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Original Paper

Boosting Innovation in India: A Policy Framework

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Abstract

Innovation and entrepreneurship are becoming increasingly important in the global economy, as emerging technologies like artificial intelligence and machine learning drive the production landscape. This paper proposes a policy framework to expand India's innovation and entrepreneurship horizons, with the goal of establishing the nation as a global research and development (R&D) powerhouse. India has made significant progress in recent years, ranking in the top 40 innovative countries for the first time in 2022. However, there are still significant impediments to innovation and entrepreneurship in India, including deficiencies in education and research, inadequate research infrastructure, burdensome regulations, and a lack of synergized approach. This paper presents a comprehensive approach encompassing improvements in research infrastructure development, regulatory reforms, fostering collaboration between industry and academia, and strong support for startups and small businesses to promote innovation and entrepreneurship in India. By implementing these measures, India can unlock its latent potential, address local challenges, pioneer cutting-edge technologies, and actively contribute to the global knowledge economy.

Keywords

Innovation, entrepreneurship, policy framework, the collaboration between industry and academia, startups

1. Introduction

In the current global landscape, innovation, and entrepreneurship are widely acknowledged as crucial drivers of economic growth and competitiveness of nations worldwide (Braunerhjelm, 2010). Countries worldwide are investing in R&D and industrial capacity to compete for geopolitical influence and increase their share in global supply chains (Aiyar et al., 2023). With the emergence of technologies like robotics and artificial intelligence in the production landscape, the significance of innovation capability in determining a nation's comparative advantage will be more crucial than ever before (United Nations Conference on Trade and Development, 2020). Given the future trajectory of production, which is increasingly innovation-intensive, it is essential for India to cultivate a vibrant innovation ecosystem with the vision of becoming a global powerhouse in research and development (R&D). In addition to its

role in maintaining economic growth, investment in research and development (R&D) is also essential for addressing a range of global challenges, including climate change, global instability, and national security (He et al., 2023; Bilgili et al., 2021; Godil et al., 2021; Holroyd, 2022; Fang et al., 2022).

With its immense potential in the form of its burgeoning economy, demographic dividend, diverse talent pool, and rich cultural heritage, India holds promising opportunities to harness the power of innovation. India is renowned for its ingenuity and resourcefulness, which are often expressed through the concept of jugaad (Arya, 2020). Although in the global innovation index rankings from the 60th position in 2017, India reached the 40th spot in 2022, the country is still generating innovation output well below its actual potential. While India possesses significant potential, it must leverage this potential by creating a conducive ecosystem that encourages innovation. A comprehensive policy framework becomes imperative to address the existing gaps and provide a roadmap for nurturing innovation, fostering collaboration, and propelling India to the forefront of global innovation. This policy paper aims to propose a comprehensive strategy to harness India's innovation potential.

2. What does the Data Say?

India's standing as the world's fifth-largest economy is undeniably impressive (Martin Armstrong; Sept 2022; While India's ranking as the fifth-largest economy is impressive, it is important to remember that this ranking is based on the size of the economy in terms of GDP. It does not necessarily mean that the average Indian is better off than the average person in other countries. Nevertheless, India's economic growth in recent years has been impressive. If India can address its problems of poverty and inequality, it has the potential to become a major economic power in the years to come). However, India lags when it comes to Gross Expenditure on Research and Development (GERD) as a percentage of GDP. Figure 1 illustrates a consistent decline in India's GERD as a percentage of GDP since 2010. The Department of Science & Technology confirms this trend, noting that India's GERD as a percentage of GDP remained relatively low at 0.66% and 0.64% in 2019-20 and 2020-21, respectively. What is even more striking is that India's GERD as a percentage of GDP pales in comparison to several other countries. As shown in Figure 1, there exists a significant gap between India and other select nations in terms of research and development expenditure.

