# Demand for Grants 2022-23 Analysis

## Science and Technology

The Ministry of Science and Technology has three departments: (i) Department of Science and Technology (DST), (ii) Department of Scientific and Industrial Research (DSIR), and (iii) Department of Biotechnology (DBT). DST is responsible for promoting new areas of science and technology, coordinating, and integrating areas of science and technology having cross-sectoral linkages. It formulates and implements policies for the promotion of science, technology, research, and innovation in the country. DSIR is responsible for promotion, development, and transfer of indigenous technology. The Council for Scientific and Industrial Research (CSIR) is an autonomous body under DSIR which undertakes research and development in diverse areas. DBT is entrusted with the promotion and development of biotechnology.

India's expenditure on Research and Development (R&D) activities remains low in comparison to developed countries. Further, R&D sector in India faces other issues such as: (i) lack of researchers, (ii) inadequate private investment, (iii) delays in approval of patents, and (iv) absence of an integrated approach towards R&D. In this note we examine the expenditure by the three Departments and discuss the key issues in the sector.

## Overview of Finances[1,2,3]

### Expenditure

In 2022-23, the Ministry of Science and Technology has been allocated Rs 14,217 crore. This comprises: (i) Rs 6,000 crore to DST (42% of the total), (ii) Rs 5,636 crore to DSIR (40%), and (iii) Rs 2,581 crore to DBT (18%). This is an increase of 5% over the revised estimate of 2021-22. Allocation to DST and DSIR in 2022-23 has increased by 15% and 6% over the previous year, respectively. Allocation to DBT has decreased by 13%. Almost all the expenditure under the Ministry is revenue expenditure (99.3% on average).

In 2021-22, expenditure by DST and DBT is estimated to be 14% and 15% lower than the budget estimates, respectively. In 2022-23, DSIR has been allocated 5,636 crore, out of which 99% of the allocation is towards the Council of Scientific and Industrial Research (CSIR). In 2022-23, DBT has been allocated Rs 2,581 crore. Out of which 51% is towards Biotechnology Research and Development, and 32% towards Assistance to Autonomous Institutions. See Tables 4, 5 and 6 in the annexure for major allocation heads under DST, DSIR, and DBT respectively.

**Table 1: Overview of Allocation (in Rs crore)**

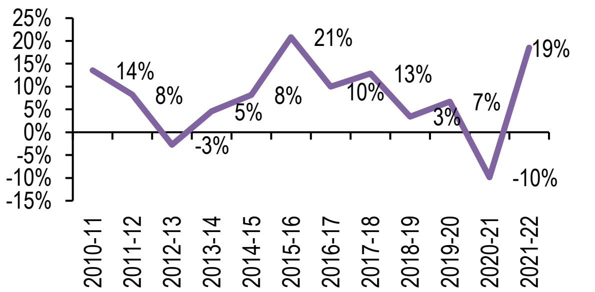
| Dept | 2020-21 Actuals | 2021-22 RE | 2022-23 BE | % Change (21-22 RE to 22-23 BE) |
|---|---|---|---|---|
| **DST** | **4,894** | **5,240** | **6,000** | **15%** |
| *-Autonomous Bodies* | 1,375 | 1,488 | 1,500 | 1% |
| *-Institutional and Human Capacity Building* | 893 | 984 | 1,128 | 15% |
| **DSIR** | **4,199** | **5,298** | **5,636** | **6%** |
| *-CSIR* | 4,202 | 5,234 | 5,563 | 6% |
| **DBT** | **2,259** | **2,961** | **2,581** | **-13%** |
| *-Biotechnology Research and Development* | 1,287 | 1,494 | 1,315 | -12% |
| **Total** | **11,351** | **13,499** | **14,217** | **5%** |

Note: BE: Budget Estimates; RE: Revised Estimates. 2020-21 Actuals of CSIR was more than DSIR due to recoveries in other heads being netted off for DSIR expenditure.
Source: Union Budget 2022-23; PRS.

### *Growth in Expenditure*

The growth in the expenditure of the Ministry has been variable during the last decade (Figure 1 and 2). The year-on-year growth in expenditure was relatively higher during the 2015-18 period. During the 2018-21 period, the growth has slowed down. In 2018-19, the expenditure by the Ministry was only 3% higher than the previous year. In 2018-19, actual expenditure by DSIR registered a negative growth as compared to the previous year (-2%). In 2020-21, all three departments witnessed a decline in expenditure as compared to the previous year: (i) -9% for DST, (ii) -14% for DSIR, and (iii) -4% for DBT. During the 2018-23 period, the compounded annual growth rate in expenditure is: (i) 5% for DST, (ii) 6% for DSIR, and (iii) 2% for DBT. The expenditure in 2021-22 is estimated to be 19% higher over the low base of 2020-21 (COVID year).

**Figure 1: Year-on-year growth in expenditure-Ministry of Science and Technology**




Note: Expenditure for 2021-22 is as per revised estimates.
Source: Union Budget of various years; PRS.

