

# Annual Report

**2014-15**

*Report of projects and papers completed, papers published, and external academic and policy advice given during the year*

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# 1. Research papers completed

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## 1.1 Dimensions of India's innovation performance

**Abstract:** India's overall GERD to GDP ratio is still less than unity despite the fact that GERD itself has grown very rapidly since the mid 2000s. All other output indicators, whether patents granted nationally or abroad, share of high technology exports in total manufactured exports, number of scientific publications etc. have shown impressive increases. Further, India has continued its technological capability building in some high technology industries such as space technology, pharmaceuticals and in Computer and Information Technology Services. The total number of R&D personnel too has shown some impressive increases although the density of scientists and engineers engaged in R&D is still a matter of concern. An analysis of the data on the performance of R&D shows the following discernible trends:

1. **Growing importance of business enterprises:** The share of government in the performance of R&D is coming down over the years and now stands at about 62 per cent. The share vacated by government is taken up by business enterprises (both private and public sector enterprises), which now accounts for about 34 per cent of GERD. The share of the higher education sector consisting of universities and other national level institutes has virtually remained stagnant at around 4 to 5 per cent. So the evolution of the country's National System of Innovation (NSI) has become more pronounced with the business enterprises sector in general and the private sector enterprises with it groping towards the core of the innovation system. The implications of this augurs well for the country as the locus of production and innovation are now happening at the same institution. As a corollary of this, the importance of research councils in the performance of R&D has gone down. In this way, India's National System of Innovation is reducing the distance between manufacturing and R&D.
2. **Industrial and regional concentration in the performance of innovation:** However concentration in the performance of R&D within five industrial sectors and certain regions has continued over this period. In other words majority of the industrial sectors and regions are excluded from the performance of innovative activity. Including the excluded is an important challenge before policy makers.

**3. Investments in agricultural R&D:** Investments in agricultural R&D: The share of agriculture in the nations' GDP has stagnated or gone down to 11.6 per cent in 2012-13. Analysis of yield growth in the important food crops of rice and wheat show sharp year on year fluctuations. The relationship between yield growth and R&D is an important one. Lack of systematic increase in yield may be related to two major factors. The first one is on the funding of agricultural research. Studies on R&D funding, however, points to an increase in funding both in nominal and real terms, aggregate and per capita terms, and in comparative terms with public funding of industrial research. Even the intensity of agricultural research (agricultural R&D as a per cent of agricultural GDP) too shows an increase over time. So funding per se does not appear to be an issue. The second problem may be attributed to the quantity of agricultural scientists in the country. Numbers on it shows a decline in its stock and the annual flows to it are also constrained by lower enrolment ratios in graduate degree programmes in agriculture. So the key to improving yields perhaps lie in increasing both the quantity and quality of agricultural scientists in the country. Another interesting aspect of agricultural R&D is the rising share of private R&D in agriculture, primarily in seed, agricultural machinery and in pesticides. But the implications of an increase in private R&D in agriculture is not the same as an increase in public R&D as the output of the former is likely to be protected by various Intellectual Property Right (IPR) mechanisms thus increasing the cost of its diffusion to farmers. Further, stricter regulation of Genetically Modified Organisms (GMOs) has meant that the only agricultural crop for which GMOs has been approved is in Bt Cotton. However sustainable forms of agriculture have been reported from isolated parts of the country. In fact world's most productive rice paddy farmer is from the state of Bihar in North Eastern part of India (he was able to raise 22.4 tonnes per hectare as against the Indian average of about 2.5 tonnes per hectare and a world average of 4 tonnes per hectare). The farmer in question achieved this spectacular performance not by adopting modern scientific technologies but by a sustainable method pioneered by civil society organisations called System of Rice Intensification (SRI). This once again has brought to the fore the importance of sustainable agriculture, which is both environmentally friendly, and soft to the pocket as far as complementary investments in irrigation, chemical fertilizer and pesticides are concerned.

- 4. Growing globalisation:** With growing FDI in both production and in R&D, the importance of MNCs in the performance of innovative activity has shown some impressive increases. The share of MNCs in both the performance of R&D and

in the number of patents granted has increased rapidly during the last five years. The main policy challenge is to effect positive spillovers from the MNCs to the local economy. At the very same time, Indian companies to have acquired knowledge assets from abroad through a wave of cross boarder M&A activity.

