics, 16(3), 333-346.

Cervellati, M.& Sunde, U.(2009). life Expectancy and economic growth: the role of the demographic transition. The Institute for the Study of Labor (IZA) Discussion Paper, 16 (2), 99-133.

Cette, G. & Jimmy Lopez, J. (2011). ICT demand behavior: an international comparison, Economics of Innovation and New Technology, 1–14.

Yunwei, C. ,Zhiping, Y. ,Shu, F. , Zhengyin, H. ,Meyer, M., &Bhattacharya, S.(2009). A patent based evaluation of technological innovation capability in eight economic regions in PR China. World Patent Information, 31, 104–110.

Chen, D.H.C.& Dahlman, C.J. (2003). Knowledge and development. A cross-section approach.World Bank Policy Research Working Paper 3366

Cheng, M.Y., Sayed Hossain, S. & Guo, J.H.(2009). Social acceptance and readiness for the knowledge-based economy in Malaysia. ASEAN Economic Bulletin, 26(3), 253–65.

Chinn, M.D.& Fairliey, R.W.(2007). The determinants of the global digital divide: a cross-country analysis of computer and internet penetration. Oxford Economic Papers,59,16–44.

Choi, C.&Yi, M.H. (2009). The effect of the internet on economic growth:evidence from cross-country panel data. Economics Letters ,105, 39–41.

Coates D.&Warwick, K.(1999).The knowledge driven economy:analysis and background.Department of Trade and Industry and the Centre for Economic Policy Research, conference paper.

Cohen, D.& Soto M. (2007). Growth and human capital: good data, good results. Journal of Economic Growth ,12, 51–76.

Colecchia, A.& Schreyer, P.(2002). ICT investment and economic growth in the 1990s:is the United States a unique case?: a comparative study of nine OECD countries. Review of Economic Dynamics, 5, 408–442.

Cooper, J.(2006). Of BRICs and brains: comparing Russia with China, India, and other populous emerging economies.Eurasian Geography and Economics, 47(3),255-284.

Corley, M., Michie, J.& Oughton ,C.(2002).Technology, growth and employment. International Review of Applied Economics, 16(3), 265-276.

Corrocher, N., & Ordanini, A. (2002). Measuring the digital divide: a framework for the analysis of cross-country differences.Journal of Information Technology, 17(1), 9–19.

Criscuolo, C.& Martin,R. (2004).An emerging knowledge-based economy in China?: indicators from OECD databases. OECD Science, Technology and Industry Working Papers, No.4.

Cukurçayır, Y. (2008).The impact of foreign direct investment spillovers and international trade on innovation capability in Turkey and comparative emerging markets. Master’s Thesis. Institute of Social Sciences, Boğaziçi University.

Datta A.&Agarwal,S. (2004). Telecommunications and economic growth:a panel data approach. Applied Economics, 36, 1649-1654.

Dewan, S., & Riggins, F. (2005). The digital divide: current and future research directions. Journal of the Association for Information Systems, 6(12), 298–337.

Dewan, S.&.Kraemer, L.K. (2000). Information technology and productivity: evidence from country-level data. Management Science, 46(4),548-562.

Diez, R.J.& Kiese, M. (2006).Scaling innovation in South East Asia: empirical evidence from Singapore, Penang (Malaysia) and Bangkok, Regional Studies, 40(9), 1005-1023.

Dimelis, S.P.& Papaioannou, S.K.(2011). ICT growth effects at the industry level: a comparison between the US and the EU. Information Economics and Policy, 23, 37–50.

Drucker, P. F. (1969).The age of discontinuity :guidelines to our changing society. New York, Harper & Row.

Dyker, D.&. Radosevic, S. (2000). Building the knowledge-based economy in countries in transition – from concepts to policies. The Journal of Interdisciplinary Economics,12,41-70.

Economist Intelligence Unit (2009). E-readiness rankings: the usage imperative, New York

Economist Intelligence Unit (2010). Digital economy rankings 2010:beyond e-readiness, New York

European Commission (2009). INNO-policy trend chart – Innovation policy progress report: Turkey

European Commission (1995). Green paper on innovation, Brussels.

