

India's Development Policy: Role of Innovation & Technology

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ARTICLE DETAILS

Article History

Published Online: 12 June 2019

Keywords

Innovation, Technology, Entrepreneur, Competition, Research and Development, Patent, Growth Rate.

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ABSTRACT

The Government of India announced 2010-2020 decade as the "Decade of Innovation". In this paper the authors study how technology and innovations have drastically flipped the market by providing tough competition among the producers, thus enabling them to sell high quality products at low price. The current level of research and development (R&D) expenditure is less than one percent of the GDP. According to the Global Competitiveness Report 2017-18, country's innovation capacity has been lower than many other countries like South Korea and USA, UK but it is better than China. The authors have made an attempt to study various challenges being faced by the entrepreneurs while innovating, the advantages and limitations of technology, the level and composition of research and development expenditure in the country and many initiatives being undertaken by the Government basis which suggestions have been made to enrich the Innovation ecosystem further in the country. The authors suggest policy makers to focus on transforming country's Innovation ecosystem by introducing a New Innovation Policy to enhance R&D investment into high-tech and efficient technologies and building appropriate institutions and infrastructure. Education system needs to be made more conducive and oriented toward entrepreneurship and innovation. Infrastructure facilities such as electricity, internet in villages need improvement. An increased level of awareness, expertise assistance to entrepreneurs for protection of intellectual property rights will induce more and more entrepreneurs to go for innovation and patents. Government should focus on tapping Global Innovation hotspots in new technologies like Artificial Intelligence, Blockchain and Robotics etc. Country should focus on targeting productive outcome driven R&D in the Government Sector, ensuring more favorable infrastructure and policy to increase the share of private sector R&D in India and increase the level of research and development expenditure in the country to achieve the target rate of two percent which will further contribute to a higher level of economic growth rate. Further, they should create an entrepreneurial and innovation conducive system for holistic progress and technological advancement ensuring sustainable development.

1. Introduction

The very onset of twenty first century has seen a great revolutionary blast of technology. People are habituated to technology that they are unable to carry their daily chores without a Smartphone / laptop. Technical change is one of the major stimulators of organizational fate. Technological change can make more prominent organizational failure rate. However, if adopted properly and suits the firm, there develops a great potential to earn huge profits. The success of a firm is not predetermined, but the capability of an entrepreneur to make a firm profitable by skillfully adapting the ways of technology makes him outcast this rigidity. Some firms productively take part in the market competition through streams of innovation. Hence, these firms raise the Industrial standards; make classic substitutes for existing products at a cheaper rate or with a high margin. Such industries try to reconfigure the products and sell them in the market as a competition. For example: - A watch company named Seiko; not only tried to compete in mechanical watches, but also experimented with quartz and tuning fork movements. Adam Smith has already established an association between economic growth and research. Most of the modern economists have attributed the consistent growth in developed countries to their rigorous research and

development activities. Innovation is a fundamental impulse of economic progress that benefits businesses, consumers and the economy as whole. It emphasizes on the development and application of ideas and technologies which is useful in making the product more efficient. Information technology has altered the way companies produce and sell their goods and services thereby enhancing their productivity and contributing to a higher growth in the economy. Several studies have shown a positive relation between R&D and economic development. A testimony to this phenomenon is the case of Germany where their automotive industry is the leading contributor in which Germany infused more than one third of the country's R&D expenditure. The evolution of mankind is due to the result of innovation and technology. Without major inventions over time, there wouldn't have been any advancement in economic and social life of the society. Innovation is a continuous process which makes it vast and complex as a subject to study both at the theoretical and practical level. Literature uses the term innovation as the activity that uses new innovative knowledge, technology and the process in order to generate a new and improvised product to flourish it in the market.

Innovations may be: (i) Product Innovation– Any advancement made in an existing good or service is innovation. Examples of product innovation can be smartphones or tablets. (ii) Process Innovation– It refers to the new or improvised production method. How easily is it accessible to people worldwide makes it more desirable. In recent times, a shift towards an online sale in retail sectors like clothing, books, groceries, machinery equipment etc. has multifold increased their sales. (iii) Marketing Innovation - It is about the product designing or packaging, marketing and pricing of the article. Many of the Japanese and Chinese made goods are sold due to their mesmerizing physical appearance. They do not serve much purpose but people develop a fancy for them. (iv) Organizational Innovation - It is the execution of new organizational methods in business, workplaces and trade practices. Changes in management techniques, strategies, mergers and acquisitions, processing units, prices customization are the key goals in this type of innovation.