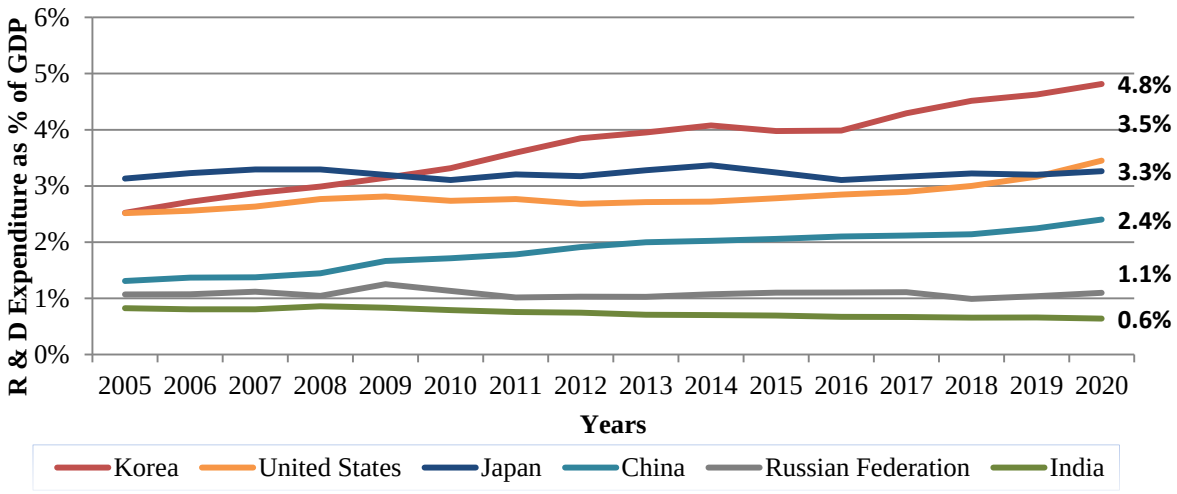

Figure 1. R&D Expenditure as % of GDP for Selected Countries

Source: World Development Indicators, World Bank

Furthermore, India faces a shortage of researchers per million people. Despite a population of 1.4 billion in 2022, India has only 1.7 million researchers, resulting in a meagre count of 1,215 researchers per million individuals (according to the UNESCO Institute of Statistics). In comparison, China, Korea, and Israel have much higher researcher densities, with 10,941, 13,667, and 8,584 researchers per million people, respectively.

Additionally, the proportion of female researchers in India remains relatively low (Rain & Anand, 2020; Schneegans et al., 2021; Huyer, 2015; DST, 2022). Although it has shown some improvement, rising from 14% in 2015 to 19% in 2018, it still lags behind other countries. For instance, Sri Lanka boasted a 47% share of female researchers in 2017, while the European Union and Switzerland had rates of 34% and 35% respectively during the same year. A low share of women in research is a matter of concern because it reflects gender inequality and hampers diversity and innovation in scientific endeavours.

India's low GERD as a percentage of GDP raises concerns about its competitiveness and progress in innovation, technology, and economic growth. To enhance growth and global standing, increased investment in research and development is crucial. In this regard, the Indian government has taken some steps to improve India's performance in innovation, which have also yielded positive results. According to the Global Innovation Index (GII) 2022 report, India entered the top 40 innovating countries for the first time since the inception of the GII in 2007. Notably, India's rank has improved from 81 in 2015 to 40 in 2022. However, there is still ample room for improvement, and continued efforts are necessary to further enhance India's innovation ecosystem.

3. Recent Initiatives Taken by the Government

The Government of India has taken a number of steps in recent years to boost innovation in the country. The government has set up a number of innovation hubs and incubators across the country to provide a conducive environment for startups and entrepreneurs to develop and commercialise their ideas. GoI has launched many schemes to foster innovations like the National Initiative for Developing and Harnessing Innovations (NIDHI), Atal Innovation Mission (AIM), MeitY Start-up Hub (MSH), Uchchatar Avishkar Yojana of Ministry of Science and Technology. Apart from that, GoI is undertaking several other initiatives also to promote an ecosystem of innovation and entrepreneurship across the length and breadth of the country. Some of these are as follows:

Inculcating the mindset of critical thinking and problem solving via ATLs: Inequality of opportunity prevents many brilliant minds from contributing to India's innovation pool (McGinnis, 2021). It is more important than ever to identify, nurture, and empower these minds. Atal Tinkering Labs (ATLs) are providing opportunities for young students to innovate by inspiring them and providing them with guidance and support across the nation’s far-flung regions. As of 31st December 2022, AIM has funded 10,000 schools to establish Atal Tinkering Labs (ATLs).