European Commission (2011). Innovation union competitiveness report, Innovation Union, Luxembourg.

Fedderke, J.(2005). Technology, human Capital and growth. 6th Annual Conference of the African Econometrics Society. Conference Paper.

Filippetti, A.& Peyrache, A.(2011). The patterns of technological capabilities of countries: a dual approach using composite indicators and Data Envelopment Analysis. World Development ,39(7), 1108–1121.

Fleisher, B. Li, H.&Zhao, M.Q.(2120). Human capital, economic growth, and regional inequality in China. Journal of Development Economics,92, 215–231.

Forrester (2007). Worldwide PC adoption forecast, 2007 to 2015, Market Report.

Frantzen, D. (2000). R&D, Human Capital and International Technology Spillovers: A Cross-country Analysis. Scandinavian Journal of Economics, 102(1),57-75.

Freund, C., & Weinhold, D.(2004).The effect of the internet on international trade. Journal of International Economics, 62, 171–189.

Friedman, T.L. & Mandelbaum, M.(2011). That used to be us: how America fell behind in the world It Invented and How We Can Come Back. New York, Farrar, Straus and Giroux.

Friedman, T.L. (2005). The world is flat: A brief history of the twenty-first century. New York, Farrar, Straus and Giroux.

Fu, X., Pietrobelli,C. & Soete, L. (2011). The role of foreign technology and indigenous innovation in the emerging economies: technological change and catching-up.World Development, 39(7),1204–1212.

Gera, S., Gu, W.&Lee, F.C. (1999). Information technology and labor productivity growth: an empirical analysis for Canada and the United States. Canadian Journal of Economics, 32(2), 384-407.

Goedhuys, M. (2007).The Impact of innovation activities on productivity and firm growth: evidence from Brazil. UNU-MERIT Working Papers, No. 2.

Gokhberg ,L. & Kuznetsova ,T.(2011). S&T and Innovation in Russia: Key Challenges of the Post-Crisis Period, Journal of East-West Business, 17(2), 73-89.

Goldman Sachs.(2003) .Dreaming with BRICs: Path to 2050.

Goldman Sachs.(2011). A Progress Report on the Building of the BRICs. BRICs Monthly Issue, 11(7), 1-4.

Goldstone, J.A.(2011,December 2).Rise of the TIMBIs. Foreign Policy. Retrieved from: http://www.foreignpolicy.com/articles/2011/12/02/rise_of_the_timbis

Greenwood, J., Hercowitz, Z.&Krusell, P.(1997). Long-run implications of investment- specific technological change. American Economic Review, 87(3), 342-62.

Gryczka, M.(2011).Changing role of BRIC countries in technology-driven international division of labor .Business and Economic Horizons, 2(2), 89-97.

Gu,W &. Ho, M.S. (2000), A comparison of industrial productivity growth in Canada and the United States, The American Economic Review,90(2),172-175.

Hegde, D.& Shapira, P. (2007).Knowledge, technology trajectories, and innovation in a developing country context: evidence from a survey of Malaysian firms. International Journal of Technology Management, 40(4), 349–370.

Hobdaya, M.& Rushb, H. (2007). Upgrading the technological capabilities of foreign transnational subsidiaries in developing countries: The case of electronics in Thailand. Research Policy, 36, 1335–1356.

Horowitz, A.S.(2003,September 15). Mexico: It's Close; It's Cheap. Computerworld, Retrieved from: http://www.computerworld.com/s/article/84829/Mexico

Hoskisson, R.E., Eden, L.,Lau, C.M.&Wright, M. (2000). Strategy in emerging economies. The Academy of Management Journal, 43(3), 249-267.

Houghton, J. & Sheehan, P.(2000). A primer on the Knowledge Economy. Centre for Strategic Economic Studies, Victoria University,1-28.