5. **Hub of frugal innovations:** India has become a hub for the creation of a number of what is referred to as frugal innovations. These are products and processes, which have more, or less the same features and capabilities of an original product but which it costs significantly less than the original product or process. One industry where its frequency is the highest is in medical devices and the health sector in general.
6. **Continued maintenance of technological capability in high technology industries:** Despite a stricter patent regime brought about by TRIPS compliance, India has continue to be an important net exporter of generic drugs to the rest of the world. Its domestic forms have continued to be innovative and have become important. In 2005, India has become the world leader in Computer and Information Technology Services and has continued to maintain and improve its lead over other nations. It is now leveraging to use this capability for diffusing governmental services to even the remotest villages through a rapid diffusion of e-governance. This in essence is a technology solution to empowering the citizens by improving governance and delivery of services.
7. **Building up of technological capability in communication:** Considerable improvements have been made in both the astronautic and even in the aeronautical segments of this high technology industry. Leveraging capabilities in communication technologies and remote sensing, the country has made considerable strides in diffusing distance education and public health interventions. Considerable strides have been made in telecommunications services as well especially in rural areas. India has shown to the rest of world that the organic way of diffusing telecommunications in rural areas is by promoting competition between telecom service providers, which would transliterate itself into lower telecom tariffs improving affordability and accessibility. Consequence has been dramatic improvements in tele densities even in rural areas.
8. **Generation of green technologies:** India's innovation policy seems to be independent from other important economic development strategies like the National Plan for Climate Change. The government is encouraging power

generation through various renewable energy programmes, such as wind, biomass, solar and small hydro, and has set a mix of fiscal and financial incentives and other policy/regulatory measures aimed at attracting private investment. However all this is confined to the central government level and only three of the states have explicit green energy policies. Some Indian enterprises have acquired considerable technological capability in the design and manufacture of wind turbines, which is by far the most important source of grid, connected green technologies.

- **Main Challenges**

Three main challenges continue: (i) Improving the quality and density of scientists and engineers engaged in R&D; (ii) India has the most generous tax regime for encouraging investments in R&D. But this has not led to a reduction in the concentration in the performance of R&D. As such the culture of R&D is not widespread. The country also continues to lack credible research grants for financing innovation (iii) linking capabilities in technologies to improve the nations human development (especially health and education outcomes) is also a continuing challenge.

Publication Status: Will be published as the chapter on India in UNESCO, World Science Report 2015

## **1.2 Leadership in India's automobile industry: case of Tata Motors Limited**

**Abstract:** Tata Motors Limited (TML) is India's largest automobile company, with consolidated revenues of US \$ 38.9 billion in 2013-14. It is the leader in commercial vehicles in each segment, and among the top three in passenger vehicles with products in the compact, midsize car and utility vehicle segments. The company is the world's fourth largest truck manufacturer, and the world's second largest bus manufacturer. Established in 1945, TML' presence indeed cuts across the length and breadth of India. Over 6 million Tata vehicles ply on Indian roads, since the first rolled out in 1954. The firm has six manufacturing plants spread across the length and breadth of the country. Following a strategic alliance with Fiat in 2005, it has set up an industrial joint venture with Fiat Group Automobiles to produce both Fiat and Tata cars and Fiat powertrains although this joint venture has come to an end in 2013. The company's dealership, sales, services and spare parts network comprises over 3500 touch points across the country. In fact TML is one of India's leading brand in the automotive industry especially when it comes to trucks and buses. Its recent forays into car production and especially its attempt and designing an extremely cheap compact car have won for it fair amounts of national and international acclaim. An interesting aspect of the