Innovations may also be classified as (i) Radical innovation – refers to such ideas which have impact on or cause significant changes in the whole industry; (ii) Incremental innovation - refers to ideas which help in improving products, processes and services; (iii) System innovation - ideas which require many labor years and several resources to accomplish. For example: satellites operations. (iv) Architectural innovation - involves reconfiguration of the invented items to make a completely different and new object. (v) Modular innovation – refers to changing the basic concept without changing the primary function or product's architecture.

There is a substantial difference between Innovation and Technology in a qualitative manner and also at personal level. Technology on hand can be considered as a scientific discovery while innovation is a process where the technology is transformed into a completely new product. An innovation made according to the consumer or the market need is called market pull innovation while an innovation based on a completely new technology is called a technology push innovation. Market pull innovation requires a strong market idea about the needs of the consumer so that the producers can qualify market needs whereas technology pushes a completely new product in which the consumer needs to be educated about the product. In technology push innovation there is a high risk of the market failure.

2. Review of literature

This topic has been of a great interest and a subject of heated discussion among economists around the globe. Schumpeter (1934) argued that "It is not the price conflict which tally, but the competition from the new products which affect the profit margin". In a market not only price competition matters; but the competition arising from the new products flourishing in the market, new type of industries having advantage of the cost and quality make the firms more efficient in the long run and this helps in improving their products and market share. Vermon R. (1966) stated that "Industrial development is stimulated by the concept of product innovation. However, with time due to obsolescence of the machinery parts, the cost of producing the products increase and hence it becomes difficult to compete in the market." S.L.

Kline and N. Rosenberg (1986) quoted that "It is a threat to treat innovation that enters the economy at a specific well-defined time interval. They undergo drastic changes which may affect economic significance in long run". According to K. Pavitt (1987), "Majority of technologies is complex and are considerably increasing. There are certain companies where technology plays a necessary role in the production process". Eisenhard (1991) narrated that "Assembling the pieces of puzzle together allows the researcher to form a complete theoretical picture of a model". Tidd (2001) stated that "Limited current knowledge about Technology and Innovation fails to provide comprehensive and compatible findings which adversely affect managers". Rutherford-Silvers (2008) depicted that "Decision making in indecisive and perilous environments is similar to decision making homologous to technology and innovation management". According to Luisa R. Blanco, James E. Prieger and Ji Gu (2015), Research and development has a strong effect on both total factor productivity and state output over the long run and found that returns to state Gross Domestic Product from R&D expenditure are 82–211%.

3. Objectives

- (a) To understand various challenges, advantages and limitations of Technology
- (b) To analyze the situation, extent and distribution of Research and Development expenditure in various sectors and to provide suggestions.
- (c) To understand the evolution and various advancements in Innovation and Technology.
- (d) To review and assess various initiatives undertaken by the Government and further suggest recommendations to enhance innovation productively.

4. Analysis

1. Current Challenges

Certain challenges faced by innovative entrepreneurs in India are discussed below:

- (i) Fragmented policy: There is no concrete policy as such focusing on entrepreneurship and innovation. The mechanism to operate fragmented, existing policies is not uniform, which leads to a defeat of the purpose of such policies.
- (ii) Inadequate funding of R&D: There was low national funding for R&D as it was mere 0.88% of the GDP during 2011-2012 (NSTMIS, 2013). Out of the total expenditure on R&D in the nation, around 63% of it is spent by the government and the total R&D expenditure of an industry is equal to an amount which would just be what a global multinational would incur on its R&D (NSTMIS, 2013).
- (iii) Lengthy and difficult mechanism: Even though funding is available from public sources and banks, the process for accessing funding is often lengthy, complex, bureaucratic and cumbersome, which is detrimental to the growth of entrepreneurship and innovation spirit in the country.
- (iv) Seed funding, Angel, venture capital: Despite over 100 angel networks working in India (e.g., Mumbai Angels, Indian Angel Network), only ten of the deals are made every year. For the country, the number of deals is quite low in comparison to many foreign countries. Indian angels are strained by various regulations making exit and investment inconvenient (Planning Commission, 2012).
- (v) Weak linkages among stakeholders: The inter-link between

