

# Foreign R&D centres in India: Is there any positive impact?

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*With the new emerging trend of internationalization of R&D, MNCs are targeting developing countries in Asia for setting up their dedicated R&D centres. The resource scarcity in developed countries, due to escalating demand on S&T infrastructure and the prohibitive cost of highly skilled manpower has brought in this new trend. The skilled manpower and the reasonably developed S&T infrastructure have been drawing MNCs to the shores of India for setting up their dedicated R&D centres. Presence of foreign R&D will have some impact on the host country; it could be negative or positive. As more and more R&D centres are being allowed to operate in India, we presume that foreign R&D has been allowed here expecting some positive impact (or benefits) on our innovation system. The benefits to India, however, is the grey area. The available literature suggests that the presence of foreign R&D centres can trigger the spillover effect onto the host country's innovation system depending on the ability, preparedness and conducive policy package of the host country.*

*This article proposes the need for a detailed investigation into the dynamics of interaction between foreign R&D centres and the Indian production and R&D system, to understand the positive impact. This would help in developing a conducive policy package for maximizing the benefits.*

**Keywords:** Foreign R&D centres, internationalization of R&D, positive impact, S&T infrastructure.

INTERNATIONALIZATION of R&D has emerged as an important mode to access the global pool of knowledge. Types and ways of establishing linkages with the resource centres in the host countries vary from contract research to setting up dedicated R&D centres. Lately, world leaders in high-tech areas are targeting developing countries in Asia for setting up their R&D centres. China and India are emerging as the most preferred destinations for MNCs. Do the host countries also derive any direct or indirect benefits from the presence of foreign R&D? In other words, is there any positive impact of its presence on the host country's innovation system. This is still a grey area. Although there is a considerable number of research articles from the perspective of business strategies of MNCs, not many rigorous studies are available on the benefits (positive impact) for the host countries. This is important for framing appropriate policy packages to enhance positive impact on the host country's economic growth. Recently, countries like China, Korea and Brazil have started investigating the balance of benefits from the activities of the foreign R&D centres in their respective countries. In the case of India, however, the issue has not attracted the attention of the relevant departments and agencies.

In this article, we try to construct an Indian scenario of the presence of foreign R&D and indicate the linkages and probable outcomes (spill-overs). We present a review of the literature on the dynamics of the globalization of R&D. This is followed by a review of the experience from other countries, where we broadly define the expected benefits for the host countries. Next, we present a broad Indian scenario by emphasizing the need for a detailed investigation on the dynamics of interaction between foreign R&D centres and the Indian production and R&D system, to study the impact. We conclude with a summary of the main argument.

## Internationalization of R&D

Internationalization of R&D is a phenomenon of the late eighties. Many MNCs set up production facilities in the growing overseas markets through their subsidiaries, or through collaborations with local companies. In many cases products have to be modified to suit the local tastes, conditions, and also locally sourced materials or components. R&D facilities were to be created to address such needs and modification of the products and technologies. The present trend of internationalization of R&D, however, goes much beyond this practice. It is more about attaining or retaining global competitiveness by having access to R&D infrastructure and capabilities from multiple sources<sup>1-10</sup>.

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Highly technically advanced domestic markets of developed countries helped MNCs in generating and sustaining certain firm, specific technological knowledge advantage. This paved the way for their growth, which was much more than what the home country market could absorb. In countries like Sweden, with more MNCs operating in high-tech areas, the S&T infrastructure could not cope with the large-scale demand on human resource and other S&T infrastructure<sup>11,12</sup>. MNCs started looking for resources in other developed countries because of competitive pressure, to create and sustain the technological knowledge advantage.

The changing faces of new technologies further augmented the process. As observed by Granstrand<sup>4,5</sup>, 'Today, a new pattern can increasingly be discerned. As a consequence of the rapidly escalating pace and costs of technological development, and the increasing number of sources of front-line technologies and their concurrent combinations in different products and processes, creating and maintaining technological competitiveness requires access to a wider range of scientific and technological skills and knowledge than is available in the home market'.