Fuelling Startup Growth: The Startup India initiative, spearheaded by the central government, is focused on cultivating an environment that nurtures startups. It encompasses a range of incentives, including tax exemptions, streamlined regulatory procedures, and access to funding (Sarkar, 2016). Under the Startup India initiative, eligible companies can get recognised as Startups by DPIIT, to access a host of tax benefits, easier compliance, IPR fast-tracking & more. Additionally, it offers invaluable mentorship and networking opportunities for aspiring entrepreneurs. As of December 31, 2022, the Department for Promotion of Industry, and Internal Trade (DPIIT) has officially recognized over 86,000 entities as startups. These startups are widely dispersed across 663 districts, spanning all 36 states and Union Territories of India. In line with its objective to promote entrepreneurship and support startups, the Atal Innovation Mission (AIM) also actively backs aspiring entrepreneurs through the establishment of Atal Incubation Centres (AICs) throughout the country, including in Tier II/III locations. Furthermore, the Small Industries Development Bank of India plays a crucial role in supporting the innovation and commercialization of pioneering technologies. It achieves this through the India Innovation Fund, a registered venture capital fund that specializes in investing in early-stage Indian firms driven by innovation. Together, these initiatives form a comprehensive framework that empowers startups, fosters innovation, and propels the growth of the entrepreneurial landscape in India.

National Research Foundation: The recently launched National Research Foundation (NRF) in July 2023 also holds immense potential to revolutionize the scientific research landscape in India. It is an apex body in India that will be responsible for providing high-level strategic direction to scientific research in the country. The mandate of NRF is to fund research projects and programs, nurture research talent in India, and promote international collaboration in research.

Despite these efforts, there are still several challenges that need to be addressed to further promote R&D

and innovation in the country.

4. Key Challenges Hindering Innovation in India

Inadequate Private Sector Investment in R&D: In contrast to advanced countries where the private sector contributes more than 70% of GERD, India's private sector contribution stands at less than 40% (V. 2022). According to the Research & Development Statistics 2023 by the Department of Science & Technology, the contribution of the private sector in R&D investment stands at 36.4% as of 2020–21. There is inadequate private sector investment along with inadequate enablers such as direct financial support to the private sector, public procurement strategies, and incentives to carry out and participate in R&D activities and mechanisms for hybrid funding models {Ministry of Science & Technology and DST, 2020)

Limited Collaboration between Academia and Industry: In India, there is limited collaboration between academia and industry which hinders innovation and the commercialization of research. Furthermore, there is also a lack of focus on applied research, which is critical for the development of new products and technologies (Bhattacharjee et al., 2021). Academic institutions and many public research centers focus on advancing science, focusing on patents, and publishing; very little systematic attention is being paid to applied R&D. Indian research is mostly skewed towards basic research and lacks application-oriented R&D. Most organizations would rather go for quick acquisition of technology rather than invest in internal R&D.

Missing middle: In India, the absence of medium-sized enterprises is notable, as most businesses are either very large or very small. Medium-sized enterprises represent only about 1% of all businesses in the country. However, literature in innovation economics indicates that these mid-sized enterprises tend to be more innovative than their smaller or larger counterparts (Bjerke & Johansson, 2015). Small enterprises often lack the necessary resources for innovation, while larger firms may have fewer incentives due to existing success. It is mid-sized firms that are rightly placed in terms of incentives to innovate (Cherif & Hasanov, 2021). Medium-sized enterprises also benefit from avoiding complex hierarchical structures found in larger companies, allowing them to operate with greater agility, and flexibility, and respond to dynamic situations more swiftly. However, despite their potential to drive innovation, the lack of medium-sized enterprises in India presents a significant challenge in nurturing a thriving innovation ecosystem.

Lack of risk capital: Indian companies have a low capacity to absorb risk, which makes it difficult for them to diversify and take on new projects (Gupta, 2011; OECD, 2018; ET Money, 2022). This is a major obstacle to the development of a Silicon Valley in India, as Silicon Valley is known for its risk-taking culture. One of the major reasons for this risk aversion is the lack of risk capital. The lack of risk capital is due to a number of factors, including the lack of a strong venture capital industry in India, the high cost of capital in India, and the lack of a clear exit route for investors. As a result, many promising startups are unable to get off the ground, and India's innovation ecosystem is stunted.