Ilyichyov, A.(2005,May 06). Technology Parks In Russia To Benefit Everyone. RIA Novosti, Retrieved from: http://www.russoft.org/docs/?doc=881

Indjikian, R.& Siegel, D. (2005). The impact of investment in IT on economic performance: implications for developing countries. World Development, 33(5), 681–700.

Insead (2011).The global innovation Index: accelerating growth and fevelopment

International Monetary Fund (IMF) (2011). World economic outlook: slowing growth, rising Risks. Washington D.C.

International Telecommunication Union (ITU) (2009). Measuring information society report ,Switzerland.

Isik,C.(2011). The importance of creating a competitive advantage and investing in information technology for modern economies: an ARDL test approach from Turkey. Journal of Knowledge Economy.Retrieved from: doi 10.1007/s13132-011-0075-2.

Isik, N.&Kilinc, E.C. (2011). The significance of research and development and innovation on regional development: a comparative analysis. Journal of Social Science, University of Eskisehir Osmangazi, 6(2),9-54.

Jalavaa, J.& Pohjola, M. (2002).Economic growth in the new Economy: evidence from advanced economies. Information Economics and Policy,14,189–210

Jalavaa, J.& Pohjola, M.(2007). ICT as a source of output and productivity growth in Finland. Telecommunications Policy,314,63–472.

James, J.(2009) .Information technology use among individuals in rich and poor countries: The disappearing divide. Telematics and Informatics, 26,317–321.

Jayachandran, S. & Lleras-Muney, A. (2008).Life expectancy and human capital investments: evidence from maternal mortality declines. NBER Working Paper No. 13947.

Jiménez-Rodríguez, R. (2012): Evaluating the effects of investment in information and communication technology, Economics of Innovation and New Technology,21(2),203-221.

Jorgenson, D.W.& Stiroh, K.J. (2000). Raising the speed limit: U.S. economic growth in the information age. Brookings Papers on Economic Activity ,No.1

Jorgenson,D.W.& Motohashi,K.(2005). Information technology and the Japanese economy. NBER Working Paper, No.11801.

Jorgenson,D.W.(2001). Information technology and the U.S. economy. The American Economic Review, 91(1),1-32.

Kaartememo, V. (2009). Russian innovation system in international comparison – the BRIC countries in focus. Electronic Publications of Pan-European Institute, 22, Accessed from: http://www.tse.fi/FI/yksikot/erillislaitokset/pei/Documents/Julkaisut/kaartemo_russian_innovation_system_in_international_comparison_2209%20web.pdf

Kafouros, M.I.& Forsans, N.(2011).The role of open innovation in emerging economies: do companies profit from the scientific knowledge of others? Journal of World Business, 2-9.

Kanamori, T.& Motohashi,K. (2006). Information technology and economic growth: Comparison between Japan and Korea. RIETI Discussion Paper Series,1-27.

Karagol, B.& Erdil, E.(2012). Macroeconomic effects of information and communication technologies in Turkey and Other OECD member Countries. STPS, Working Paper,1-53.

Kelley, A. & Schmidt, R.(1995).Aggregate population and economic growth correlations: The role of components of demographic change. Demography, 332.

Kenaroglu, B.(2003). Implications of information technology in developing Countries and Its Impact in Organizational Change. STPS, Working Paper,1-21.

Kiley, M.T. (2001). Computers and growth with frictions: aggregate and disaggregate evidence. Carnegie-Rochester Conference Series on Public Policy, 55(1), 217-228.

Kim, D.K.(2007). Information technology, economic Growth, and employment: Evidence From Time-Series Analyses. Journal of Applied Business Research 23(1),71-78.

Knight, P.T (2010). e-development in Brazil. Journal of Knowledge Economy,2(1),77–116.

Kooshki, F.M.& Ismail, R.(2011). The impact of information and communication technology development on economic growth. International Conference on Sociality and Economics Development. IPEDR,10, 235-239.

Kplinger (2010,March).Top ten emerging markets. Retrieved from: http://www.kiplinger.com/infographics/emerging_markets/

Lederman, D.& Maloney, W.F. (2003). R&D and development. World Bank Policy Research Working Paper. No.3024.