industry, especially small-scale and medium enterprises and academic or R&D institutions is weak. There is no easy exchange of manpower across industries and academia or R&D institutions, which limits the capacity for their common understanding and technology transfer. (vi) Non-conducive education system: Our education system is quite focused on careers and grades and is not much oriented toward entrepreneurship and innovation. The situation gets further deteriorated because of issues such as delays in the funding process or various support reaching innovation projects; lack of good facilities and infrastructure in the educational establishment; (vii) Poor infrastructure facilities in villages: Basic infrastructure facilities such as electricity, internet, roads and rail, and even the availability of a skilled workforce, are unevenly distributed in India and are often weak in smaller cities or towns and rural parts of the country. So, there is less scope for entrepreneurship and innovation to flourish in these areas. (viii) Risk aversion behavior: Entrepreneurs in India are reluctant to work on innovative ideas due to low availability of funds, high funding costs and risks involved. Hence, they mostly seek established technology as the base for starting their business. The potential larger returns from innovation usually takes time to realize, so not many entrepreneurs are able (or willing) to take the risks. (ix) Lack of intellectual property rights protection: The intellectual property rights regime is poor in India. Innovators do not usually seek protection for their intellectual property unless they are forced to. Patent education is very low even among educated innovators and there is a lack of availability of expertise assistance, except in the medicine and pharmaceutical industry.

2. Advantages and Limitations of Technology

The technology invention has made it highly convenient for us to communicate with anyone across the globe. The education industry depends on the Information Technology department to improve learning and teaching, skills for community services and efficient administration. Technological advancement can help a country in eliminating poverty by providing various work opportunities to the unemployed. Technology and innovation help in creating substitute products at a relatively cheaper rate. The World Wide Web has made the world a social community. It is because the information from all over the world is widely accessible on the net. Technology further helps in saving time, provide ease of mobility, leads to cost efficiency, make provisions for better communication means and improved banking services. In this modern era, the advancement in Artificial Intelligence System would be capable of thinking, which will be one of the great advantages of the modern technology. While as part of its limitation, technology has taken away our freedom from us, as we significantly depend on it even for our routine work. We may not be able to solve a simple mathematical problem without a calculator, and just struggling. No doubt technology has made our life fast paced, it has made us more efficient in our work, but in the process we have become slaves of it. Instead of solving problems with our mind, we mostly rely on technology for faster results. For instance, if we wish to go to a particular place; we would probably use GPS system rather than struggling with maps for understanding different directions. Though technology has made it easier for us to communicate

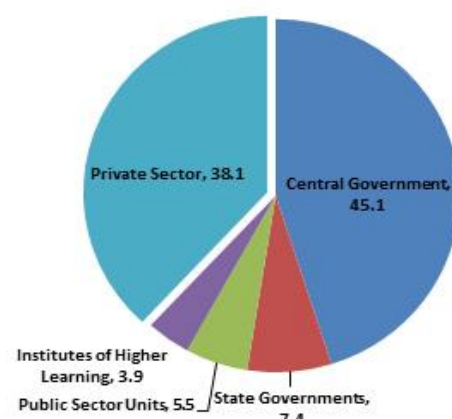
globally, but it has isolated us from the people sitting right next to us. Now people have time to contact strangers around the globe through phone calls or video calls, but they refuse to mingle with their neighbors. In many cases, they don't even know whether their neighbors even exist. This would pose questions whether the new technology is worth or not. Technology was supposed to make our life easier, but it has made it even more complicated in various ways.

3. Expenditure on Research and Development

Currently India spends less than one percent of its GDP on R and D expenditure; whereas for the China and US, the numbers stand at 2.04 percent and 2.7 percent respectively (source: World Bank). Expenditure on R and D should be considered as an investment which leads to more optimal and efficient production methods which can have long term favorable impact on the growth trajectory. One innovation or invention can fire many more. For example: Through smartphone usage, GPS has helped in providing Location Based Services (LBS). Interestingly, the present GPS receiver uses General Theory of Relativity formulae, proposed by Albert Einstein around 100 years ago! However, due to spill-over effects, the potential benefits of new ideas might not be reaped by the people who innovate them. Perhaps that is why the private sector may be less motivated to spend on R and D activities. The government needs to provide interventions such as protecting intellectual property rights, tax incentives, providing direct support such as supply and finance conveniences, to increase R and D activities of the private sector, (OECD, 2004). Private and public investment plays contrasting but supportive roles in providing momentum to the research. A report regarding the analysis of investment trends in the UK estimates that a one percent rise in public expenditure on R and D leads to 0.48-0.68 percent increase in the private expenditure on R and D (Economic Insight report April 2015). R&D in India mainly comes from two sources, public R&D (government exploration in agriculture, defence, space, atomic energy, etc.) and private R&D (Example: large companies R&D expenditure in the area of electronics, pharma etc.) The figure below shows the breakup of R&D expenditure in India.