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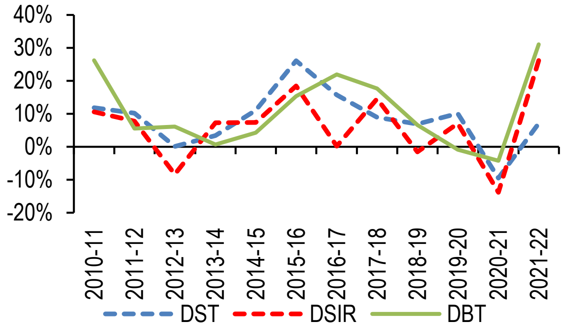
Regarding the expenditure of DST, the Standing Committee on Science and Technology (2020) had observed that there is a need for enhancement in the medium-term expenditure framework (MTEF) allocation to the DST.[4] MTEF provides a three-year rolling target for the expenditure of a department.[5] The Committee recommended that DST should pursue the Ministry of Finance for revision of the MTEF to a higher base level. This will help DST in carrying out its new initiatives and future plans.[4]

**Figure 2: Department-wise year-on-year growth in expenditure**

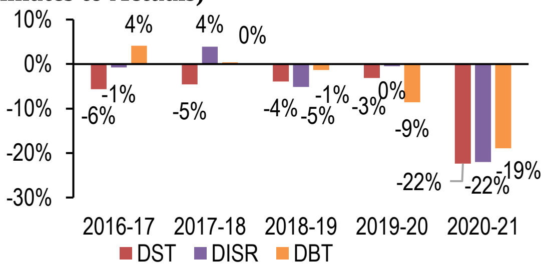



Note: Expenditure for 2021-22 is as per revised estimates.
Source: Union Budget of various years; PRS.

### *Underutilisation of funds*

During the 2016-20 period (four years), on average, DST spent 4% less than the budget estimates (Figure 3). The corresponding figures for DSIR and 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. The Standing Committee on Science and Technology (2021) observed that budget allocation for DST and DSIR was reduced at the 2020-21 revised stage due to COVID-19.[6,7]

**Figure 3: Underutilisation (Change from Budget Estimates to Actuals)**

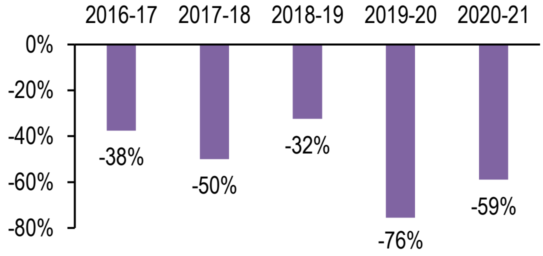



Source: Union Budget of various years; PRS.

### *Underutilisation of funds for Industrial Research and Development*

DSIR utilises funds under Industrial Research and Development head towards: (i) Promoting Innovations in Individuals, Startups & MSMEs (PRISM), (ii) Patent Acquisition and Collaborative Research & Technology Development (PACE), (iii) Building Industrial R&D and Common Research Facilities (BIRD) and (iv) Access to Knowledge for Technology Development & Dissemination (A2K plus) programmes of the Department. The actual expenditure under this head has been lower than the budget estimates in all years between 2016-17 and 2019-20 (50% on average).

**Figure 4: Underutilisation - Industrial Research and Development head under DSIR**



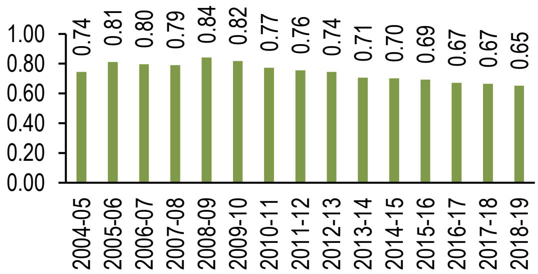

Source: Union Budget of various years; PRS.

## Issues for consideration

### *India's expenditure on research and development on a decline*

Investment in science is measured in terms of gross expenditure in research and development (GERD).[8] It includes expenditure on research and development by business enterprises, higher education institutions, governments, and private non-profit organisations. GERD as a percentage of GDP has been declining since 2009-10 (Figure 5). GERD in 2018-19 was estimated to be 0.65% of GDP (latest year till which estimates are available).[9]

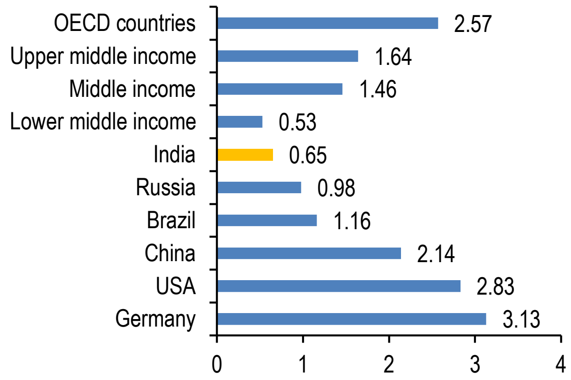
**Figure 5: GERD falling since 2009-10 (Figures in % of GDP)**




Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

India's GERD (2018) was substantially lower than countries such as Germany, USA, China, and Brazil (Figure 6). However, India's GERD is higher than the average for lower-middle-income group countries. The Science, Technology, and Innovation Policy, 2013 (administered by the Ministry of Science and Technology) had observed that increasing GERD to 2% of GDP has been a national goal for quite some time.[10] The Policy had observed that the target for GERD could be achieved by 2018-19 if the private sector at least matches the expenditure level of the public sector.[10] The Standing Committee on Science and Technology (2021) recommended the DST to enhance the GERD as a % of GDP by promoting private sector investment in R&D.[6]

**Figure 6: India's GERD as a % of GDP among the lowest (2018)**

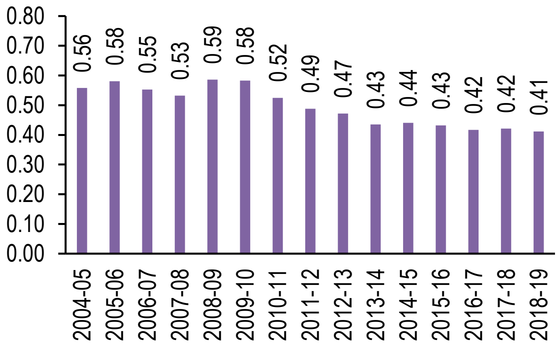



Note: Data for lower middle-income countries is from 2017.
Source: World Bank; PRS.

