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## **Significance of Research and Development in Knowledge Economies like India**

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### ***Abstract***

*The knowledge economy is powered by research and development. OECD explains knowledge based economy as an economy that is directly based on the production; distribution and generation of employment access all industries (OECD, 1996). According to an official American report, the economies of East/Southeast and South Asia - including China, India, Japan, Malaysia, Singapore, South Korea, and Taiwan- represented 34 percent of the global R&D total in 2011. India has witnessed a phenomenal increase in R&D investment over the past few years, which touched USD 6.8 billion in 2004 at CAGR of 45 percent over 2002-04. The concept of knowledge economy, international scenario of R&D, expenditure on R&D in India, sector-wise expenditure on R&D in India, various sources of funds in India, patents and grants to India for R&D etc. are studied under present paper. Challenges faced by this sector and steps undertaken by Government of India are also discussed.*

**Keywords:** *Knowledge Economy, Knowledge-Based Industry, Research and Development.*

*“The term knowledge based economy was first introduced by the Organization of Economic Co-operation and Development (OECD). OECD explains knowledge based economy as an economy that is directly based on the production; distribution and generation of employment access all industries (OECD, 1996).”*

**INTRODUCTION:** The influence of multiple factors such as foreign direct investment, mobility of factors of production in cross-countries (Economic Social and Commission for Asia and the Pacific, 1999), level of democracy and inequality (Sen, 1999), technology and information flow (Orna, 1990), integration and regionalism (Fort and Webber, 2006) have introduced newer factors which are key factors in knowledge economy. But these factors were ignored by classical economists. World’s Gini-Coefficient in 2005 was 0.67, which is an increase of 10 percent, compared with 1990. This increase has been created to the use of knowledge which is the most vital factor in the growth and development of an economy. The knowledge economy is powered by research and development (Debnath, S.C. and Kenji Yokoyama, 2009; APEC, 2000).

**OBJECTIVES OF PRESENT STUDY:** Objectives of Present Study, “Role of Research and Development in the Transition of India as Knowledge Economy,” are as following–

- To describe the concept of knowledge economy.

- To study the essential prerequisites of knowledge economy.
- To discuss the international scenario regarding research and development.

**CONCEPT OF KNOWLEDGE ECONOMY:** The term knowledge based economy was first introduced by the Organization of Economic Co-operation and Development (OECD). OECD explains knowledge based economy as an economy that is directly based on the production; distribution and generation of employment across all industries (OECD, 1996). The Knowledge Economy, as Prime Minister Tony Blair of Great Britain has said, “No new economy ... there is one economy, all of its being transformed by information technology... it is a profound economic revolution.” Economic success is increasingly based on upon the effective utilization of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage. The term Knowledge Economy is used to describe this emerging economic structure. The OECD has produced a composite indicators of ‘investment in knowledge’ made up of investment of R&D, investment in higher education and investment in IT software. On the basis above index, three groups of economies are -

