Science indicators in development time

The Economic Survey of India 2017–18 (ref. 1), while introducing a chapter on science and technology for the first time, asks an intriguing question: Does India spend enough on R&D in development time – that is, how does India fare today compared with other countries at a similar development level, and whether the Indian trajectory today will allow it to catch up with other countries?

On the input side, figure 2 of the report[1] answers this question by plotting R&D as a share of GDP against per capita GDP for a set of comparable countries. It shows that India was, at some point, spending more on R&D as percentage of GDP than countries like China at the same level of GDP per capita. However, more recently, it underspends even relative to its income level. Most countries, including East Asian countries like China, Japan and Korea have increased the spending on R&D (GERD or gross expenditure on R&D) as a percentage of GDP. India, on the other hand, has not registered any significant increase and if the current rate is projected, it would just barely reach GERD of 1% of GDP by the time it is as rich as USA.

On the output side, figure 5 of the report[1] looks at India's performance on patents in development time. Using WIPO data, it is seen that India's low patent output could be due to its lower middle-income status. Even here, it lags behind China at similar development levels, suggesting that rising income alone will not allow India to catch up in the near future if current trends are continued.

Here we shall look at the well-curated data from the 2018 report of Science and Engineering Indicators[2]. Appendix table 4-12 gives GERD and GERD/GDP for selected countries or regions during the period 1981–2015. Appendix table 5-27 compiles science and engineering articles in all fields, by region/country/economy for the period 2003–2016 using a fractional count basis. Appendix table 6-3 arranges the nominal GDP, again by region/country/economy for the period 2001–2016 in terms of millions of current US dollars. Appendix table 8-4 gives USPTO patents granted, by region/country/economy for the period 2000–2016.

The data can be analysed to see how some key input and output indicators for India compare with those of the comparator countries. Figure 1 shows the GERD/GDP ratio for India and comparator countries, where the chronological time runs from 2003 to 2015. This partially confirms the finding reported in figure 2 of the Economic Survey[1]. However, at no point during this window has India spent more on R&D as a percentage of GDP than China, even at the same level of GDP per capita. China is on a trajectory that seems to be headed to where Japan is at present. If the current trajectory is projected, India would probably just reach GERD of 1% of GDP by the time it is as rich as USA.

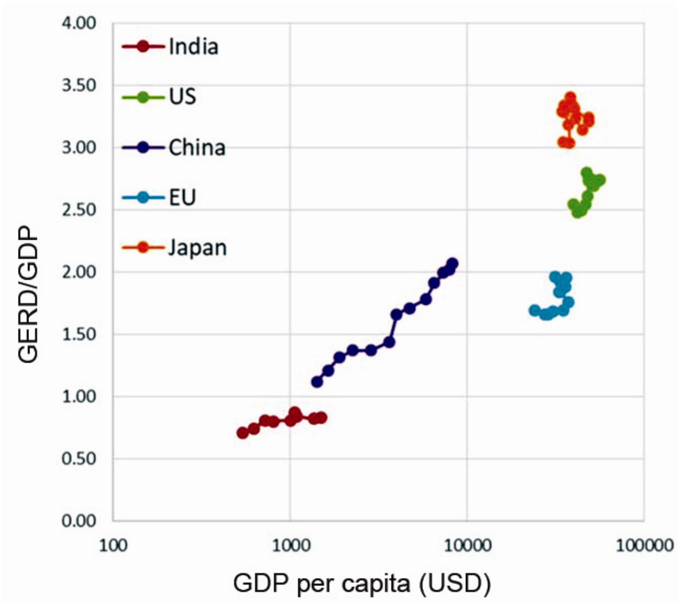

Figure 1. GERD/GDP ratio as a percentage for India and comparator countries where the chronological time runs from 2003 to 2015.

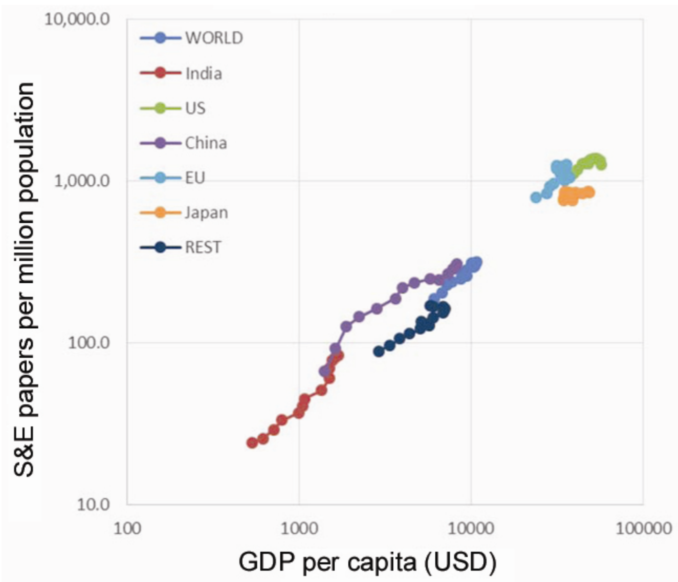

Figure 2. Science and engineering papers per million population for India and comparator countries where the chronological time runs from 2003 to 2016.