***Public sector investment on R&D on a decline; lowest since 2004-05***

The Science, Technology, and Innovation Policy, 2013 had observed that the public sector has led the expenditure on R&D in the country.[10] This includes expenditure by: (i) all central government ministries, (ii) public sector units, (iii) state governments, and (iv) higher education institutes. Expenditure by the public sector has also been declining since 2008-09 (Figure 7). Expenditure by the public sector towards R&D is estimated to be 0.41% of GDP in 2018-19, the lowest since 2004-05.

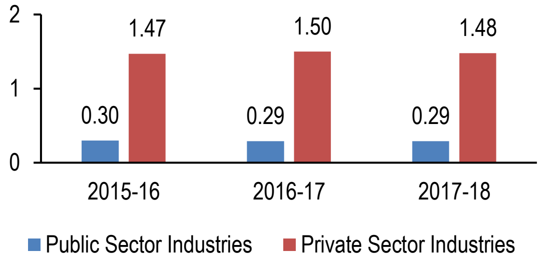
**Figure 7: Declining expenditure by the public sector on R&D (Figures in % of GDP)**




Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

Public sector corporations spend a lesser portion of their sales turnover on R&D as compared to private sector companies (Figure 8). In 2017-18, private sector companies spent 1.48% of their sales turnover on R&D. The corresponding percentage for the public sector industries was 0.29%.

**Figure 8: Percentage of sales turnover spent on R&D (Figures in %)**

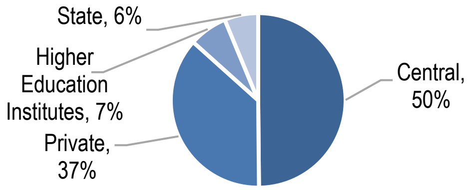



Note: Data for public sector refers to 103 industrial R&D units. Data for private sector refers to 2,007 industrial R&D units excluding scientific and industrial research organisations. The public sector contributed 48% of the total sales turnover of the considered units in 2017-18.
Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

***Need to increase investment in R&D by state governments***

The Economic Survey (2017-18) observed that the government expenditure on R&D is undertaken almost entirely by the central government. There is a need for greater state government spending (Figure 9).[8]

**Figure 9: Sector-wise source of funds for R&D in 2018-19**



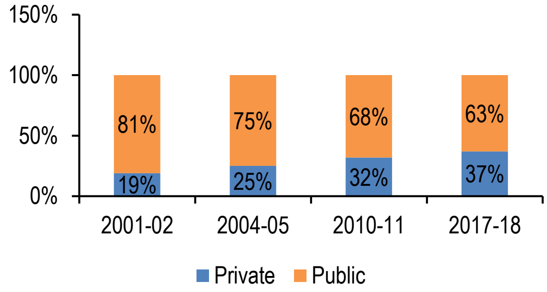

Note: Central sector includes expenditure by central ministries and central public sector units. State sector includes spending by the state ministries/organisations and state agricultural universities. Examples of Higher Education Institutes are IITs and Indian Institute of Science, Bangalore.
Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

The annual growth rate of R&D expenditure of states in 2017-18 over 2009-10 was 8.2%.[11] In 2017-18, the share of state sector in national R&D expenditure was 6%. A few states accounted for a major share of the total state-sector R&D expenditure. More than 55% of the total R&D expenditure of the states was accounted by seven states- Gujarat, Tamil Nadu, Punjab, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, and Assam (Table 9 in annexure shows state-wise share of R&D expenditure).[11] Further, state-wise distribution of number of patent applications filed by Indians during 2017-18 shows that more than 75% applications were from seven states- Maharashtra, Tamil Nadu, Karnataka, Delhi, Telangana, Uttar Pradesh, and Gujarat.[11]

***Share of private sector investment low in national expenditure on R&D***

It is observed that in countries where R&D investment is about 2% or more of their GDP, major contribution (>50%) comes from the private sector.[8] The Economic Survey (2017-18) had observed that in countries such as the USA, China, Germany, and Japan, the share of the private sector in the overall spending in research and development is significantly higher.[8] In India, the contribution of private sector is 37% and the rest 63% of national R&D expenditure comes from the government (Figure 10). The Economic Survey (2017-18) Survey took note of an analysis by a private organisation (Forbes, 2017).[8] According to this analysis, India had 26 firms in the list of top 2,500 global R&D spenders as compared to 301 Chinese companies. 19 of these 26 firms were in three sectors: (i) pharmaceuticals, (ii) automobiles, and (iii) software. India had no firms in five of the top ten R&D sectors as opposed to China, which has a presence in each one of the top five sectors.

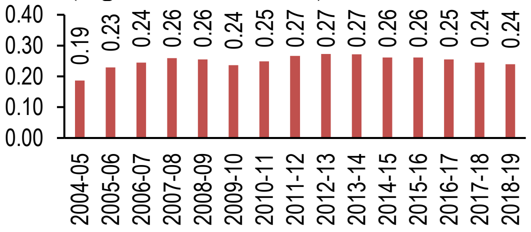
**Figure 10: % share of public investment in R&D more than private investment**




Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

The Science, Technology, and Innovation Policy, 2013 Policy had stressed that the expenditure on R&D by the private sector needs to go up.[10] It had observed that an increase in private investment is necessary for translating R&D outputs into commercial outcomes.[10] However, the expenditure on R&D by the private sector has decreased from 0.27% of GDP in 2012-13 to 0.24% of GDP in 2018-19 (Figure 11). NITI Aayog (2018) noted that low investment by the private sector in R&D is a key challenge in the development of the innovation ecosystem in the country.[12] Note that the Draft Science, Technology, and Innovation Policy, 2020 seeks to double the GERD and the private sector contribution to GERD in five years.[13] Since October 2019, companies have been allowed to use corporate social responsibility funds (CSR) for contributions towards research.[14] They can spend CSR funds as contributions to public-funded incubators, research organisations and universities engaged in research in science, technology, engineering, and medicine.

