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RESEARCH ARTICLE

Scientific Temper and Innovation: Key drivers for India's Economic Development

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ABSTRACT

This study discusses about scientific temper and reviews India's policies that play a lead role for the country in performing high on the Global Innovation Index, which is a key factor in driving global economies. Inculcating scientific temper among the citizens is of paramount importance for the development of the nation, since a large section of the society is still caught in the quagmire of superstitions and obscurantist practices. Innovation helps societies and countries in creating better jobs and improving ambience and quality of people's everyday life. Although India has made major strides in development in almost every sphere, it has slid down on the Global Innovation Index from 23 in 2007 to 81 in 2015. Policy planners have to take corrective measures to increase our investment in education and research and development, augment market sophistication, internationalize collaborations, and remove administrative obstacles.

Keywords: Scientific Temper, Innovation, R&D Funding, Scientific Policy Resolution,

Introduction

India has undergone a major leap at all stages of development since the early nineties when successive governments globalized the economy inviting participation of global investors in key sectors. As a result, the economy of the country strengthened over the years. The country has made major strides in sectors like telecommunications, agriculture, road, space, energy and defence etc. However, we are far behind in innovation compared to other Asian countries like Singapore,

South Korea and China, let alone Japan (Dutta *et al.,* 2015). The country even cannot boast of having one of the best and safest highways of the world, though the country is one of the largest manufacturers of automobiles (http://www.ibef.org/industry/india-automobiles.aspx).

During the last one decade, the world has seen the power of innovation and its different constituents in revolutionizing the business and economic landscape. With the growth of the knowledge economy, the world is also witnessing how innovation empowers individuals, communities and countries with far-reaching impact on business, politics and society (Dutta *et al.,* 2015). What is equally important is the increasing role that innovation plays in accelerating economic growth and prosperity of a nation. India has been catching up with the pace of global and regional economies by globalizing its market and offering business sops. However, the lack of scientific temper and competitiveness in manufacturing and market sophistication, infrastructure, skilled manpower and bureaucratic delays are important factors that require attention of the policy makers to make the country par excellence on innovation index.

Scientific temper is characterized by such traits as healthy scepticism, universalism, objectivity and rationality. Promotion of these and other universal human values should become an integral part of the education process in India. An efficacious method of fostering scientific temper in the societies could be by imparting knowledge of science through observation, experimentation and demonstration.

India's Policies in Science and Technology

The wealth and prosperity of a nation depend on the effective utilization of its human and material resources through industrialisation. The use of human resource for industrialisation demands education in science and training in technical skills. After Independence, the major challenges before India were to make the country self-reliant in indigenous technology and agricultural production to feed its large population, and to provide higher education to the larger masses. The major famines of the mid and late nineteenth century made India work on bringing a revolution in the agriculture sector through

innovation to overcome food deficits. To increase agricultural yields with improved agronomic technology and modern agricultural practices, the country began the Green Revolution in the 1960s, which has been a major success in making India self-reliant in agricultural production (http://pib.nic.in/feature/feyr98/fe0798/PIBF2107983.html).

India's enormous human resources can only become an asset in the modern world when educated and trained. Higher education sector in India has witnessed an impressive growth, about 35 times, since Independence with ~20 Universities in 1950 rising to ~700 in 2015 (British Council India Report, 2014). Likewise, India's Science and Technology policies have evolved with its needs through phases.

India declared its Scientific Policy Resolution of 1958 (SPR, 1958) to 'foster, promote and sustain' the 'cultivation of science and scientific research in all its aspects". It was then assumed that the technology would flow from the country's established science infrastructure. The Technology Policy Statement of 1983 (TPS, 1983) emphasized on the need to attain technological competence and self-reliance (http://dst.gov.in/st-system-india/science-and-technology-policy-2013). The Science and Technology Policy (STP) of 2003 marked a shift from the earlier policies and addressed science and technology together emphasizing the need for investment in Research and Development (R&D) (http://dst.gov.in/st-system-india/science-and-technology-policy-2013). It called for integrating programs of socio-economic sectors with the national R&D system and articulated upon the need for technological innovation and creation of a national innovation system.

India declared 2010-20 as the 'Decade of Innovation' and introduced 'Science, Technology and Innovation Policy', 2013 (STI Policy, 2013) during the 100th Indian Science Congress in Calcutta (DST Annual Report, 2013; (http://dst.gov.in/st-system-india/science-and-technology-policy-2013)). Scientific research utilizes money to generate knowledge, and by providing solutions, innovation transforms knowledge into wealth. Thus, innovation is the crucial factor in driving economic advancement of a nation.

The STI Policy 2013 aspires to promote scientific temper, make careers in science, research and innovation attractive, build world class infrastructure for gaining global leadership in some frontier areas of science, position India among the top five global scientific powers by 2020, bring fresh perspectives to bear on innovation in the Indian context, and trigger changes in the mindset and value systems to recognize, respect and reward performances which create wealth from S&T derived knowledge. India's R&D investment has been under 1% of the Gross Domestic Product (GDP) and increasing Gross Expenditure in R&D (GERD) to 2% of the GDP has been a national goal for some time (DST Annual Report, 2013). Currently, the private sector investment in R&D is one third of the total investment which has to increase significantly for converting R&D outputs into commercial outcomes (http://dst.gov.in/st-system-india/science-and-technology-policy-2013).