There are three distinct patterns of internationalization of R&D. What has been described above was a pattern when MNCs from developed countries were seeking R&D and technological inputs from other developed countries of similar technological competence. Thus USA used to be the main destination of MNCs from Sweden. Although companies like Sandvik (Swedish MNC) had their production facilities in India (also a small R&D unit for cutting tools for local Indian market, outside Sweden), the major R&D facilities were set up in other developed countries.

The newly industrialized countries like Japan and Korea set up a new pattern of international R&D. They started scouting new technological knowledge by setting up R&D centres mainly in USA. The best example of this pattern is the Korean initiative for 486 chips development. Korea was about ten years behind Japan and USA in developing the technology. It quickened the learning process with its own R&D centres in the Silicon Valley<sup>13</sup>.

The more recent trend of developed countries targeting developing countries is the emerging third pattern. What was initially the stray problem of resource shortage (R&D infrastructure and manpower) for individual countries (like the example of Sweden), turned out to be a major problem for all developed countries. The domestic S&T resources became inadequate to face the pressure of competition and consequent pressure on the process of innovation. The developing countries, therefore, became the destination. As stated by Hakanson and Nobel<sup>11</sup>, 'Supply conditions in the market for engineers and technical knowledge may in some foreign countries be so favourable that they induce companies to set up local research establishments to "tap into" the local scientific infrastructure, be it in terms of labor market for scientists and engineers, privileged access to local universities and research institutions etc'.

This is the situation which brings in more and more of R&D centres by MNCs to the Asian countries, especially to India and China<sup>14</sup>. US firms overseas R&D activities<sup>15</sup> has increased from 3% in 1994 to 10% by 2002. As observed by UNCTAD, 'the expansion of R&D into selected developing countries is a reaction to increased competition, which forces firms to innovate more at lower cost. TNCs are especially attracted to host countries that have the appealing combination of low wages and large pools of skilled workers. The historical near-monopoly of developed countries on scientists and engineers is diminishing. In 2000/01, for example, China, India and Russia together accounted for a third of all tertiary technical students in the world'<sup>16</sup>. Manpower shortage on the one hand and manpower utilization on the other, have also been the main factors for the shift towards developing countries. A large part of this skilled manpower is under utilized, and therefore, is easily accessible to foreign R&D centres who can offer comparatively attractive compensation, better career options and exposure to frontiers of R&D<sup>15,17,18</sup>.

The match between supply and demand guided the flow of foreign R&D to the shores of developing countries, including India. The comparative advantage of the Indian supply side can be understood from the responses of 500 senior executives in a recent global survey by the Economic Intelligent Unit<sup>19</sup> of the *The Economist*. The finding is reproduced in Table 1. India tops the preference list when it comes to 'access to highly skilled labour force, R&D activities and new opportunities in outsourcing'.

Overall, however, China scores over India in the UNCTAD study on FDI for R&D. Figure 1 reproduces the results of the UNCTAD survey on attractive prospective locations of R&D centres. India, according to the survey, is the third most preferred destination after USA and China. The survey refers to the period 2005–09. In an earlier survey for 2004, India's position as an attractive R&D destination was sixth. India has thus moved up by three positions.