Lee, H.I,&Khatri, Y. (2003).Information technology and productivity :growth in Asia.IMF Working Paper,15,1-17.

Lehr, W. (2012).Measuring the Internet: The Data Challenge. OECD Digital Economy Papers, No. 194, OECD Publishing.

Lehr, W.& Lichtenberg, F. (1999) Information technology and its impact on productivity: firm-level Evidence from Government and Private Data Sources 1973–1993. Canadian Journal of Economics, 32(2), 335–362.

Lorentzen, P., McMillan, J. & Wacziarg, R.(2005). Death and development. NBER Working Papers, No. 11620, 1-70.

Loveman, G.W.(1994). An assessment of the productivity impact of Information Technologies," in Allen, Thomas J. and Scott Morton, Michael S. (Ed.), Information Technology and the Corporation of the 1990s: Research Studies, Oxford University Press,84-110.

Lundvall, B.A. & Johnson, B. (1994). The Learning economy. Journal of Industry Studies,1(2),23–42.

Lundvall, B.A.& Borrás, S. (1998) The Globalizing learning economy: implications for innovation Policy, European Commission, Brussels.

Mahmooda, I.P.& Singh, J. (2003). Technological dynamism in Asia. Research Policy,32,1031–1054.

Malhotra, Y. (2003).Measuring Knowledge Asset of a Nation: Knowledge Systems for Development. Knowledge Management Measurement: State of Research Paper , 68–126. Retrieved from: www.kmnetwork.com/KnowledgeManagementMeasurementResearch

Mansfield, E.(1972). Contribution of R&D to economic growth in the United States. Science, New Series, 175(4021), 477-486.

Marcin, P.(2004). The Impact of ICT on Growth in Transition Economies. MPRA Paper No. 29399, 1-34.

Martínez, D., Rodríguez, J., & Torres, J.L.(2008). The productivity paradox and the new economy: the Spanish case. Journal of Macroeconomics 30 (4), 1569–1586.

Martínez, D., Rodríguez, J.&Torres, J.L. (2010). ICT-specific technological change and productivity growth in the US: 1980–2004. Information Economics and Policy, 22, 121–129.

Masso, J. &Vahter ,P.(2008). Technological innovation and productivity in late-transition Estonia: econometric evidence from innovation surveys, The European Journal of Development Research, 20(2), 240-261.

Michie, J.,Oughton, C. & Pianta, M. (2002). Innovation and the Economy, International Review of Applied Economics, 16(3),253-264.

Mingyong, L. ,Shuijun, P.& Qun, B.(2006). Technology spillovers, absorptive capacity and economic growth. China Economic Review,17,300–320.

Mocˇnik,D.& Širec, K. (2010). The determinants of Internet use controlling for income level: Cross-country empirical evidence. Information Economics and Policy,22,243–256.

Mohnen,P.,Mairesse, J. & Dagenais,M.(2006). Innovativity: A comparison across seven European countries, Economics of Innovation and New Technology, 15(5),391-413.

Molina-Domenea, M.A. & Pietrobelli,C.(2012). Drivers of technological capabilities in developing countries: An econometric analysis of Argentina, Brazil and Chile. Structural Change and Economic Dynamics,1-12. doi:10.1016/j.strueco.2011.11.003

Motohashi, K.& Yuan, Y.(2009). IT, R&D and productivity of Chinese manufacturing firms. RIETI Discussion Paper Series,7,1-20.

Mu, R. & Fan, Y. (2011): Framework for building national innovation capacity in China, Journal of Chinese Economic and Business Studies, 9(4), 317-327.

Nadiri, M.I.(1993). Innovations and technological spillovers. NBER Working Paper No. 4423

Nascia, L. &Perani, G. (2002): Diversity of innovation in Europe.nternational Review of Applied Economics, 16(3), 277-293.

Nasir, A., Ali, T.M.,Shahdin, S.& Rahman, T.U (2011). Technology achievement index 2009: ranking and comparative study of nations. Scientometrics, 87, 41–62.