**Figure 11: Low expenditure by private sector on R&D (Figures in % of GDP)**

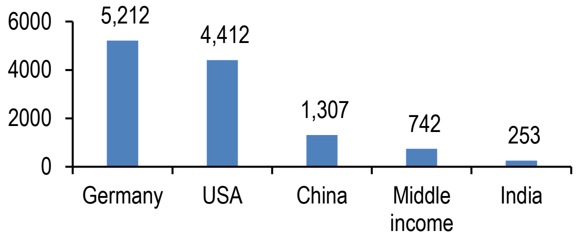



Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

***Low number of researchers per million people***

India's researchers per million people have increased from 157 in 2011 to 253 in 2018.[15] However, it remains significantly low when compared to other countries (See Figure 12).

**Figure 12: Researchers per million people (2018)**




Note: Data for USA and Middle-income countries is from 2017 and 2015 respectively
Source: World Bank; PRS.

Note that India's gross enrolment ratio (GER) in higher education itself is low as compared to these countries. In 2018-19, India's GER in higher education was 26.3%.[16] In comparison, the GER in higher education in countries such as USA, China, and Germany was 88%, 49%, and 70%, respectively.[17] The National Education Policy 2020 recommends increasing GER in higher education to 50% by 2035.[18] The Economic Survey (2017-18) observed that considerable improvement in mathematics and cognitive skills is required at the primary and secondary education level to enable the R&D ecosystem in the country.[8] The National Education Policy 2020 also aims to improve foundational literacy and numeracy and cognitive capacities of students.[18]

***Low number of female researchers***

The Ministry of Science and Technology observed that women in India face several challenges in moving up the academic and administrative ladder due to systemic barriers and structural factors.[19] The share of female researchers in India has increased from 14% in 2015 to 19% in 2018.[15] However, it is less than other countries such as Sri Lanka (47% in 2017), European Union (34% in 2017), and Switzerland (35% in 2017).[15] A Report by UNESCO (2015) noted the lack of women's participation in research globally.[20] Further, it stated that women actively pursue bachelor's and master's degree but their participation drops at the PhD level. High proportion of women in tertiary education is, thus, not translated to a greater participation in research.[20]

The share of female researchers in engineering and technology in India also remains low. In 2018, share of female researchers in engineering and technology was 14%.[15] Initiatives to promote gender equity in the field of research include: (i) Women Scientists Scheme (2002-03) that seeks to give financial incentives (fellowships, and grants) to women in the age group 27-57 years who wish to pursue research in various fields, and (ii) Gender Advancement for Transforming Institutions (2020), that aims to mentor institutions in order to make them more inclusive and sensitive towards women, and to promote gender equity in science, technology, engineering and mathematics

(STEM) domains.[19,21]

***Inadequate incentives for researchers***

UNESCO (2021) observed that university graduates in India from STEM represent a little over one in four graduates.[15] Science graduates also make up a greater share of the total than graduates in engineering and technology.[15] UNESCO (2021) observed that, although India has a low researcher density, there is little evidence to show that demand for STEM graduates has increased, as investment in R&D has not kept pace with the rise in GDP.[15]

NITI Aayog (2018) had observed that the link between research, higher education, and the industry is weak and nascent in India.[12] It further observed that so far, the education system has not focussed on cultivating scientific temperament at an early age. Even in the later stages, the lack of career opportunities in basic sciences leads to the diversion of potential researchers to other rewarding sectors. It had recommended that once the Higher Education Commission is set up, the Commission may consider giving credits for innovation and startups.[12] The Commission should also consider setting up online entrepreneurial development courses in colleges and universities.[12] The Higher Education Commission is proposed to replace the existing regulatory institutions for higher education.[12]

The Economic Survey (2017-18) also noted that more than one lakh people with PhDs, who were born in India, live and work outside India.[8] In USA alone, the number of immigrant scientists and engineers from India increased from five lakh in 2003 to 9.5 lakh in 2013.[8] It noted that government programs such as Ramanujan Fellowship Scheme, INSPIRE Faculty Scheme, and Ramalingaswami Re-Entry Fellowships provide opportunities to Indian researchers residing in foreign countries to work in Indian universities. However, the number of people returning has been modest (243 during 2007-12 and 649 during 2012-17).[8] The Survey recommended enhancing the scope of these schemes to also provide additional support for good research instead of just financial incentive. The additional support should include: (i) laboratory resources, and (ii) ability to hire post-docs.[8]

***Exploring upcoming areas of R&D***

The Draft Science and Tech Policy (2020) noted that India is largely dependent on the import of technologies in the priority sectors (such as agriculture, health, energy, and environment).[13] The Policy outlined the need to achieve self-reliance and address local problems, through science, technology, and innovation.[13] Further, it observed that there is a need to focus on: (i) indigenous development of technology, (ii) providing sustainable solutions through technology, and (iii) promoting the development of disruptive technologies (such as blockchain, and artificial intelligence).[13] NITI (2021) Aayog recommended undertaking steps to promote R&D in emerging fields such as artificial intelligence artificial intelligence, automation, and cybersecurity.[28] The National Strategy for Artificial Intelligence, NITI Aayog (2018) noted the need to promote R&D in artificial intelligence technologies to improve health care, education, agriculture, and to enable smart cities infrastructure, and smart mobility.[22]