company is that it is an extremely integrated one, vertically speaking, having close access to both raw materials (like steel) and equipment (like machine tools) from its wholly owned subsidiaries or from other member firms in its larger business group. All these favourable factors have added to its leadership position in India's fast growing automotive industry. This chapter is primarily about the sources of this leadership position achieved by the company. The chapter is structured as follows. Section 1 will discuss the emergence of a number of leading firms from India of which TML, our present case, is one such leader. Section 2 provides some detailed information about the recent resurgence of India's automotive industry. Section 3 discusses our reasons for considering TML as a market leader. Section 4 delves into the sources of this leadership position achieved by TML in terms of firm, sector and country level factors. Section 5 summarises the main findings of our case study. In this chapter, we have demonstrated that TML is a market leader in India's fast growing automotive industry. It fulfills the three conditions of market leadership, market share, global reach and being innovative, very well. The sources of this leadership were explained through a series of firm, sector and country level factors. However maintenance of leadership on a continuous basis for a fairly long time may not be taken for granted. Leadership positions can easily be challenged in a globalized world where new leaders can challenge TMLs currently unassailable position. For this a leader has to be eternally vigilant from the innovation point of view.

Publication Status: Will be a chapter of the forthcoming book Malerba, Franco, Sunil Mani and Pamela Adams, (Eds., 2016, forthcoming) *Rise to Market Leadership*, Cheltenham, UK and Northampton, Mass, USA.

### 1.3 Sources of Market Leadership (This is the introductory chapter)

**Abstract:** The emerging economies are some of the fastest growing countries in the world. A precise definition of an emerging economy does not exist. However, there is fair amount of consensus that the concept refers to developing countries that have been experiencing extremely high rates of growth on a continuous year-on-year basis and that are increasingly integrated with the world economy through the movement of products and services, capital (read as FDI), and persons (read as cross-border migration). China, India and Brazil are among these countries. They are three of the largest economies in the world not only in terms of GDP, but also in terms of population and size of the domestic market. As the importance of these national economies has grown, so too has the role of these countries in international discussions concerning political, economic and social issues across the globe. Economic growth in these countries has been accompanied by the emergence of several new domestic firms.

These firms have become not only leaders in their own markets but, in many cases, also significant participants in the global economy in both medium and high technology sectors. Moreover, these firms have been able to establish positions of leadership in the face of competition from both established multinational corporations from the U.S. and Europe and newer players from the Asian continent (i.e. Korea, Taiwan). Explaining the sources of such leadership is the focus of the book.

The concept of leadership is complex. Our focus is on firms whose competitive position is based on either new products or advanced process technology or on production and marketing skills. Like the ground breaking work by Nelson and Mowery (1999) on the rise to “industrial leadership”, we are concerned with the commercial success of technological innovations, rather than with the process of innovation itself. Unlike the cases examined by the chapter is the Nelson and Mowery book on industrial leadership, however, our focus is on the sources of market leadership by specific firms. First, firms that are market leaders hold dominant positions in their domestic market in terms of market share. This does not mean that they are necessarily the largest players in the domestic industry, but they should be among the largest. It is clear that, given the size of the domestic market in all of the emerging economies under study here, a dominant position at the domestic level offers significant advantages in terms of scale for further growth and competitiveness. But it is important to note that we do not consider large market share, even in such massive markets, as sufficient to confer the title of market leader to specific firms. High market share based on the successful imitation and/or commercialization of products developed by other firms does not denote a market leader. Rather, market leaders have two additional characteristics. They must have what we term ‘global reach’. This means that these firms are active not only on the domestic market, but they span internationally in various ways and forms. Their global reach may range from getting access to foreign knowledge through licenses and R&D agreements with foreign firms and research organizations, to international joint-ventures in R&D, production or marketing, to exports, to foreign direct investments abroad. Therefore global reach means that a market leader is able to open links at the international level and be also a player on the global arena. Finally, market leaders are innovative. With the term innovation we encompass a wide range of changes in products and processes, from adaptation to the local market, to original improvements and modifications, to incremental innovations, to radical changes in products, production processes and technologies. Thus innovativeness means that a market leader is dynamic in terms of technologies, products and processes and does not just simply replicate and imitate existing leaders. But how did these firms grow to become market leaders? What were the sources of leadership for these firms in such emerging economies? This book will explore these questions by examining the evolution of a number of market leaders



across different industries. The framework for our analysis consists of three levels of analysis: the firm level, the country level and the sector level. At each level, we identify a number of critical factors that supported the development of market leadership. It is our conviction, however, that it is not possible to understand the rise to market leadership by examining any one set of factors in an of itself. Rather market leadership, as defined above, can only be explained by looking at the interaction of such factors across all of these levels.