Weak enforcement of intellectual property rights: The weak enforcement of intellectual property (IP) rights hinders the ability to combat imitators and free riders, thereby acting as a major barrier to investment in R&D and the overall growth of a country's economy (Kataria, 2015). For Intellectual Property Rights to be effectively upheld, strong IP laws must be accompanied by a strong enforcement mechanism. Without enforcement, the benefits of IP rights cannot be realized. Therefore, it is crucial to strengthen the legal and regulatory framework for protecting intellectual property by bolstering the enforcement and adjudication mechanisms to effectively address IPR infringements.

High Lab to Land time: The 'Lab to Land' time is too long in India (Kumar, 2022). Renowned public-funded institutions like the Council of Scientific & Industrial Research (CSIR), Defence Research and Development Organization (DRDO), Bhabha Atomic Research Centre (BARC), Indian Council of Medical Research (ICMR), Indian Council of Agricultural Research (ICAR), Indian Space Research Organisation (ISRO), along with prominent universities across the country, have developed many frontline technologies. However, the rate of transfer of these technologies to industry and for societal benefits is low. The major weaknesses of publicly funded R&D and technology institutions like CSIR, DRDO, BARC, ICMR, and ISRO are their poor marketing skills and information dissemination (India Invents, 2018).

Underutilization of funds: As mentioned above, India's share of expenditure on research and development as a percentage of GDP remains very low. However, it is even more peculiar to note that whatever paltry funds are allotted to spend on R&D, they also remain underutilized. For instance, the actual expenditure of the Department of Scientific and Industrial Research (DSIR), which utilizes funds for promoting innovations in Individuals, Startups and MSMEs, has been lower than the budget estimates in all years between 2016-17 and 2019-20. During the 2016-20 period (four years), on average, the Department of Science and Technology (DST) spent 4% less than the budget estimates. The corresponding figures for DSIR and Department of Biotechnology (DBT) are 1% and 2% respectively. In 2020-21, actual expenditure is lower than the budget estimates for all three departments: (i) -22% for DST and DISR each, and (ii) -19% for DBT.

Hurdles in procuring laboratory equipment: The present system of procuring laboratory equipment is quite cumbersome for researchers. They need to embark on a labyrinthine journey of paperwork through a Global Tender Enquiry (GTE), that leads them through the research institute, to the line ministry, and finally to the secretary of that ministry for consent (Sinha, 2023).

5. Way Forward

Financing Innovation: Financing innovation remains a major issue since banks show unwillingness to extend credit to newly established enterprises due to a lack of collateral and a high risk of default (Cusmano, 2014). Venture capitalists' investments have moved away from early stages to later stages worldwide (Bhalla & Mukul, 2023). This can be demotivating to a young and aspiring entrepreneur who has the innovative capacity but not the money. This is where the government can step in—it can create an

ecosystem that promotes financing innovative ideas by promoting venture capitalism and seed capital for Startups. This can be in the form of reducing capital gains tax, higher spending on R&D, expediting administrative processes, providing seed funding, etc.

Increased access to R&D infrastructure: R&D-based innovation is dependent on the availability and access to research infrastructure (V et al., 2022). The ability of a firm to use laboratories and research facilities inside and/or outside the premises is a major factor in its ability to develop R&D innovations. There is a need to develop clusters-based R&D centers. These centers can provide R&D support and capacity building for cluster members. These centres will offer a range of supportive measures, such as assistance in patenting and licensing, and facilitating grant applications, providing information on emerging technologies, innovation diagnosis, Further, they will also include competitive intelligence, which involves technological benchmarking, generating technology maps, etc.

Improved Collaboration between Industry and Academia: In India, there still exists a lack of synergy between academia and industry (Mangipudi, 2020). Working with academia and research institutions can allow firms to gain early access to research outputs and influence the research agenda of these institutions (Scandura & Iammarino, 2022, pp. 1000-1036). Subsequently, industrial firms can reduce their costs by outsourcing their research and collaborating with educational institutions. Provisions for extended sabbaticals in academia and industry may be widely promoted to support knowledge and expertise exchange between industry and academia. Funding mechanisms must be developed to pilot the technologies developed in academic/research institutes.