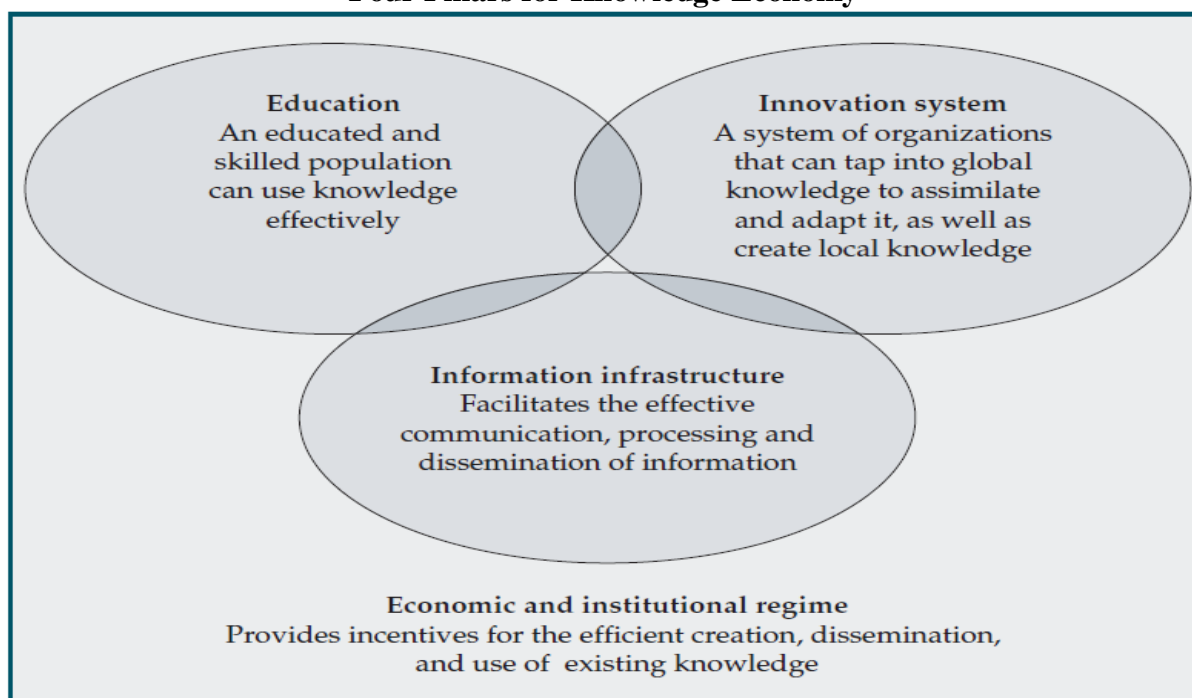
- A) In high knowledge investment economies such as North America, OECD Asia and Japan, investment is around 6 percent of GDP.
- B) In middle knowledge investment economies such as Northern Europe and Australia, investment is between 3 and 4 percent of GDP.
- C) In low investment economies such as Southern Europe, investment is between 2 and 3 percent of GDP (Source : OECD Face book 2006, p.131)

Knowledge economy is not just a description of high-tech economy but also covers its application to all sectors, even agriculture sector.

**THE ESSENTIAL PREREQUISITES OF A KNOWLEDGE ECONOMY:** World Bank highlighted the four pillars for knowledge economy which are:-

- 1) **Educated and Skilled Human:** - Peter Drucker firstly introduced the term ‘Knowledge Workers’ in his book ‘Post Capitalist Society’ (1993). According to him knowledge workers refer to professionals such as doctors, teachers and consultants who deal with the realm of the mind while the knowledge technologists work with their hand and mind in advance industries such as IT, medicines etc. (Drucker, P.F., 1993). In knowledge economy skilled and competent people are at the heart of business. Hence, lifelong learning and continue improvement spirit among human resource must develop.
- 2) **A Desire and Modern Information Infrastructure:** - It will facilitate the effective communication, dissemination and processing of information and knowledge. Information infrastructure is essential in knowledge based economy.
- 3) **An Effective Innovation System** - Knowledge economy is powered by research and development. An effective innovation system comprises of firm, research centers, consultants, universities and organizations which enhance and explore the knowledge for economic growth and development. For under developed countries, foreign direct investment is the mode of research and innovation.
- 4) **The Country’s Institutional Regime** - It should allow the creation, diffusion and proficient use of knowledge. It includes the macro economic framework, foreign trade policy, finance and banking, government policy which creates a favourable business climate for the development of knowledge based economy.