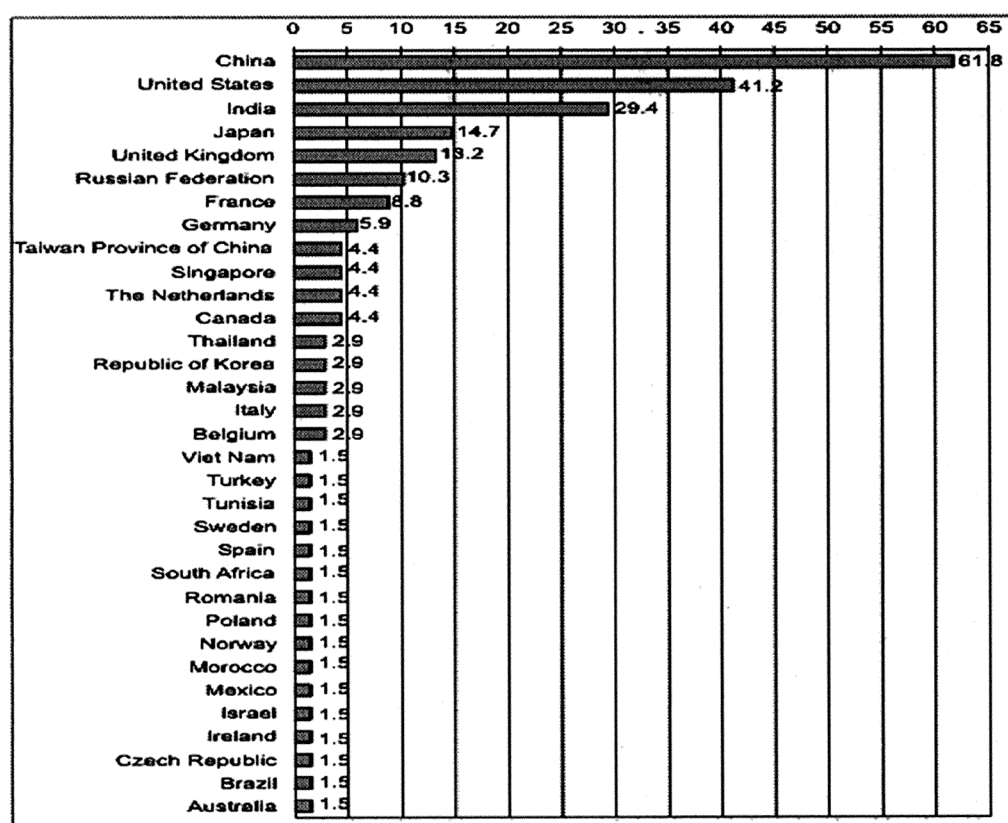
MNCs are drawn to India for various reasons, more so for the highly skilled manpower and for access to R&D activities. The foreign R&D centres try to establish links with Indian R&D institutions and firms to achieve their goals. In this scenario, the question that comes to mind is whether such linkages can have any positive impact on Indian production and R&D. If it is so, what are the probable spillovers? In the following section, experiences of some developing countries are discussed to understand the process of spillover to the host country.

### Positive impact on host countries: The global experiences

From the perspective of the host country, the first important issue is regarding the relevance of the foreign R&D centres in the context of S&T and R&D priorities of the host country. It may as well be argued that it is *in situ* brain-drain. The traditional form of brain drain (migration

**Table 1.** Destination of FDI: Choice of the 500 executives

	China	Euro area	Japan	Russia	USA	UK	India	New EU entrants	Brazil
New consumer markets	49	9	2	5	7	2	9	15	4
Low-cost labour	50	2	0	3	1	0	29	12	3
New partnership possibilities	20	22	5	5	14	4	12	14	3
New corporate markets	23	22	3	5	17	3	7	15	4
Access highly skilled labour force	6	22	7	3	14	6	30	10	2
New opportunities in outsourcing	16	9	1	3	7	2	46	12	4
Acquisition opportunities	15	20	2	5	13	5	8	22	9
Research and development activities	11	20	5	4	22	7	24	6	3
Greater efficiency in supply chain	17	26	6	2	22	5	10	9	3

Source: Economist Intelligence Unit<sup>19</sup>.**Figure 1.** Most attractive prospective R&D locations, 2005–09 (per cent of respondents mentioning the location). Source: UNCTAD<sup>15</sup>.

of human resources) is seen as a national loss of human resources for the development of which a state has spent significant amount of scarce resources, but which is not available for the use of that state. In the context of foreign R&D centres, the brain does not have to migrate. It is accessible in its own soil at much lesser cost. The brain is used for the purpose of the foreign companies, whose priorities may not coincide with that of the state.