Better coordination between different stakeholders: The major stakeholders pursue their individual agenda without a concerted, coordinated plan of action (Brown, C., & Olsen, P., 2018, 20(7), 1051-1078). Thus, there is a vacuum in planning/strategizing for higher R&D spending. This needs to be addressed by facilitating interconnectedness and collaboration between the different stakeholders in the STI ecosystem. An empowered body is needed to steer holistically the management of science in the country. The proposed body will help in managing and steering inter-ministerial, inter-disciplinary research besides breaking silos among various scientific departments/agencies. It will also be chartered to ensure there is no duplication of technology development amongst departments, or research institutions.

Reversing Brain drain: To reverse brain drain, it is crucial to tap into the untapped potential of skilled Indian scientists abroad. This can be achieved by creating suitable opportunities for their return, including not only faculty positions but also pre-faculty and advisory roles. The government has already initiated fellowships and internships to support returning researchers, and such schemes should be expanded and promoted across ministries. Additionally, recruiting foreign expertise, particularly in science and technology, could further enhance research opportunities in India.

Better awareness about the existing schemes: There is a need for better streamlining and consolidation of overlapping schemes, enhancing awareness, and reducing bureaucratic hurdles in accessing existing research-related schemes. A centralised database on all forms of financial incentives may be made

available to promote incentives for innovation and enable continuous monitoring and evaluation of program performance.

Foreign Funding in R&D: There is a need for more FDI that not only provides capital but also brings advanced technology, equipment, and management experience, which can produce spillover effects, such as demonstration, learning, and staff turnover effects (W., 2022). Opportunities for foreign MNCs to invest in the country's STI landscape should be strengthened and made more accessible. The immense potential of foreign MNCs in STI human resource development should be explored through envisaging joint training and skill-building programs.

Research-Linked Incentives: We need to complement the successful Production Linked Incentive Schemes with Design and Research Linked Incentives, rewarding global firms that expand research capacities in India (Roshan & Mukherjee, 2022). A comprehensive "RLI" scheme can encourage even more global companies to open R&D centres in India — creating thousands of high-skill jobs.

Providing Innovation Vouchers/ Knowledge Vouchers to MSMEs: According to the National Manufacturing Innovation Survey 2021-22, only 25.01% of the 8,074 MSMEs and large firms surveyed were identified as innovative. The government can establish knowledge vouchers (also called innovation vouchers, research vouchers, or simply vouchers) as a special incentive for linking SMEs to knowledge providers. The knowledge voucher is a coupon that entitles SMEs to a number of free consultancy or research visits to large, knowledge-intensive organizations (companies, research institutes, and educational institutions). The vouchers have been a success in the Netherlands, and many firms have used them (Roelandt & Wiel, 2020).

Ensuring greater ease of doing Research: It is imperative to address the core issue at hand, the bureaucratic impediments that often hinder R&D. While the NRF does make significant strides in resolving the funding gap, the crux of the research problem often commences with the paperwork and bureaucratic procedures that precede the actual research (Sinha, 2023). From the usage of zero-balance accounts to the procurement of lab equipment, researchers are often mired in administrative procedures that detract from their primary purpose of producing innovative research.

6. Conclusion

There exists a critical need for India to establish an enabling environment for innovation. This paper highlights the importance of policies, institutions, and capabilities that foster the generation, commercialization, diffusion, and assimilation of knowledge in the economy. The vision of the Atmanirbhar Bharat Abhiyan, as envisioned by the Hon'ble Prime Minister Shri Narendra Modi, calls for self-reliance and reduced import dependency in various sectors. And to achieve this vision, increasing India's investment in research and development (R&D) is imperative. Consequently, it would necessitate fostering a conducive ecosystem with incentives for the private sector and expediting the conversion of ideas into startups by commercializing public research outcomes. An overarching framework for innovation is crucial to overcome the challenges hindering India's progress in innovation. This

framework should encompass measures to enhance educational institutions, develop digital infrastructure, streamline regulatory processes, protect intellectual property rights, and support startups and SMEs. There is a need to provide necessary support mechanisms throughout the entire life cycle of innovation. By fostering a culture of innovation and providing essential resources, India can unleash its potential and make significant contributions to the global knowledge economy.

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