**Figure 1**  
**Four Pillars for Knowledge Economy**

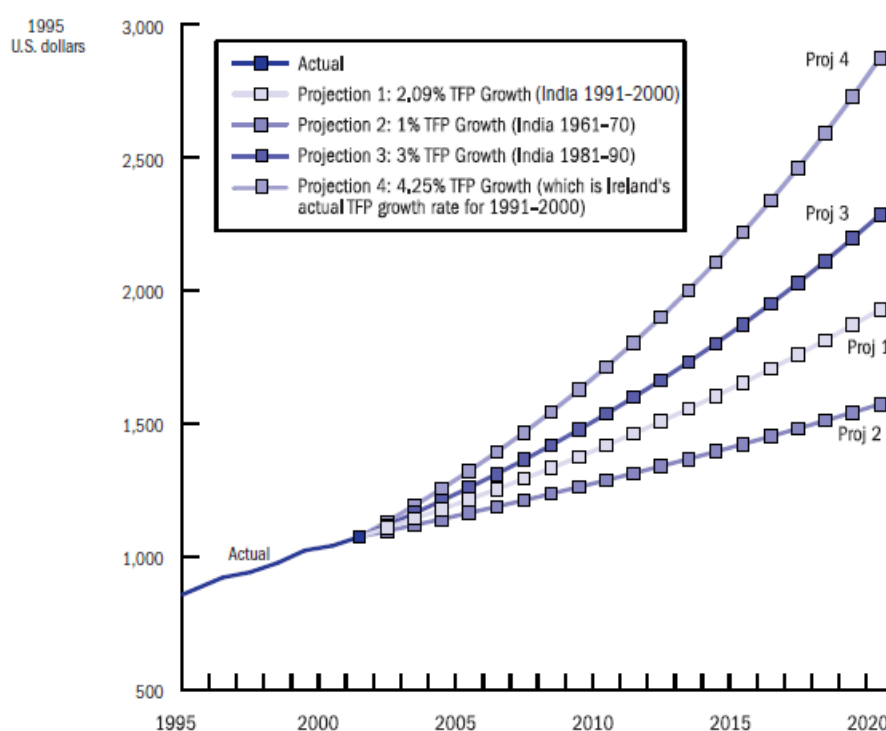


Source: World Bank, 2007.

**INDIA EMERGING AS KNOWLEDGE ECONOMY:** India is moving towards the new growth path of higher expansion due to the phenomenal success of new economic reforms pursued since 1991. It was the affirmative contribution of the growing knowledge economy. A recent study of the World Bank (World Bank, 2005) categorically submits a future prospective projection of high economic growth on the basis of calculating Total Factor Productivity (TFP), which exhibits country's learning capability. Figure 2 the study shows that India can easily connect knowledge resources to attain higher economic growth if its public governance system is reoriented (Raghwan, V.P., 2012).

Figure-2

FIGURE 1

**India: Real Gross Domestic Product Per Worker, Alternative Projections, 1995–2020**

*Note:* For all four projections, capital, labor, and human capital are assumed to grow at their 1991–2000 average annual growth rates for India, that is, 5.41, 2.23, and 0.58 percent, respectively. For the growth-TFP decomposition to be more precise, labor force figures rather than total population are used as a measure of the amount of “labor” available for use as a factor of production in the Indian economy. According to World Bank databases, in 2001 India’s GDP (in 1995 U.S. dollars) was \$495 billion and its population was 1.03 billion, of which only 461 million were in the labor force. As such, India’s GDP per capita in 2001 was approximately \$480, whereas GDP per worker was around \$1,070.

*Source:* Knowledge for Development Program.

Source: World Bank, 2005.

Figure 2 depicts that projection 1, 2, and 3 plot real gross domestic products (GDP) per worker (1995 U.S. dollars) for India assuming different TFP growth rates from 2002 to 2020. All things being equal, the projected GDP per worker for India in scenario 4 in 2020 is about 50 percent greater than in scenario 1. Knowledge can make a difference between poverty and wealth (World Bank, 2005). In its report “India as Knowledge Super power : Strategy for Transformation (2001), Planning Commission focuses on education as the foundation for the knowledge based economy and examines issue related to connectivity, governance and use of information technology. As part of a strategy to become knowledge based economy, it recommends a four tiered for increasing employment in the new economy that includes:-

- Creating structure for biotechnology promotion and application.
- Promoting Knowledge-based service industries in which India has competitive strengths (such as software & IT).
- Packing and marketing traditional knowledge, especially in medicine.
- Improving capacity building in three mutually supportive areas – human resource development, R&D capabilities and the application of technologies flowing from innovations.

The report highlights several areas critical to India’s transition to the knowledge economy: (i) creating employment opportunities and rising the level and quality of education (ii)

encouraging high-tech science and technology (iii) Enhancing expenditure on R&D (iv) improving linkages between technology development and application by fostering close ties between research and business (India, Planning Commission, 2001).