The other side of the issue is the ability of the host countries to extract benefits from the presence of the foreign R&D centres. In fact, it offers a good opportunity to many developing countries to access frontiers of research in technology and also management of technology and R&D<sup>15,20</sup>. In case of many countries the positive impact of foreign R&D has been reported by various studies<sup>4,5,15,18,21</sup>. According to Dunning<sup>22</sup>, there is a possibility

of indirect positive as well as some negative effect on the host country's innovative system. Foreign R&D centres can contribute to the host country's innovation system through their linkages with the host country's institutions<sup>8,15,23</sup>. The positive effect is basically in terms of certain spillover effects, competitiveness among the local firms, contract research work to host country's R&D organizations, and local firms having access to high technology through partnership/collaboration. How the presence of MNCs would affect the host country depends upon many factors, like the level of technological advancement of the host country, conducive policy measures, local innovation system, S&T infrastructure, etc.

It has been observed that the S&T system in some of the developing countries is more suited to cater to the requirements of the MNCs rather than the local firms. In

Brazil, MNCs have more interaction with the local universities and research institutions than the local firms<sup>15,18,24</sup>. The important aspect is the necessity of a dynamic industrial base in addition to the supportive S&T infrastructure to absorb the spillover effect. Some studies on Korea, Brazil and China have focussed on the issue of linkages with the host country's innovation system and the probable implications to the innovation dynamics of the host country. The Korean study, based on a survey of the foreign R&D centres operating in Korea, has focused on many important issues like competitiveness among the local firms and benefit to the R&D system in terms of joint research activities, technology transfer, etc.<sup>25</sup>. The study emphasizes on the need for a policy package to derive benefit for the host country. A Brazilian study points out that the host country's innovation system gets linked to the global system, where the MNCs R&D centres have strong local S&T linkages<sup>18</sup>. Contribution of the R&D centres to the host country's innovation system depends upon the strength of their S&T links with local and global partners. The nature and type of linkages and also their extent have implications on the host country's R&D and production system. Similarly, a study on the Shanghai innovation system has presented some preliminary evidence to show that there is technology spillover from MNCs to the local economy. Here, the spillover is in the form of setting up of joint research laboratories, with local universities and this has triggered similar joint research laboratories being set up by some of the local large firms with the universities. The other observed effect has been the spin-off firms from the R&D centres of MNCs<sup>21</sup>. Studies do indicate the possible benefits to the host country's innovation system, but not much is known about its impact<sup>7,15,18,20,21</sup>. According to Narula and Zanfei<sup>26</sup>, to reap the benefits from foreign R&D, it is essential for the host country to have the basic technological capability to absorb the spillover from its activities.

The following typology is indicative of the linkages and their outcomes<sup>7,8,15,17,18,20–22,27</sup>.

#### *R&D centres of MNCs and local universities/R&D institutions*

(a) Collaboration resulting possibly in joint research laboratories; (b) Setting up of specialized training centres; (c) Centres of excellence; (d) Contract research; (e) Joint research projects with links to other global universities and R&D centres; (f) New curriculum development and (g) Upward movement in the value chain.

#### *R&D centres of MNCs and local human resource*

(a) Utilization of highly skilled labour force; (b) Manpower mobility; (c) Spin-off firms; (d) Reverse brain-drain, brain circulation and global networking; (e) Human

resource spillover (they move to other firms or set up new enterprises).

#### *R&D centres of MNCs and local firms*

(a) Joint product development to cater to the global market; (b) Contract for product development; (c) Access to global market and (d) Competitiveness.

These findings (Figure 2) sketch the likely benefits from foreign R&D centres to the host countries.