National Association of Software and Services Companies (Nasscom) (2009).Information technology market report.

Nelson, R.R. (1982). The role of knowledge in R&D efficiency. The Quarterly Journal of Economics, 97(3), 453-470.

Nelson, R.R.& Phelps, E.S.(1966). Investment in humans, technological diffusion, and economic growth. The American Economic Review, 56(1), 69-75.

O’Neill, J.(2001). Building better global economic BRICs. Global Economics Paper,No.66

O’Neill, J.(2006). How solid are the BRICs?.Global Economics Paper, No.134,

OECD (1996).The Knowledge based economy, Paris.

OECD (1999), OECD Science, technology and industry scoreboard: benchmarking knowledge-based economies, Paris.

OECD (2000).A new economy ? : The changing role of innovation and information technology in growth, Paris.

OECD (2001). The new economy: beyond the hype, Paris.

OECD (2005). Oslo manual: guidelines for collecting and interpreting innovation data. Third Edition.

OECD (2007). OECD reviews of innovation policy-South Africa, Paris.

OECD (2009) Globalization and emerging economies – Brazil, Russia, India, Indonesia, China and South Africa, Paris.

OECD (2010) OECD information technology outlook, Paris.

OECD (2010a). Measuring globalization: OECD economic globalization indicators,Paris.

OECD (2011). OECD guide to measuring the information society, Paris.

OECD (2011a) Science, technology and industry scoreboard 2011.Retrieved From: doi:10.1787/sti_scoreboard-2011-en

OECD (2011b) OECD reviews of innovation policy-Russia, Paris.

Oktay, E. &Kaynak, S. (2007).Türkiye ve avrupa birliği ülkelerinin bilgi ekonomisi girdi ve çıktı değişkenleri arasındaki kanonik ilişkinin araştırılması.Atatürk Üniversitesi, İktisadi ve İdari Bilimler Fakültesi Yayınları, 10(2),419-440.

Oliner, S. D. & Sichel, D. E. (2000). The resurgence of growth in the late 1990s: is information technology the story? Journal of Economic Perspectives, 14 (4), 3-22.

Ongan-Baskaya,M.G.&Erdil,E.(2003).Technological change and ICTs in OECD countries. STPS Working Paper, 1-47.

Oulton, N. (2001). ICT and productivity growth in the UK.Oxford Review of Economic Policy, 18(3),363-379.

Oulton, N. (2010). Long term implications of the ICT revolution: applying the lessons of growth theory and growth accounting. Conference Paper. The ICTNET Workshop on The Diffusion of ICT and its Impact on Growth and Productivity, Department of Economics, University of Parma, 16-17 December.

Ozkanli, O., Erdil, E.&Akdeve, E.(2008). Innovation and relationships in industrial districts: the case of Turkey. TEKPOL Working Paper Series,1-26.

Pamukçu, M.T.& Erdil, E.(2011). Analyzing R&D activities of foreign enterprises in emerging economies: lessons from Turkey. TEKPOL Working Paper Series.

Papaioannou, S.K. & Dimelis, S.P. (2007): Information technology as a factor of economic development: evidence from developed and developing countries. Economics of Innovation and New Technology, 16(3), 179-194.

Parham,D., Roberts, P.& Sun, H.(2001).Information technology and Australia's productivity surge.Productivity Commission Working Paper No.1681.

Pazaroglu, V.M. & Gurler, O.K.(2007).Telecommunication investment and economic growth: panel data approach. Finans Politik& Ekonomik Yorumlar, 44(508),35-43.

Pilat, D. & Lee, F.C. (2001). Productivity growth in ICT-producing and ICT-using industries: A source of growth differentials in the OECD?. OECD Science, Technology and Industry Working Papers,No.4

Pohjola, M.(2000). Information technology and economic growth: a cross-country analysis. The United Nations University, World Institute for Development Economics Research Working Paper.No.173.

Pohjola, M. Information technology, productivity, and economic growth : international evidence and implications for economic development, New York; Oxford University Press, 2001.