**RESEARCH AND DEVELOPMENT – AN INTERNATIONAL SCENARIO:** The economies of East/Southeast and South Asia- including China, India, Japan, Malaysia, Singapore, South Korea, and Taiwan- represented 34 percent of the global R&D total in 2011, according to an official American report. China (15 percent) and Japan (10 percent) were the largest R&D performers in this group. After the United States and China, Japan is the third largest spender in R&D. The largest EU performers spend comparatively less, Germany (\$93 billion, seven percent), France (\$52 billion, four percent), and the United Kingdom (\$10 billion, three percent). R&D spending by South Korea has also been rising in recent years and accounted for four percent (\$60 billion) of the global total in 2011. Taken together, these top seven countries account for about 72 percent of total global R&D. The Russian Federation, Taiwan, Brazil, Italy, Canada, India, Australia and Spain make up the next tier of performers, with total R&D expenditures ranging from \$20 billion to \$35 billion. The top seven countries, along with the second group of eight economies, together account for 84 percent of current global R&D. (<http://www.firstpost.com>).

**Table -1**  
**Global R&D Funding (2006)**

Countries	GDP, PPP (US \$ billion)	R&D, PPP (US \$ billion)	R&D as % of GDP	R&D as % of World
<b>Americans</b>	15,155	374.9	2.47	35.70
<b>United States</b>	12,416	343	2.76	32.70
<b>Asia</b>	19,203	387.2	2.02	36.90
<b>China</b>	8,815	141.7	1.61	13.50
<b>Japan</b>	3,995	136.7	3.4	13.00
<b>India</b>	<b>3,779</b>	<b>38.8</b>	<b>1.03</b>	<b>3.70</b>
<b>Europe</b>	14,072	264.3	1.88	25.20
<b>Rest of world</b>	2,073	23	1.11	2.20
<b>Total</b>	50,503	1049.4	2.08	100.00

Source: Global R&D Report, 2007 ([www.rdmag.com](http://www.rdmag.com))

Table 1 conveys that United States is funding the highest percentage of GDP ie 2.76 percent on R&D whereas India is just funding just 1.03 percent on R&D as percentage of GDP. India is funding research and development just 3.70 percentage of the world in 2006. It is fairly poor in the world map of R&D.

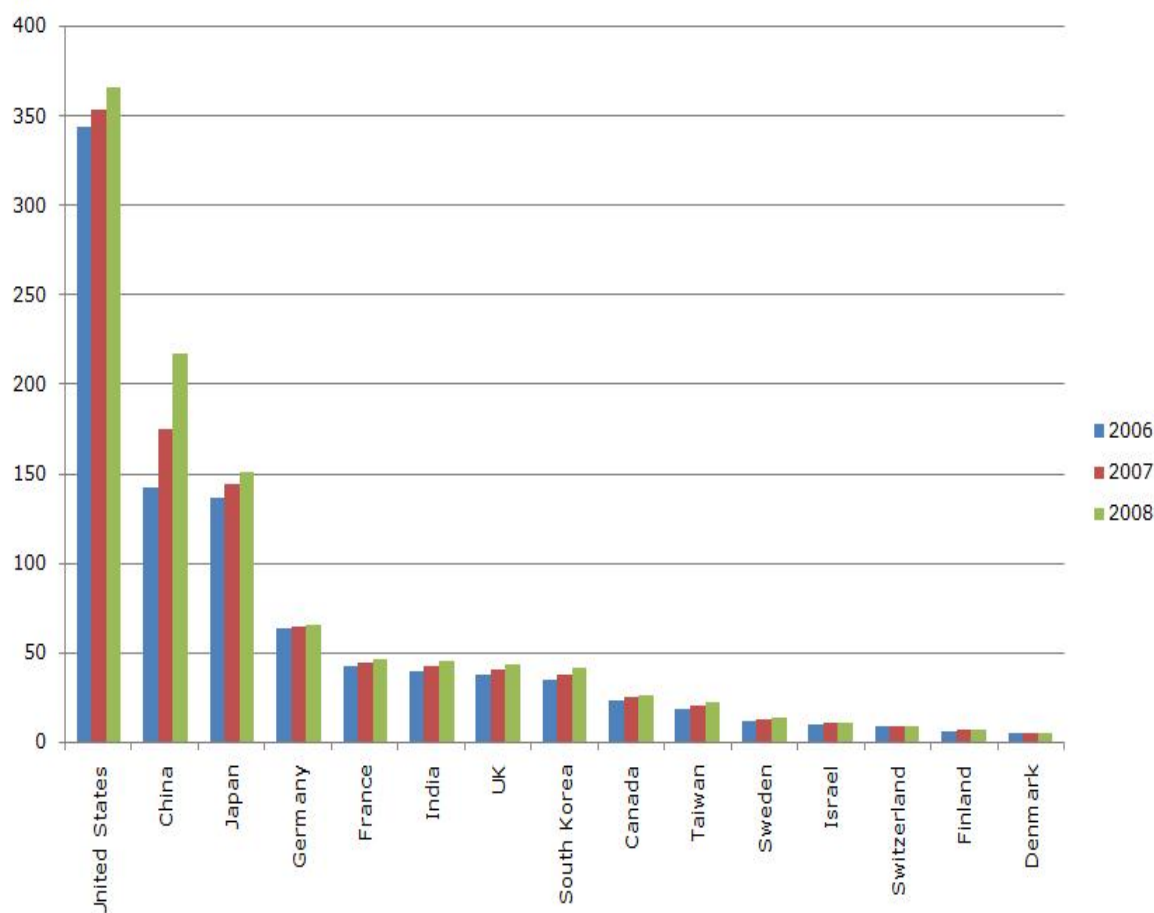
**Table -2**  
**Global R&D Spending (In Percentage)**