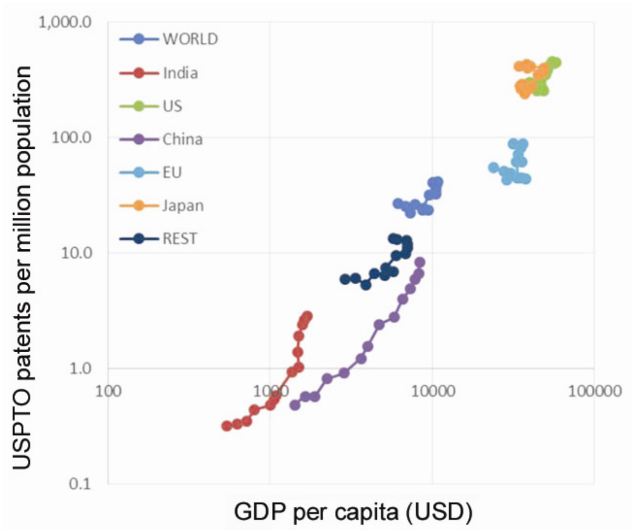

Figure 3. USPTO patents per million population for India and comparator countries where the chronological time runs from 2003 to 2016.

Figure 2 plots S&E papers per million population for India and comparator countries and regions (including the world taken as a whole and the rest of the world). The chronological time now runs from 2003 to 2016. There is a point during this development time window where India (2012–2016) is nearly where China (2003–04) was at the same level of GDP per capita. China is headed to where Japan, the European Union (EU) and USA are at present.

Figure 3 plots USPTO patents per million population for India and comparator countries and regions (including the world taken as a whole and the rest of the world). The chronological time runs from 2003 to 2016. Unlike the findings in figure 5 of the Economic Survey[1], India (2010–2016) was noticeably ahead of China (2003–2011) at lower levels of GDP per capita. Since then, China has accelerated and is headed to where Japan, the EU and USA are at present. India is also on a promising trajectory as far as USPTO patents are concerned.

1. http://mofapp.nic.in:8080/economicsurvey/ (accessed on 31 January 2018).
2. https://www.nsf.gov/statistics/2018/nsb20-181/assets/nsb20181.pdf (accessed on 19 January 2018).

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Water management

The commentary by Shantha Mohan *et al.*[1] begins with a description of the complex water challenges faced by India. These challenges such as population explosion, urbanization, rising demand for water from agriculture, energy, industry; water pollution, inefficient use of water, poor management and poor institutional scenario exist all around the country, including the eight regional zones identified by the study conducted by National Institute of Advanced Studies (NIAS), Bengaluru[1]. However, it is observed that the challenges identified for these zones and zonal water partnerships (ZWPs) get narrowed down conveniently into isolated water issues bereft of the complexities mentioned at the beginning. For example: (1) Designing policies, programmes and action plans to stop the destruction of water bodies in Hyderabad and identifying strategies to rehabilitate water urban bodies. (2) Identification of problems of frozen pipes that supply drinking water at sub-zero temperatures in Jammu and Kashmir. (3) Preparation of framework for integrated drinking water plan through participatory approach in the districts of Madhya Pradesh, Maharashtra and Andhra Pradesh. In fact, the real challenge for integrated approach lies in managing complex water problems and not selective or isolated water issues chosen conveniently.

Shantha Mohan *et al.*[1] state, 'Striving for inclusiveness, transparency, accountability and gender sensitivity are the core values of zonal partners'. However, the note is not transparent with respect to ZWPs and therefore contrary to the core values stated. Nowhere do the authors mention about the participants/actors/stakeholders/gender representation in the ZWPs to show that they are truly integrated. The information regarding the type and composition of the communities involved in ZWPs is absent. The note informs that 20% of dalits do not have access to safe drinking water and 48.4% of dalit villages do not have access to water sources. However, it does not mention whether weaker sections of the society are part of ZWPs and other decision-making venues of such partnerships and, if so, up to what percentage they are represented. While the authors state in the beginning that water resources need to be managed at numerous levels, with the involvement of several stakeholders and professionals from diverse disciplines, it is unclear in the note, the levels, stakeholders and professionals from diverse disciplines represented in ZWPs. It is also unclear whether the Department of Science and Technology (DST) or NIAS has partnered with the Ministry of Water Resources, River Development and Ganga Rejuvenation or the Central Water Commission or the Ministry of Drinking Water Supply or the Ministry of Urban Development in the true spirit of integrated approach. Neither the NIAS