Powell, W.W.& Snellman, K.(2004).The knowledge economy.Annual Review of Sociology,30,199-220.

Quah, D.T. (1997).Increasingly weightless economies. Bank of England Quarterly Bulletin,37(1),49–56.

Quah, D.T. (1999). The weightless economy in growth. The Business Economist, 30(1), 40–53.

Quah, D.T.The weightless economy in economic development, in: Matti Pohjola (Eds.), Information Technology, Productivity and Economic Growth: International Evidence, Oxford University Press, 2001.

Quibria, M. G., Ahmed, S.N., Tschang, T.& Reyes-Macasaquit, M.-L. (2003) Digital divide: determinants and policies with special reference to Asia, Journal of Asian Economics, 13, 811–825.

Radelet, S., Sachs, J.,& Lee, J.(1997). Economic growth in Asia. HIID Development Discussion Paper ,No. 609.

Radhakrishnan, S.(2007). Rethinking knowledge for development: transnational knowledge professionals and the “new” India. Theory and Society,36(2),141-159.

Raffo, J., Lhuillery, S. & Miotti, L. (2008). Northern and southern innovativity: a comparison across European and Latin American countries, The European Journal of Development Research,20(2), 219-239.

Ramesh, S.(2012). China's transition to a knowledge economy. The Journal of Knowledge Economy.doi: 10.1007/s13132-012-0092-9

Rao, S.S.(2005). Bridging digital divide: efforts in India. Telematics and Informatics,22,361–375.

Romer, P.M. (1986) .Increasing returns and long term growth. Journal of Political Economy, 94, 1002-1037.

Rothkopf, D.J. (2011, December 9). T' time for the BRICs?. Foreign Policy Magazine. Retrieved from: http://rothkopf.foreignpolicy.com/posts/2011/12/08/t_time_for_the_brics

Round, V.(2007).Firm-level research on innovation and productivity: Russian experience . Institute of Statistical Studies and Economics of Knowledge.Retrieved from: http://www.merit.unu.edu

Roztocki, N., & Weistroffer, H.R. (2008). Information technology investments in emerging economies. Information Technology for Development.,14(1), 1–10.

Roztocki, N. &Weistroffer, H.R. (2011).Information technology success factors and models in developing and emerging economies.Information Technology for Development,17(3),163-167.

RT (2012,April 20).BRICS: No rights - no cash. Retrieved from: http://rt.com/business/news/imf-brics-finance-money-fund-us-lagarde-551/

Salvatore, D.(2003). The new economy and growth in the G-7 countries. Journal of Policy Modeling,25,531–540.

Samoilenko, S. (2008). Contributing factors to information technology investment utilization in transition economies: an empirical investigation. Information Technology for Development, 14(1), 52–75.

Samoilenko, S. &Osei-Bryson, KM. (2011).The spillover effects of investments in telecoms: insights from transition economies. Information Technology for Development,17(3), 213-231.

Schaaper, M. (2009).Measuring China's innovation system: national specificities and international Comparisons. STI Working Paper ,No.2009/1.

Schreyer, P. (2000). The contribution of information and communication technology to output growth: a study of the G7 countries. OECD Science, Technology and Industry Working Papers, No.2000/2.

Schumpeter, J.A. (1947). The creative response in economic history.The Journal of Economic History,7(2),149-159.

Segerstrom, P. (1998).Endogenous growth with scale effects. American Economic Review, 88, 1290–1310.

Serdar, D.M.(2003). A system dynamics approach for technology improvement policy analysis: the case for Turkey.STPS Working Paper, No.4.

Sharma, S.& Thomas, V.J.(2008). Inter-country R&D efficiency analysis: an application of data envelopment analysis. Scientometrics,76(3),483–501.

Simon, J.& Wardrop, S. (2002). Australian use of information technology and its contribution to growth.Research Discussion Paper, No.2, Reserve Bank of Australia, Sydney.Retrieved from: http://www.rba.gov.au/publications/rdp/2002/pdf/rdp2002-02.pdf

Solow, R. M. (1956).A contribution to the theory of economic growth. Quarterly Journal of Economics,70(1), 655–694.