Countries	2006	2007	2008 (Estimated)
<b>Americans</b>	35.70	34.5	33.1
<b>United States</b>	32.70	31.4	30.1
<b>Asia</b>	36.90	38.8	40.8
<b>China</b>	13.50	15.6	17.9
<b>Japan</b>	13.00	12.8	12.4
<b>India</b>	<b>3.70</b>	<b>3.7</b>	<b>3.7</b>
<b>Europe</b>	25.20	24.6	23.9
<b>Rest of World</b>	2.20	2.2	2.1

Source: Global R&D Report, 2007([www.rdmag.com](http://www.rdmag.com))

Table 2 reveals that in 2006 Asia is spending the highest amount ie (36.90 percent) in research and development, followed by Americans (35.70 percent) and US (32.70). India is just spending 3.70 percent on research and development, has remain constant from 2006-08.

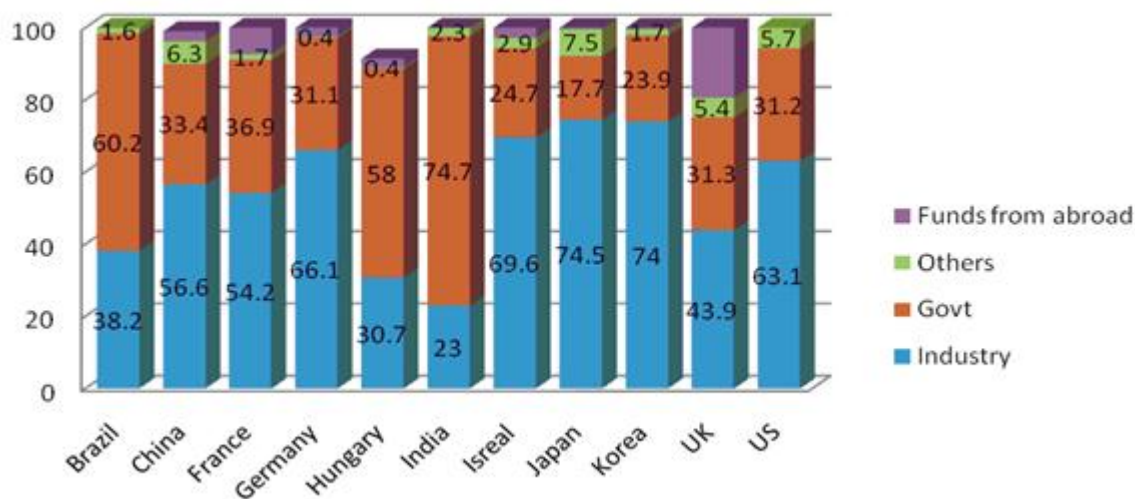
**Figure -3**  
**GERD for Selected Countries 2006-08 (PPP US \$ Billion)**



Source: Global R&D Reports 2007

Figure 3 indicates that US is the global leader in research and development. China is showing its positive transformation in 2007-08 and has occupied second position in research and development. India also is in top club of countries.