**Table 2: National research expenditure by areas (2017-18)**

| Sector | % Share |
|---|---|
| Health | 19% |
| Defence | 17% |
| Agriculture, forestry, and fishing | 13% |
| Industrial production and technology | 10% |
| Exploration of Space | 9% |
| Transport, telecommunication and other infrastructure | 9% |
| Energy | 7% |
| General advancement of knowledge | 7% |
| Others | 11% |

Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

Some recent measures to incentivise R&D across sectors include:

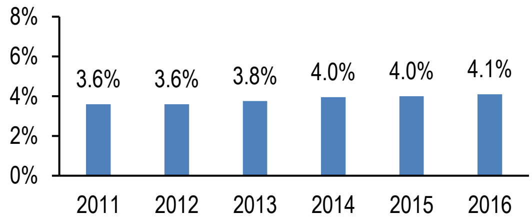
- In December 2021, the Union Cabinet several programmes to promote R&D and manufacturing in semiconductor and electronic display industry in India.[23] The Ministry of Electronics and Information Technology will take steps to modernise and commercialise the Semi-Conductor Laboratory, an autonomous body engaged in R&D in areas of microelectronics.
- Ministry of Electronics and Information Technology released the National Strategy on Blockchain (2021) which seeks to promote advanced research in indigenous blockchain technology.[24] It identified the lack of availability skilled manpower as a challenge for the development of blockchain.
- The National Mission on Transformative Mobility and Battery Storage, approved in March, 2019, seeks to promote R&D in production of electric vehicles and batteries.[25]
- In 2021, a production linked scheme for promoting telecom and networking products manufacturing in India.[26] Under the scheme, there is a component to provide capital expenditure on R&D and product development. The total outlay of the Scheme is Rs 12,195 crore (2021-22 to 2025-26).
- In the 2022-23 budget speech, there were two announcements for promoting R&D- (i) government contribution and support for R&D in upcoming fields such as artificial intelligence, drones, green energy, and space economy, and (ii) introduction of a PPP scheme for delivery of digital and high-tech services to farmers with involvement of public sector research alongside other stakeholders.[27]

NITI Aayog (2021) noted that R&D should be geared towards providing solutions to national problems such as climate change, inadequate potable clean water, and affordable healthcare.[28] The use of R&D outputs for providing end-to-end solutions requires strong linkage of the R&D sector with central and state governments. NITI Aayog recommended: (i) formulating an oversight and monitoring mechanism may be formed to oversee R&D programmes, and (ii) constituting six sector task forces on R&D mission on water, agriculture health, energy, climate change, and national security.

***Share in global scientific publications increased but target set in the 2013 Policy likely to be missed***

The Economic Survey (2017-18) noted that looking at scientific publications can help in assessing the productivity and quality of research.[8] The Science, Technology, and Innovation Policy 2013 observed that India's share in the global scientific publications had increased from 1.8% in 2001 to 3.5% in 2011.[10] The Policy had set a target of doubling the global share in the scientific publications by 2020.[8] By 2016, India increased its share in the global scientific publication to 4.1% (latest data available).[9] The compounded annual growth rate (CAGR) for scientific publications during the 2011-2016 period for India has been 6.4% as against the CAGR of 3.7% for the world.[9] If the publication output were to grow at the same rate, India's share in 2020 will be about 4.5%. This will be lower than the target set by the 2013 Policy for 2020 (7% share in the global scientific publications).

**Figure 13: Share in Global Scientific Publication (SCI Database)**



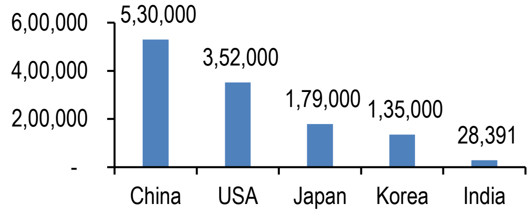

Note: Data is as per the Science Citation Index (SCI) Database.
Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

The Economic Survey (2017-18) observed that in addition to increasing publications, India needs to improve in terms of high-quality research output (measured as highly cited articles).[8] It noted that India lags considerably on this parameter when compared to other large countries such as USA and China.[8]

***Low number of patents in India; delays in patent approval***

There has been gradual increase in the filing and granting of patents in India. The number of patents filed in India has gone up from 39,400 in 2010-11 to 58,502 in 2020-21 and the patents granted in India has gone up from 7,509 to 28,391 during the same time period.[30] India's ranking in Global Innovation Index has also improved, from 81 in 2015-16 to 46 in 2021.[30] However, the number of patents granted in India is low when compared to other countries like China, USA, Japan, and Korea.[30]

**Figure 14: Patents granted (2020)**

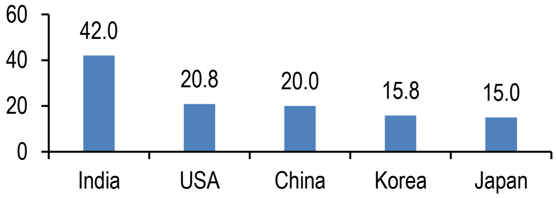



Source: Economic Survey (2021-22); PRS.