Publication plan: Will be a chapter of the forthcoming book Malerba, Franco, Sunil Mani and Pamela Adams, ( Eds., 2016, forthcoming) *Rise to Market Leadership*, Cheltenham, UK and Northampton, Mass, USA.

## 2. On going research papers

### **Diffusion of Broadband in India, Trends, Determinants and Challenges** {with V. Sridhar (International Institute of Information Technology)}

**Abstract:** An interesting aspect of India's economic liberalization efforts set into motion in 1991 was that it has now a very modern and state-of-the-art telecommunications services sector. The sector is almost entirely driven by mobile phones. India has now close to a billion mobile phones and the density of mobile phones is now touching almost 77 per 100 people. There has also been considerable decline in the rural-urban divide in the availability of mobile phones and this has largely been achieved through significant reduction in the average price of voice communication. India has now one of the cheapest telecom services anywhere in the world. It is hypothesised that the country has achieved the high diffusion of mobile phones through promoting competition in provision of communications services. The Herfindhal index (H-index) has never exceeded 0.16 over the period 1998 through 2014. However this significant improvement in the availability of mobile phones have not been matched in the availability of broadband services in the country. The broadband, despite policy support, has diffused very slowly: as on March 31, 2015 there are only 99.20 million broadband subscribers in the country and a lion's share of these are mobile internet subscribers (Telecom Regulatory Authority of India, 2015). Further, it is assumed that majority of these subscribers are in urban areas and there are frequent complaints about the price and quality of broadband connections. Both mobile and broadband are distributed mostly by the same providers but the concentration in the provision of broadband is higher than in mobile services with the H-Index for the former working out to 0.19. A number of what is usually referred to as Over-the-Top (OTT) services such as those enabling communication (Skype, Viber etc), social networking (Facebook, Twitter, LinkedIn) and messaging (WhatsApp) are now being increasingly used and the increased demand for those from young population is bound to increase the diffusion of broadband in the country. In the context, the present study attempts to answer the following three questions:

- What is the rate of diffusion of broadband Internet in India and also the trends in it over time?

- What are the factors that determine the observed trends in the diffusion of broadband and the trends in its diffusion across urban and rural areas and across the states in the country?
- What are the specific policy challenges to increase the rate of diffusion of broadband especially in the rural areas of the country?

Expected date of completion: December 31, 2015

### 3. Publications during 2014-15

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#### Journal Articles

- Mani, Sunil, (2014) 'Emergence of India as the World Leader in Computer and Information Services', *Economic and Political Weekly*, Vol. 49, No. 49, pp. 51-61.
- Mani, Sunil, (2014) 'Doesn't India Already Have an IPR Policy?' *Economic and Political Weekly*, Vol. 49, No. 47, pp. 10-13.
- Mani, Sunil, (2014) 'Industrial Investments in Kerala, Trends, Constraints and Future Prospects', *The Journal of Industrial Statistics*, Vol. 3, No. 2, pp.169-198.

#### Chapters in Books

- Mani, Sunil (2014) 'Innovation: The World's Most Generous Tax Regime' in Bimal Jalan and Pulapre Balakrishnan (eds.), *Politics Trumps Economics, The Interface of Economics and Politics in Contemporary India*, New Delhi: Rupa, pp. 155-169.
- Mani, Sunil (2015) 'Economic Liberalization and the Performance of Public Sector Enterprises in India', in Edmund Terence Gomez, Francois Bafoil, and Kee-Cheok Cheong (eds.), *Government-Linked Companies and Sustainable, Equitable Development*, New York: Routledge, pp. 18-38.