Figure: Annual R&D Expenditure in India

How the annual R&D spending in India is split (%)



Source: Department of Science & Technology

As per the figure above, non-private R&D accounts for 62% with central Government shares being the highest at

around 45% while, the private sector and the industry contribute to 32%. India's share of the public sector is highest among the list of countries which includes Germany, France, US, Russia, UK, Korea, Mexico, Spain, Japan, Italy, Australia and China. A more favorable infrastructure and policy can help increase the share of private sector R&D in India.

4. Evolution of IT Sector innovations

In the development of an economy, innovation plays a decisive role. It gives the market completely new products to rely on and help the consumers to choose and use the desired products. Hence some major outstanding inventions have taken the world by aback are: (i) Extend Fertility: Conceiving the market for egg preservation: - In April 2003, an MBA student Christy Jones came up with a completely new venture to help women conserve their fertility for long. She had a company named 'Extend fertility' which would commercialize a technique known as egg freezing, in which the women's egg is extracted and stored in low temperatures to preserve it for future use. The research has been very fruitful to the cancer patients whose treatment course could damage their eggs. (ii) Nike: Changing the Sneakers Game: Nike is a multinational corporation in USA. It is involved in the design and manufacturing and world-wide selling of shoes, sports equipment, accessories, and sports products. The company was founded by a coach named Bowerman whose student succeeded in achieving two gold medals in the summer Olympics. Bowerman made the first Nike shoes from waffle iron for his student. This presents an inspirational story turned into a multinational company which at present hires many high - profile athletes and sports teams across the globe for their promotional offers. The company is well-known for its artistic skills in making comfortable shoes which enhances an athlete's performance. (iii) Apple Phones: The real transformation of the internet economy, mobile phone business and in many ways the society as a whole flourished when iPhones were launched into the market. It turned the mobile industry upside down. Though not very innovative but the competition level has reached its height in the recent era of mobile phones. In 90s, Nokia being the biggest player in the cellphone market takes a goodbye with the launch of 'qwerty' keypad phones which was overruled by smartphones soon. Earlier blackberry phones were contemplated to be optimum in the mobile industry but not for long since the initiation of iPhone in the year 2007. (iv) Rolls - Royce: The cars manufactured by Rolls-Royce is of high quality with an elite status. They are built to specifications with their integral designs. The company was established in 1904 by Charles Rolls and Henry Royce. The company in the early era specialized in making jet engines. It had the capacity to nonstop cross Atlantic. However, It wasn't the jet for the airplanes. Each engine is built manually, and the company makes tremendous efforts day and night in order to keep their cars unique and their styles intact. Hence, the result shows that till date around 65% of the cars made by the company are still on the road. It is the superb quality with the outstanding designs which keeps the brand going till date making their turnovers in billions.

5. Government's Initiatives to Stimulate Innovation

(i) In the Agriculture Sector, the Government has given a big push to the technology usage and also embraced Direct