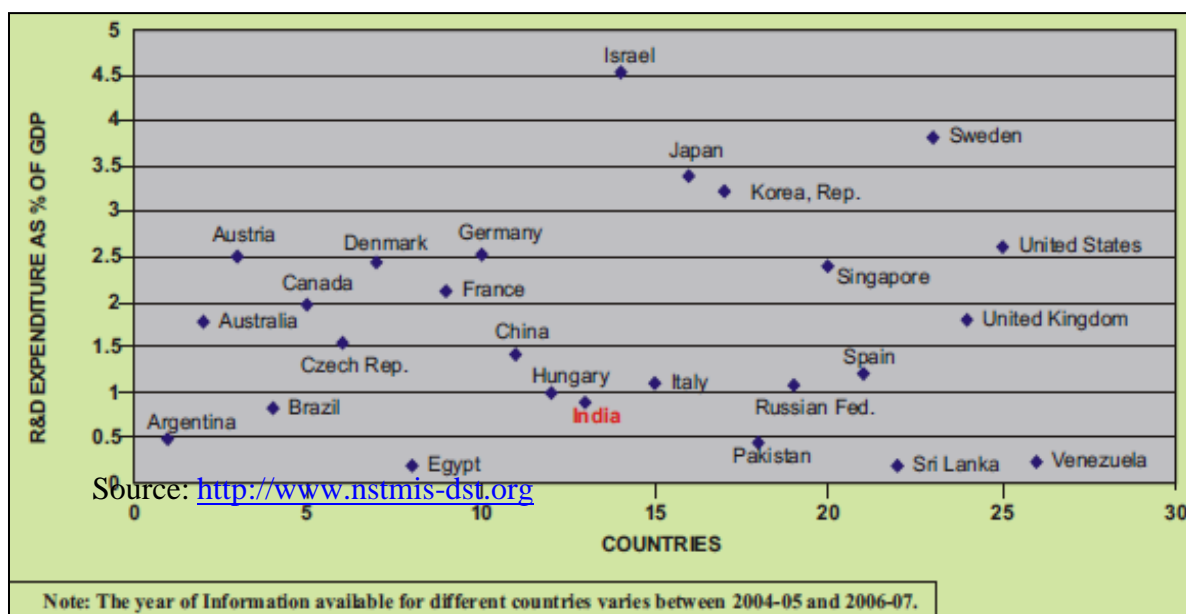
**Figure - 4**  
**Different Sources of Funds**



Source: Global R&D Reports 2007

There are different sources of funds such as government, industry, abroad and others. Figure 4 reveals that government is the major source of funding in India, Brazil and Hungary. In most of the countries, industries are primary source of funding in research and development. In India government is funding 74.7 percent, followed by industry 23 percent and by others it is 2.3 percent.

**Figure – 5**  
**International Comparison**



In global economy maximum expenditure on R&D is incurred by the developed countries as compare to under developed countries. Most of the developed countries spent more than two percent of their Gross Domestic Product on R&D. India spent 0.88 percent and China spent 1.42 percent of their GDP. The countries such as Argentina, Egypt, Pakistan and Sri

Lanka spent less on R&D as compare to India. India's share in global patenting is small. However in recent years there is a considerable increase in number of patents granted by Indian Patent Office. The number of USA patent grants to CSIR, increased from six in 1990-91 to 196 in 2003-04. India must promote science education, develop science and technology infrastructure and strengthen the legal system for protecting copy rights and patents.

**Conclusion:** Growth of knowledge-led economy and industries depends on research and development. Indian economy has been witnessing a rapid increase in research and development investment over the past few years. India's share in global research and development is still small. Hence, India must focus on science education, training to human resource, develop science and technology infrastructure and strengthen the legal system for protecting copy rights and patents Focus must be given to attract the foreign investment in knowledge-led industries and also try to increase the number of international collaboration.

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