The area of intersection with local R&D system and universities on the one hand and the production system on the other, indicates the linkages with foreign R&D centres. Through the modes, various types of linkages have certain outcomes. These outcomes spillover to the production system as well as R&D/university system; or in the innovation system. It is the flow from outcomes to the production and R&D systems that requires close attention from the host country for deriving desirable benefits from the presence of foreign R&D centres. Important questions arise about: (a) The extent and nature of outcomes; (b) Extent and nature of spillover in the production and R&D systems so that the outcomes do not remain restricted to the formal linkages, and (c) Adequacy of the modes of linkages and alternative desirable modes for better outcomes and spillover. Close monitoring of these aspects would indicate the direction and needs of policy incentives required to enable the domestic innovation system to benefit from foreign R&D.

#### **Foreign R&D centres in India**

According to the TIFAC report<sup>28</sup>, over 100 foreign organizations (mainly MNCs) have opened R&D centres in India over the last decade. Broadly, two types of foreign interests have established their R&D units in India. Some are involved in incremental innovations and their main aim is to support the existing products introduced in India. However, some R&D centres such as Texas Instruments, General Electric, and IBM are engaged in developing new products<sup>8,15,20</sup>. Compared to the earlier periods, a significant shift is observed in the types of MNCs who are now opening their R&D centres. Earlier, many of the MNCs had their R&D set-up as a support to their production unit. Late entrants are now opening their dedicated independent R&D centres for taking up R&D activities in new and emerging research in high-tech areas.

Table 2 presents the scenario of foreign R&D centres in India. During 1996–2000, more countries have established their R&D centres in India. This has been the phase when India became a centre for global R&D activities. The US has the maximum number of R&D centres with maximum R&D workers employed. Investments by foreign firms in India have been rising sharply. Intel announced over a billion-dollar investment over the next

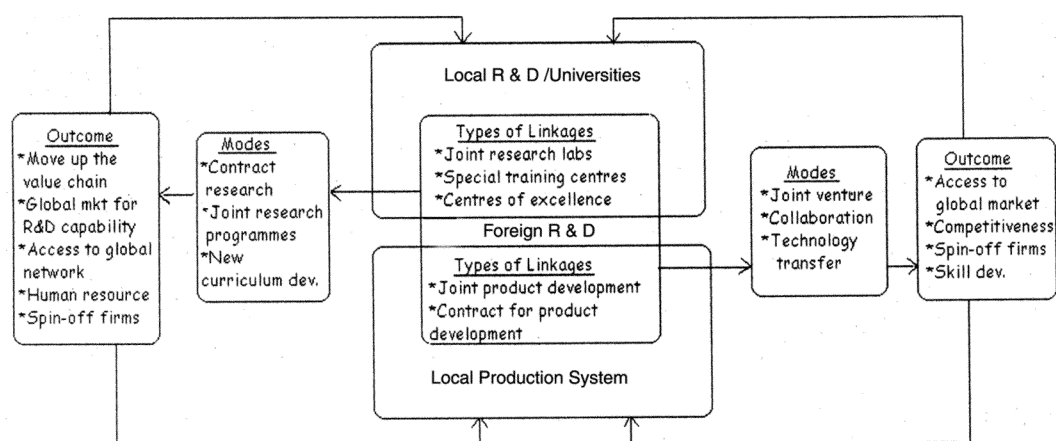


Figure 2. Desirable flow of benefits from foreign R&D centres to host countries.