Sridhar, K.S.&Sridhar, V. (2004). Telecommunications infrastructure and economic growth: evidence from developing countries.Applied Econometrics and International Development, 7(2), 38-61.

State of Victoria.(2007). Emerging ICT market strategy: South Africa. Department of Innovation, Industry & Regional Development. Retrieved from: http://www.mmv.vic.gov.au/Assets/606/1/MMVSthAfricaStrategyNov2007.pdf

Stiglitz, J.E. (1999) .Public policy for knowledge economy.Department for Trade and Industry and Center for Economic Policy Research. Accessed: http://akgul.bilkent.edu.tr/BT-BE/knowledge-economy.pdf

Sveiby, Karl Erik (1997). New organizational wealth: managing & measuring knowledge-based assets.San Francisco: Berrett-Koehler Publishers.

Tan,H.B.&Hooy, C.W.(2007). The development of East Asian Countries towards a knowledge-based economy:a DEA analysis.Journal of the Asia Pacific Economy,12(1), 17–33,

Teixeiraa, A.A.C.& Fortuna, N.(2010). Human capital, R&D, trade, and long-run productivity:testing the technological absorption hypothesis for the Portuguese economy, 1960–2001.Research Policy,39,335–350.

Udo, G., Bagchi, K.K., & Kirs, P.J. (2008). Diffusion of ICT in developing countries: a qualitative differential analysis of four nations. Journal of Global Information Technology Management, 11(1), 6–27.

Udo, G.J.&Edomo, F.M.(2000). Information technology transfer to African nations: an economic development mandate.Journal of Technology Transfer, 25, 329-342.

Undersecretariat for State Planning Organization (SOP) Information Society Department (2011). Information society strategy 2006-2010, Ankara.

Undersecretariat for State Planning Organization (SOP) Information Society Department (2011). Information society statistics of Turkey. SPO Publication,No. 2829,Ankara.

UNESCO (2010). Science report :current status of science around the world, Paris.

Van Ark, B., Inklaar R.& McGuckin, H.R.(2003). ICT and productivity in Europe and the United States. Where do the differences come from? CESifo Economic Studies, 49(3), 295–318.

Van Ark, B., O'Mahony, M.& Timmer, M.P.(2008).The productivity gap between Europe and the United States: trends and causes. Journal of Economic Perspectives, 22(1), 25–44.

Vu, M.K.(2011). ICT as source of economic growth in the information age: empirical evidence from the 1996–2005 period. Telecommunications Policy,35, 357–372.

Warsh, D. (2006). Knowledge and the wealth of nations : a story of economic discovery. New York , W. W. Norton,

Wong, K.P., Ho, Y.P.,&Autio, E. (2005). Entrepreneurship, innovation and economic growth: evidence from gem data.Small Business Economics, 24(3), 335-350.

World Bank (2004).Turkey: knowledge economy assessment study, Washington D.C.

World Bank (2008). Measuring knowledge in the world's economies: knowledge assessment methodology and knowledge economy index. Washington, D.C.

World Bank (2011).Knowledge for Development: Results, Connectivity, Openness.

World Economic Forum .(2010). The Lisbon review 2010: towards a more competitive Europe?, Switzerland.

World Economic Forum. (2011). The global competitiveness report 2011–2012, Switzerland.

Yeloglu, H.O.(2009). First impressions on information economic variables : a comparative study between Turkey and OECD countries (1995-1999). Information World.10(2), 246-260.

Yi,M.H.& Choi,C.(2009).The effect of the Internet on economic growth: evidence from cross-country panel data.Economics Letters, 105(1), 39-41.

Yoo,SH. (2003): Does information technology contribute to economic growth in developing countries? a cross-country analysis.Applied Economics Letters, 10(11), 679-682.

Ženko, Z., Mulej, M. & Jure Marn, J. (2004). Innovation before entry into the EU: the case of Slovenia, Post-Communist Economies, 16(2), 169-189.