#### Other Publications

- Mani, Sunil (2015) 'Growth of High Technology Industries in India', *Yojana*, Vol. 58, (November), pp. 11-14.
- Mani, Sunil (2014) 'India and Software Service Industry', *Mathrubhumi Yearbook Plus*, pp. 38-50.
- Mani, Sunil (2014) Review of the book ARCHITECTS OF GROWTH?: Sub-national Governments and Industrialization in Asia. Edited by Francis E. Hutchinson. Singapore: ISEAS, 2014. xxv, 399 pp. (Tables, figures, maps.) US\$49.90, paper. ISBN 978-9-814414-53-1, Pacific Affairs, Vol.88, No: 2, 2014.

**4.Seminars/Conferences/Workshops  
attended(2014-15)**

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**Seminars presented at CDS**

- ‘Industrial Investments in Kerala, An Analysis of its Trends, Constraints and Future Prospects’, (22 August, 2014)
- ‘Dimensions of India’s Innovative Performance’, (13 November, 2014)

**Seminar papers presented outside CDS**

- Presented a paper on ‘Changing Role of the State in Innovative Activity, The Indian Experience’ at the *International Conference on Future Perspectives in Innovation and Governance in Development* at United Nations University-MERIT, Maastricht, The Netherlands on November 27, 2014.
- Was a discussant to paper on ‘Prospects and Constraints of Manufacturing Growth in India’ presented at the conference on *Achieving Accelerated Manufacturing Growth: The Promise and Challenges*, MIDS and the British Northern Universities India Forum (BNUIF), Chennai, January 2, 2015.
- Presented a paper on ‘International Technology Transfer to and from India: An Analysis of India’s Engagement with Asian Countries’ at the *International Workshop on ‘Firm- to Firm matching with Technology Transfers in the Local Economy: Findings from Southeast Asia’*, IDE-JETRO, Bangkok, Thailand, February 10, 2015.
- Participated as an external examiner in the Viva Voce Examination of a doctoral dissertation at the National Institute for Advanced Studies, Bangalore, April 2, 2014.
- Invited to write the chapter on “India” in the UNESCO Science Report 2015.

## 4.Seminars/Conferences/Workshops attended(2014-15)

- Gave the key note address on 'What do we know about FDI Inflows to India?' at the National Seminar on 'FDI In India in the Neo liberal Regime', Government Victoria College, Palghat, October 28, 2014.
- Gave a lecture on 'Strategic Role of State in Promoting Innovations at the Firm Level The Indian Experience,' at the National Seminar on 'Strategic Management in a Globalized Scenario', Deva Matha College, Kuravilangad, Kottayam, January 13, 2015.
- Gave a lecture on 'On the Growth of India's Economy: An Analysis of its Positive and Disquieting Features and the Challenges Ahead' at the fourth Saintgits-Duquesne Academic Programme, Saintgits Institute of Management, Kottayam, May 12, 2014.
- Taught an elective on 'Innovation and Technology Policy (EC-248)' to PGDM students, Indian Institute of Management Calcutta, Kolkata, -Ten lectures of 1 hour and 30 minutes each during February 4-14, 2015.
- Taught an elective on 'Innovation and Technology Policy' to Master level students at the University of Toulouse Jean Jaures, Toulouse, France, - 16 hrs of lectures during March 18-28, 2015.

## **5. External involvement in academic and policy Advice**

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- Member, Governing Board, International Centre for Free and Open Source Software.
- Honorary Visiting Professor, University of Toulouse Jean Jaures, Toulouse France.
- Part Time Visiting Faculty, Indian Institute of Management Calcutta, Kolkata.
  
- Participated as an external examiner in the Viva-Voce Examination of a doctoral dissertation at the National Institute for Advanced Studies, Bangalore, April 2, 2014.
  
- Member, Editorial Advisory Board, Research Policy (Elsevier).
- Member, Editorial Board, International Journal of Technology and Globalization (Inderscience).
- Member, Editorial Board, International Journal of Technological Learning, Innovation and Development (Inderscience).
- Member, Editorial Board, International Journal of Development and Social Research.
  
- External Referee to: Research Policy, Economic and Political Weekly, Higher Education for the Future
  
- Contributor to *World Science Report 2015*, UNESCO.
  
- Commentator and adviser to the special issue on “Science in India’ , *Nature*, Vol. 521, Issue 7551.

## **6. Personnel Associated with the Unit**

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