One of the key reasons for relatively low patents in India is the low expenditure R&D.[30] The Standing Committee on Commerce noted that India grants a low number of patents (as compared to China and the USA), which can be attributed to low spending on research and development (0.7% of the GDP in 2020).[29] It recommended: (i) allocating funds to each government Department for research, (ii) providing incentives to private companies for undertaking research, and (iii) directing large industries to give CSR funds for research.[29]

The Economic Survey (2021-22) observed that the procedural delays and complexity of the process is another cause for low patents in India. [30] The average pendency for final decision in acquiring patents in India is 42 months as of 2020. This is much higher than other countries (See Figure 15). Note that average pendency for final decision in acquiring patents has reduced in India from 64 months in 2017 to 42 months in 2020.[30]

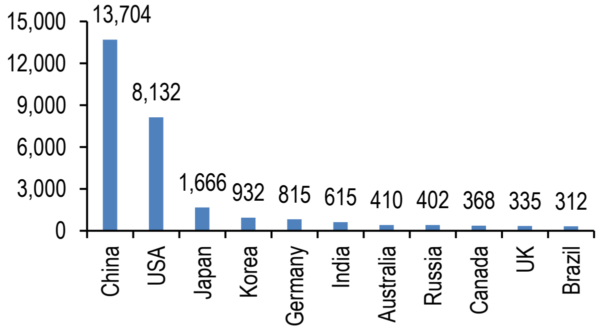
**Figure 15: Average pendency for final decision in acquiring patents (in months) (2020)**




Source: Economic Survey (2021-22); PRS.

Delay in India's patent application is also due to the low number of patent examiners in India.[30] The number of patent examiners in India in 2020 were 615 as opposed to 13,704 in China, 8,132 in United States and 1,666 in Japan (Figure 16).

**Figure 16: Number of patent examiners (2020)**

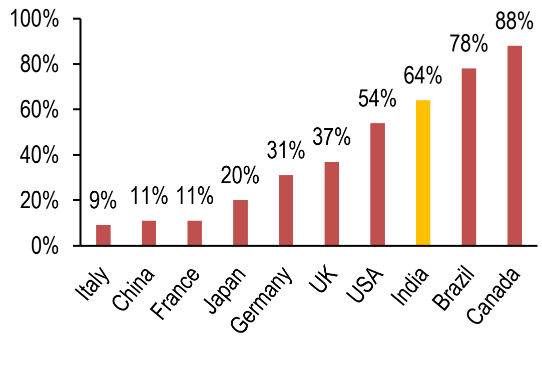



Source: World Intellectual Property Indicators, 2021; PRS.

***Resident share in patent applications needs to increase***

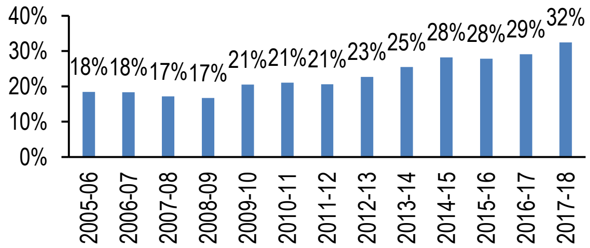
The Economic Survey (2017-18) had observed that patents reflect a country's standing in technology.[8] During the 2007-18 period, the patent applications filed in India grew at a CAGR of 3%.[8] As can be seen in Figure 17, a larger number of patent applications in India are filed by non-residents (64% in 2019) as compared to countries such as China (11%) and USA (54%).[31] However, the share of residents in patent applications has been steadily increasing (Figure 18).[9] The Economic Survey (2021-22) noted that the number of patents application are increasingly coming from Indian residents rather than MNCs.[30] The share of Indian residents in total applications has increased from 20 per cent in 2010-11 to around 30% in 2016-17 and 40% 2020-21. The Economic Survey (2020-21) had observed that resident share in the patent applications needs to rise further for India to become an innovation nation.[31] The Standing Committee on Commerce noted that only 36% (2019-20) of patents filed in India are filed by domestic entities.[29] It attributed this to lack of awareness of Intellectual Property Right (IPR), and recommended the Department for Promotion of Industry and Internal Trade (DPIIT) to increase awareness among small businesses, artisans, and establishments in remote areas with participation of non-governmental organisations.[29]

**Figure 17: Percentage of patent applications filed by non-residents in the top 10 economies (2019)**




Source: Economic Survey 2020-21; PRS.

**Figure 18: Percentage of patent applications filed in India by residents**




Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

***Role of universities in R&D needs to increase***

The Economic Survey (2017-18) observed that in several countries, universities play a critical role in both creating the talent pool for research as well as generating high-quality research output.[8] However, publicly funded research in India is concentrated in specialised research institutes under different government departments.[8] This leaves universities to largely play a teaching role. Hence, universities play a relatively small role in research activities. The Survey recommended linking national laboratories to universities for improvement in the knowledge ecosystem.[8] The National Education Policy (2020) proposed to establish a National Research Foundation (NRF) to enable a culture of research through universities.[32] NRF seeks to promote R&D through suitable incentives at the state universities and other public institutions where research capacity is limited.

***Foreign Direct Investment in R&D remains low***

The Office of the Principal Scientific Advisor noted that Foreign Direct Investment (FDI) is one of the key factors for enhancing R&D exports.[33] India's share in global R&D exports was about 2.8% in 2019.[33] R&D exports include: (i) licensing of intellectual property, (ii) technology embodied in exported intermediate goods, (iii) technology transfer through FDI, and (iv) outflow of technical services. India has a trade surplus in R&D services.[33] During 2011-20, India's R&D exports grew at a CAGR of 26.6%, the highest growth among the top 10 exporting countries in R&D.[33] However, R&D accounts for only a tiny share of FDI inflows into India (0.25% in 2018-19).[34] Further, it is mostly concentrated in four sectors - Information and Communication Technology, Natural Sciences and Engineering, Pharmaceuticals, and Clinical Research (more than 80%).[34] The Economic Advisory Council to the Prime Minister suggested a goal of increasing yearly FDI inflow into R&D to USD 300 million by 2022.[35] However, FDI in R&D has been on a decline since 2015-16 (Table 3).[34]

**Table 3: FDI equity inflow (in USD million)**

| Year | R&D | Total | % Share |
|---|---|---|---|
| 2015-16 | 235 | 40,001 | 0.59% |
| 2016-17 | 84 | 43,478 | 0.19% |
| 2017-18 | 107 | 44,857 | 0.24% |
| 2018-19 | 110 | 44,366 | 0.25% |
| 2019-20 | 67 | 49,977 | 0.13% |

Source: Note titled "FDI into R&D: Current Status and Way Forward" by the Office of the Principal Scientific Advisor; PRS.