Innovation — Key for Spurring Economic Growth

'*Innovation is defined as the application of knowledge in a novel way, primarily for economic growth'* (EIU Report, 2009). It holds far-reaching promise for triggering economic growth of countries at all levels of development. Every year INSEAD ranks economies on the Global Innovation Index (GII) since 2007. There are eight pillars the INSEAD considers in ranking a nation on GII (World Business, 2007). These include (both inputs and outputs): (1) Institutions and policies, (2) Human capacity, (3) Infrastructure, (4) Technological sophistication, (5) Business markets and capital, (6) Knowledge, (7) Competitiveness, and (8) Wealth. The GII is aimed at serving not only as a tool for determining a country's relative response capacity, but also gives an unambiguous picture of its strengths and weaknesses in respect to innovation-linked policies and practices.

India's ranking on GII was 23 in 2007 which has been sliding down since then and figures at 81st position in 2015 (Dutta *et al.,* 2015). On the contrary, China has improved significantly and is up at 29th position on GII in 2015. The main reason for this jump is that China is making continuous efforts to build a more innovative economy with heavy investment in

R&D and higher education. China is inviting foreign investments to establish collaborative research laboratories to carry out cutting-edge research. China's R&D expenditure as percent of GDP is ~2% whereas that of India is ~1% or less of her GDP. The United Kingdom (U.K.) has made impressive growth in its ranking on GII; the country has been second during two consecutive years 2014 and 2015, and up from the 10th position in 2011 on GII ranking. The U.K. with less than 1% of the world's population, produces 16% of the top quality published research (Dutta *et al.*, 2015).

Innovation quality is the main driver in all major economies of the world. Innovation is the key for driving economic progress and competitiveness for both developed and developing economies. Innovation is not only restricted to R&D laboratories, but also includes social innovations and business model innovations as well as technical skills (Dutta *et al*., 2014). Market sophistication, investment and government policies are equally important factors in the innovation ranking of an economy.

Creating world-class universities and investing in R&D is essential for staying ahead in the global race for successful innovation that eventually drives the economy of a nation (Dutta et al., 2015). In the western countries, the top class research and innovation come from the Universities. On the contrary, in India most of the Universities have largely been rendered as centres of teaching, in spite of having a vast human talent pool. Besides, many scientists/faculties in India are involved in publishing their works in predatory journals to quickly earn tenure and promotion (Beall, 2012). This consequently degrades the quality of scientific research and impacts the overall performance of the nation in R&D.

Civilizations across the world have evolved with traditional knowledge and superstitions have been inherent practices in almost every society. The perception of people towards science changed with the Industrial Revolution during the late seventeenth and early eighteenth centuries. The apathy of the people at large towards science is largely due to sluggishness of dissemination and popularization of science by the government agencies.

After the Industrial revolution and particularly after independence of India, the policy planners in the country realized the need for popularizing science in day-to-day life and its role in economic development. This led to the declaration of SPR 1958 by the Government of India and introduction of Five Year plans by the Planning Commission. A need was felt for developing scientific temper among people and creating an ambience where both science and scientists become a source of inspiration for the people of the country to make science as a profession (Sahoo, 2005). However, there is still a need to change the illogical and superstitious attitude of the masses, for instance the fear generated in the minds of the public towards genetically modified crops like Bt Brinjal. Villages and towns in India are the rearing ground of ancient practices and blind belief that hold back the country. Science and scientific temper in the people cannot progress with superstitions and obscurantist practices. Therefore we need to change the attitude of the people, especially of the rural population, towards science.

In the Twelfth Five Year Plan, the Ministry of Science and Technology, Government of India initiated several important schemes of research grants to tap University talent pool and motivate young researchers towards high quality research giving a major boost to the research output. Nevertheless, the Government of India has to allocate more funds for R&D and provide sops for equal participation of private sectors, so that India's Gross Expenditure on R&D (GERD) increases from 1% to 2% of its GDP, which has been a national goal for the last decade (http://dst.gov.in/st-system-india/science-and-technology-policy-2013).

Conclusion

India's per capita R&D expenditure has more than doubled since 2004-05, however its expenditure in University higher education has not increased proportionately. At present, India spends less than 1% of its GDP on R&D, whereas most developed nations spend more than 2% of their GDP on R&D. The government has to increase funding in R&D to achieve the goal of 2% of India's GDP. Two third of India's Gross Expenditure on R&D (GERD) goes to three strategic sectors — defence, space and nuclear

energy. The education sector has to be given due priority and promotional incentives have to be linked to productivity.

The Global Innovation Index emphasizes the key role innovation plays as a central driver of economic growth, prosperity and better job opportunities. It has been an important component in the relative success of societies economically, socially and intellectually. Innovation is not just about evolving new ideas. It is about converting these into value-added products and services that require a conducive environment to flourish.

A country's readiness is linked to its ability to garner the best from leading-edge technologies, vast human capacities, improved institutional performance, and better organisational and operational capabilities. Scientific temper has to be built and strengthened in students at the right age so that we produce scientists of high calibre and ethics, and our contribution in global high quality research goes up. India requires well-balanced performance in terms of infrastructure, market sophistication, knowledge, technology and creative outputs. The country has to provide a safety net to innovators to make a dent at the international level.

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