Benefit Transfer mode for convenient delivery of credit, extension services and other inputs to marginal and small farmers. Agricultural R&D is the major source of innovation, which is required to sustain agricultural efficient growth in the long-term (FAO, 2012). There has been betterment of ideas in Eleventh Plan with important innovation- **Rastriya Krishi Vikas Yojana (RKVY)** formulated to bring more flexibility for the states and provide them various incentives to spend more on agriculture. (ii) The country's first Green Revolution had origin in the 'Seed-Fertilizer Irrigation' technology, its second Green Revolution must have its roots from 'radiation-induced mutation technique and Biotechnology' along with cohesive nutrient, pest & water management technology. (iii) Atal Innovation Mission (AIM) is an innovation stimulation platform involving researchers, academics and entrepreneurs drawing upon international and national episodes to foster an innovation, R&D culture in India. (iv) Innovation in Science Pursuit for Inspired Research (INSPIRE) Faculty Scheme, which is one of the government programs, provide directions to Indian researchers living in foreign countries, to work in Indian institutes/universities. The introduction of JAM (Jan Dhan— Aadhaar— Mobile) now strengthened by Unified Payments Interface, holds a significant potential for the country. (v) The IBC resolution procedure could manifest a precious technology for handling issues in the Indian corporate sector as per Economic Survey 2017-18. The launch of 'Make in India' programme on 25th September 2014 focused on making country a global centre for research, manufacturing & innovation and an important part of the global supply chain. (vi) National Innovation Council (NIC; innovationcouncil.gov.in) is "the major footstep in the creation of a system that will make provision for mutually strengthening methodologies, policies, and recommendations to boost and implement innovative performance in the nation" (Nation Innovation Council, 2010). (vii) The *Science, Technology and Innovation Policy 2013* presented various policy initiatives to build up an innovation ecosystem and encourage the development of innovation-based entrepreneurship culture in the country. (ix) The India Inclusive Innovation Fund has been planned to "combine dynamism of enterprises and innovation to sort out the issues of the bottom of pyramid in the country" (National Innovation Council, 2014). The government will contribute around 20% of the fund, and the rest 80% will be contributed by bilateral/multilateral development agencies, Indian and global corporations, financial institutions and insurance companies. (x) India's efforts in the promotion of bilateral cooperation and investment in the field of innovation had a strong effect in 2017. The theme of innovation, startups and R&D remained as main agenda in nearly all the bilateral visits of Prime Minister Narendra Modi and in other diplomatic meetings. The introduction of the Technological Innovation Fund and India-Israel Industrial research and development and India organizing the Global Entrepreneurship Summit (which was convened by the US) in 2017 depicts strong intent of the government in respect of innovation diplomacy.

5. Conclusions and Recommendations

Technology no doubt provides solutions to the society of its immediate problems. It has proved to be our greatest benefactor in the construction of a completely new world, keeping up the old world intact. However, there exists

"Technological dilemma". This is the dilemma between over dependence of life on advance technologies and a threat that it might hamper the quality of life. Technology has made it so much easier to grasp knowledge and information about anything and everything. Technology and innovation have flipped the market by providing tough competition among the producers making them sell high quality products at low prices. The more one knows about the technology the more one can take advantage of its efficiency. Every invention aims to earn maximum value from each dollar spent on developing a technology. Since everything has its pros and cons so does the technology. Man has become the slave of modern-day gadgets. It is important to focus on the factors which yield high productivity and brings technological changes in the society. Despite various initiatives being undertaken by the Government, a lot needs to be done to match the government's target of achieving R&D expenditure of two percent of the GDP, as this will also help in increasing the manufacturing base under the Make in India program and lead to a higher trajectory of growth rate.

Given that India currently ranks 57 out of 127 countries as per the Global Innovation Index 2018, there is still a long way to go in enhancing our ranking to gain further competitive strength globally in improving the innovation culture. Although there are various challenges being faced by the entrepreneurs while innovating, some of the suggestions as derived from the study can be incorporated by the policy makers to enhance the innovation and technology driven culture in the country. The authors suggest that there is a need to enhance the inter-

linkage between the industry, especially small-scale and medium enterprises and academic or R&D institutions. Education system needs to make more conducive and oriented toward entrepreneurship and innovation. Infrastructure facilities such as electricity, Internet in villages needs improvement. An increased level of awareness, expertise assistance to entrepreneurs for intellectual property rights protection will induce more and more entrepreneurs to go for innovation. Policy makers should focus on transforming country's Innovation ecosystem by introducing a New Innovation Policy to enhance R&D investment into high-tech, efficient technologies and building appropriate institutions and infrastructure. The focus should be on targeting productive outcome driven R&D in the Government sector, ensuring more favorable infrastructure and policy to increase the share of private sector R&D in India. They should ensure increase in the level of research and development spending (which has been stagnant for years at less than one percent) in the country to achieve its target rate of two percent of the GDP, which will further contribute to a higher level of economic growth rate. Government should focus on tapping Global Innovation hotspots in new technologies like Artificial Intelligence, Blockchain and Robotics etc. Further, by creating an entrepreneurial and innovation support system through a collective community of practitioners, international and national experts and other partners, objectives of Atal Innovation Mission (AIM), innovative platform can be fulfilled successfully for the economy's meaningful development and to increase the welfare of the citizens of the country.

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