***Adoption of technologies developed by public-funded research organisations is low***

NITI Aayog (2018) had observed that the rate of transfer of technology developed by public-funded institutions such as the Council of Scientific and Industrial Research (CSIR) is relatively low.[12] It highlighted poor marketing skills and information dissemination as key reasons for this.[12] It suggested the following measures to enhance technology commercialisation by public-funded institutions:

- Value addition centres may be set up in these institutions for: (i) upscaling technologies and improving technology readiness level, (ii) coordinating with investors to incubate entrepreneurs, (ii) enabling commercialisation and marketing, and (iii) providing technology support during production.

- A National Technology Data Bank should be created by the DST which will act as the central database for technologies that are ready for deployment or under development.
- Public funded research institutions should focus on the development and deployment of socially relevant technologies in areas such as clean drinking water, sanitation, energy, healthcare, and organic farming. These technologies have a large potential for commercialisation.

The Standing Committee on Science and Technology (2021) observed that the research done in industrial sciences by National Laboratories under CSIR is credible.[7] However, it noted that there is still a gap between the requirements of the industries and the research output of the National Laboratories. The Committee recommended that avenues for translation of technology and commercialisation of research should be further augmented. CSIR should work towards bridging the gap between the needs of industries and research provided by the laboratories.

***Tax incentives for R&D to the private sector have been reduced***

India used to allow a weighted tax deduction of 200% of expenditure towards in-house research and development to corporations.[31] This was reduced to 150% from April 2018. This is going to be reduced further to 100% from April 2021. The Standing Committee on Science and Technology (2020) was informed that withdrawal of tax incentive on R&D as well as exemptions on funds spent in acquiring patents by the private sector, has negatively affected the R&D investment in the private sector.[4] The Committee observed that the tax incentive had stimulated R&D spending by the private sector.

***Public procurement does not encourage new and innovative technologies***

NITI Aayog (2018) had observed that public procurement is biased in favour of experienced and established products and technologies.[12] This discourages new and innovative technologies offered by startups.[12] It recommended that:

- international competitive bidding should be resorted to only when Indian manufacturers are unable to supply products or services of comparable international quality;
- to adopt innovative technologies, experts or scientific practitioners should be mandatorily included on committees related to public procurement; and
- Indian startups should be given preference in the technical evaluation for public procurement.

Following incentives are available to startups recognised by the Department for Promotion of Industry and Internal Trade: (i) relaxation in prior turnover and prior experience requirements, subject to meeting of quality and technical specifications (notified in March 2016), (ii) relaxation in bid security deposit requirements (notified in July 2017).[36,37,38] Startups can also get the opportunity to work on trial orders with the government.[36] The recognised startups are allowed to offer their products and services for procurement on government's e-marketplace platform.[39] This is aimed at helping startups to introduce unique innovations to government and public sector unit buyers.[39]

# Annexure

**Table 4: Major Allocation Heads-DST (in Rs crore)**

| Particular | 2020-21 Actuals | 2021-22 BE | 2021-22 RE | 2022-23 BE | % Change from 2021-22 RE to 2022-23 BE |
|---|---|---|---|---|---|
| Autonomous Bodies | 1,375 | 1,488 | 1,488 | 1,500 | 1% |
| Institutional and Human Capacity Building | 893 | 1,100 | 984 | 1,128 | 15% |
| Innovation, Technology Development and Deployment | 630 | 952 | 701 | 813 | 16% |
| Statutory and Regulatory Bodies | 751 | 950 | 975 | 903 | -7% |
| *-Science and Engineering Research Board* | 741 | 900 | 900 | 803 | -11% |
| *-Technology Development Board* | 10 | 50 | 75 | 100 | 33% |
| Research and Development | 396 | 594 | 457 | 604 | 32% |
| Survey of India | 423 | 531 | 472 | 524 | 11% |
| National Mission on ICPS | 270 | 270 | - | 350 | - |

Note: SERB: Science and Engineering Research Board; TDB: Technology Development Board; ICPS: Interdisciplinary Cyber Physical Systems. RE: Revised Estimates; BE: Budget Estimates. Autonomous bodies include 25 research institutes.
Source: Expenditure Budget; PRS.

**Table 5: Major Allocation Heads-DSIR (in Rs crore)**

| Particular | 2020-21 Actuals | 2021-22 BE | 2021-22 RE | 2022-23 BE | % Change from 2021-22 RE to 2022-23 |
|---|---|---|---|---|---|
| Total-CSIR | 4,202 | 5,144 | 5,234 | 5,563 | 6% |
| *a. National Laboratories* | 3,802 | 4,669 | 4,759 | 5,103 | 7% |
| *b. Capacity Building and Human Resource Development* | 400 | 475 | 475 | 460 | -3% |
| Industrial Research and Development | 13 | 21 | 21 | 29 | 38% |
| Assistance to PSEs for Other Scientific Research Schemes | 9 | 14 | 11 | 10 | -9% |

Note: RE: Revised Estimates; BE: Budget Estimates.
Source: Expenditure Budget; PRS.