Table 2. Country-wise R&D centres, R&D investment and R&D workers employed in India: A profile up to 2003

Country	Number of R&D centres	Year of establishment			Number of R&D workers in R&D centres established (R&D investment in million rupees)		
		Prior to 1995	1996–2000	Beyond 2000 up to 2003	Prior to 1995	1996–2000	Beyond 2000 up to 2003
Austria	1	1			50 (100)		
Canada	3		2	1		539 (400)	55 (110)
Taiwan, China	2		1	1		10 (8)	500(2700)
Denmark	1		1				5 (1.5)
France	5	1	2	2	800 (900)	150 (18.2)	20 (20)
Germany	7		7			2050 (3452.4)	
Japan	7	1	3	3	NA	50 (225)	50 (197.2)
Korea	3		2	1		650 (4500)	NA
Mauritius	2		1	1		10 (5)	255 (510)
The Netherlands	3	1	1	1	400 (400)	30 (225)	100 (200)
Norway	1	1			NA		
South Africa	1		1			50 (30)	
Sweden	2	1	1		60 (12)	20 (40)	
Switzerland	2		2			170 (340)	
UK	7	1	2	4	100 (20)	250 (500)	604 (569)
USA	53	12	21	15	6330 (12175)	4940 (11051.3)	2646 (930.01)

Source: TIFAC report<sup>28</sup>.

five years<sup>29</sup>, while Cisco announced over a billion-dollar investment over the next three years<sup>30</sup>. This would increase its staff strength in India threefold. GE<sup>31</sup> sets a goal of US \$8 billion in revenues and US \$8 billion in assets in India by 2010. Du Pont India plans to set up a knowledge centre in India in the next three years, which would mean that the R&D strength will rise ten fold<sup>32</sup>. Firms like Ford India and Honda Siel along with domestic firms such as Ashok Leyland and Maruti Udyog spent a total of Rs 300 crore on R&D activities<sup>33</sup>.

Clinical research by MNCs is one area which had significant investment in the Indian pharmaceutical sector. The John F. Welch Technology Centre (JFWTC) in Bangalore, is General Electric's (GE's) first and largest integrated, multidisciplinary research and development centre outside the US. GE has employed over 2400 people in its

R&D centres for medical equipment, aviation engines, consumer durables, etc. More than one-third of researchers in these centres are Indians who have returned to India from the US. This is brain circulation, which is now being observed in most of these developing countries<sup>27</sup>.

Table 3 shows a few representative cases of foreign R&D investments in India, their nature of alliance with the domestic R&D and production system, and the mode of linkages.

Various modes and types of linkages that are evident from Table 3 match the global experiences mentioned above. The main trend of foreign R&D in India is to tap the skilled human resource and the scientific institutions, for entry into the Indian market. In some cases this has resulted in the creation of new knowledge centres or new production plants. The alliances have also resulted in

**Table 3.** Examples of foreign R&D alliances in India

Alliance	Mode	Type of alliance
Du Pont–RIL	Alliance for DuPont's entry into the Indian market.	New centre
Du Pont–CSIR	R&D for process and product technologies in India Research agreement. DuPont to have access to CSIR facility and get its talent	DuPont setting up knowledge centre
Emerson–Tata Liebert	Joint venture	Emerson buys over Tata's stake to form new firm
Ericsson–WIPRO	Total R&D outsourcing. WIPRO acquires resources—professionals, assets. WIPRO to provide R&D consultancy service to Ericsson	WIPRO takes over R&D of Ericsson
Ericsson–TCS	Pact for telecom solutions	New development centre
GE–TCS	Creating new facility to cater to global operations of GE, enhancing TCS capabilities	TCS to have access to global market
GE–Satyam Computer Service Ltd	Joint venture	New facility for global activities of GE
Hewlett Packard–IIT Chennai	Research to help global efforts of HP	New facility
HP–IISc Bangalore	Joint research	New product development
Synopsys–View Logic System Inc	Partnering for getting work done for Synopsys	Synopsys setting up new centre for easy jobs and later for major jobs
Diebold–Tata Infotech	Contract agreement, manufacturing and marketing products of Diebold	Tata Infotech gets into new market
GE International–TCS	Creating new facility to cater to global operations of GE. Facility utilized by customers of both firms	Enhancing TCS capabilities. TCS to have access to global market
GE–Satyam Computer Services	New facility	New product development
Lucent–Finolex	Finolex gets technology from Lucent	New plant
Toyota–IICT	Contract research to IICT	New laboratory set up.

Source: IBID, and various business and corporate news.

joint product development for Indian and even for the global market. The GE–Satyam alliance is one such example. HP's linkages with R&D institutes like IITs and IISc, Bangalore for new product development for the global market is another such example. Indian firms, through alliances with foreign firms, also have access to the global market as in the case of TCS. The GE–TCS alliance in India resulted in the setting up of a new facility to cater to the global operations of GE. Due to this, the capabilities of TCS were enhanced and it also had access to the global market. Diebold had a contract agreement with Tata InfoTech for the manufacture of its product in India, thus resulting in Tata InfoTech entering a new market. The Ericsson–WIPRO alliance turned out to be beneficial for WIPRO, as it provided R&D consultancy services to Ericsson and later took over the R&D of Ericsson. In India, the link between R&D centres and the education system has led to the introduction of new curricula. This has been the case with Motorola, which has introduced a postgraduate degree course in advanced telecommunications engineering in the Pune Institute of Advanced Technologies. Similar patterns of skill development are observed in Costa Rica, Mexico, Singapore, etc.<sup>15</sup>.

There are certain observable changes taking place in the Indian production and R&D system. An Indian firm and a public research institute have jointly formed a research centre to work in high-tech areas to compete with global players. The creation of CranesSci MEMS Lab is one such example. Partnership between Cranes Software International Systems and IISc has resulted in the creation of a new culture in micro and nano technology busi-

ness in India<sup>34</sup>. The emerging new business culture among Indian scientists is creating a new trend in entrepreneurship. Another interesting feature is that the Indian firms are creating high-tech facilities to cater to global requirements. Recently, Jubilant Organosys has inaugurated a state-of-the-art Drug Discovery Centre in Bangalore, which would provide innovative solutions to global pharmaceuticals and life-sciences companies<sup>35</sup>.

It is to be noticed from the above discussions that linkages were mainly with established companies or R&D organizations. In Figure 2, this is indicated by the overlap of the foreign R&D space and those for domestic R&D and production systems. While explaining Figure 2, we have argued that the efficacy of the foreign R&D is finally to be justified by its spillover to the remaining space outside the overlaps. It is essential to probe the linkages and to delineate the process of change that is taking place in the Indian innovation system. The direct benefits that are accruing to the institutions and organizations having linkages with foreign R&D centres and the extent of the spillover effect need to be investigated.

According to the UNCTAD report, the significant increase of R&D expenditure and patenting activities of Indian firms could be due to technology spillover effect of R&D activities of TNCs in India. The possible impact, according to UNCTAD, is that the presence of these foreign R&D centres can encourage commercial culture among scientists and engineers, and inculcate innovative culture among the local firms<sup>20</sup>. Issues that need further investigation are as follows: What is the nature and extent of linkages with the Indian production and R&D system?

What are the observable changes in competitiveness in the Indian sectors (not only in organizations that have linkages) where foreign R&D centres are concentrated? What are the shifts and changes in the R&D, marketing, human resource and production profile of the firms and public R&D institutions where foreign R&D centres have their linkages?

## Conclusion

While enumerating the benefits of the entry of foreign R&D into India, we have tried to argue that the actual benefits would be from the knowledge spillover effect of the various linkages in the overall innovation system of the country. This needs to be investigated to study the positive impact. The benefits, however, does not accrue automatically. A lot would depend on the ability and preparedness of the R&D and production system to extract benefits from the presence of the foreign R&D centres in India. There has to be proper monitoring and scrutiny of the extent and nature of the spillover effect realized by the host country and an appropriate incentive system has to be developed to accentuate the process.

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ACKNOWLEDGEMENTS. We thank Pradosh Nath, NISTADS, New Delhi for his academic inputs. We also thank Rammi Kapoor, NISTADS for help.

Received 27 December 2006; revised accepted 19 December 2007