**Table 6: Major Allocation Heads- DBT (in Rs crore)**

| Particular | 2020-21 Actuals | 2021-22 BE | 2021-22 RE | 2022-23 BE | % Change from 2021-22 RE to 2022-23 BE |
|---|---|---|---|---|---|
| Biotechnology Research and Development | 1,287 | 1,660 | 1,494 | 1,315 | -12% |
| Industrial and Entrepreneurship Development | 341 | 960 | 710 | 365 | -49% |
| Assistance to Autonomous Institutions | 577 | 807 | 697 | 830 | 19% |
| Biotechnology Industry Research Assistance Council | 28 | 40 | 25 | 35 | 40% |

Note: RE: Revised Estimates; BE: Budget Estimates. Autonomous institutions include 16 R&D institutions.
Source: Expenditure Budget; PRS.

**Table 7: Key Statistics-Department of Biotechnology**

| Indicator | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22* |
|---|---|---|---|---|---|---|---|---|
| Ongoing Projects | 2,212 | 1,955 | 1,893 | 2,165 | 2,460 | 2,405 | 2,081 | 2,143 |
| Projects Sanctioned | 656 | 415 | 552 | 831 | 847 | 594 | 259 | 161 |
| Ongoing International Collaborative Projects | 42 | 66 | 79 | 101 | 139 | 96 | 69 | 82 |
| Scientists Supported (PI/CoPI) | 4,801 | 4,493 | 4,569 | 5,121 | 5,553 | 4,521 | 2,364 | - |
| Research Personnel (JRF+SRF+RA) | 5,766 | 6,076 | 6,180 | 6,195 | 6,221 | 6,312 | - | - |
| CTEP-Proposals Sanctioned | | | | | | | | |
| *Conferences* | - | - | 161 | 92 | 83 | 96 | 8 | 16 |
| *Travels* | - | - | 522 | 421 | 314 | 317 | 303 | 15 |
| *Exhibitions* | - | - | 9 | 8 | 9 | 17 | 16 | 3 |
| *Popular Lectures* | - | - | 6 | 13 | 10 | 28 | 2 | 9 |
| Technologies Generated | 117 | 90 | 136 | 75 | 82 | 119 | - | - |
| Publications | 2,482 | 2,494 | 2,654 | 1,904 | 3,478 | 3,758 | - | - |
| Patents Filed | 186 | 160 | 181 | 102 | 93 | 76 | - | - |

Note: *as of February 13, 2022. PI: Principal Investigator; CoPI: Co-Principal Investigator; JRF: Junior Research Fellowship; SRF: Senior Research Fellow; RA: Research Assistant. CTEP: Conference, Travel, Exhibition, and Popular Lectures.
Source: Dashboard of the Department of Biotechnology as accessed on February 13, 2022; PRS.

**Table 8: Key Statistics-Department of Science and Technology**

| Indicator | 2018-19 | 2019-20 | 2020-21 | 2021-22 |
|---|---|---|---|---|
| **Human Capacity Building** | | | | |
| Fellowships provided | 1,16,854 | 92,869 | 2,528 | 2,323 |
| Number of people trained | 20,381 | 2,805 | 77,972 | 33,995 |
| Number of conferences | 640 | 389 | 531 | 521 |
| **Research and Development** | | | | |
| New R&D Projects | 3,658 | 691 | 1,014 | 53,410 |
| Ongoing Projects | 7,982 | 10,479 | 4,004 | 2,906 |
| **Institutional Capacity Building** | | | | |
| New R&D Infra | 251 | 102 | 325 | 352 |
| **Innovation and Startups** | | | | |
| Number of Innovations | 468 | 658 | 797 | 937 |
| Startups | 898 | 791 | 815 | 549 |
| **International Cooperation** | | | | |
| International Collaborative Visits | 3,302 | 774 | 1 | 6 |
| Ongoing Projects | 478 | 2,931 | 2,554 | 1,702 |
| Fellowships | 66 | 144 | 147 | 262 |
| Number of Manpower Trained | 1,221 | 569 | 283 | 336 |
| **Science and Engineering Research Board** | | | | |
| Number of Ongoing Projects | 6,033 | 26,664 | 30,532 | 23,156 |
| Number of New R&D Projects | 2,492 | 2,076 | 1,641 | 748 |
| Human Resource Development | 2,912 | 2,049 | 658 | 118 |
| Development Activities | 2,212 | 1,868 | 0 | 135 |
| **Autonomous Institutions** | | | | |
| Number of Publications | 2,336 | 2,624 | 3,702 | 3,164 |
| Number of PhDs Produced | 221 | 296 | 217 | 183 |
| Number of Manpower Trained | 1,896 | 5,452 | 4,120 | 5,975 |
| Number of Patents Granted | 38 | 98 | 138 | 107 |

Source: Dashboard of the Department of Science and Technology as accessed on February 10, 2022; PRS.

**Table 9: % Distribution of R&D expenditure by states (2017–18)**

| State | % Share |
|---|---|
| Gujarat | 10.9 |
| Tamil Nadu | 9.5 |
| Punjab | 7.6 |
| Andhra Pradesh | 7.5 |
| Madhya Pradesh | 6.7 |
| Uttar Pradesh | 6.5 |
| Assam | 6.3 |
| Haryana | 5.2 |
| Karnataka | 5.1 |
| Jammu & Kashmir | 4 |
| Uttarakhand | 3.9 |
| West Bengal | 3.8 |
| Telangana | 3.8 |
| Chhattisgarh | 3.6 |
| Maharashtra | 3.1 |
| Rajasthan | 2.7 |
| Kerala | 2.2 |
| Himachal Pradesh | 2.2 |
| Odisha | 2.1 |
| Manipur | 1.4 |
| Jharkhand | 1.3 |
| Bihar | 0.7 |
| Meghalaya | 0.1 |

Source: Research and Development Statistics 2019-20; Ministry of Science and Technology; PRS.

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