



Impact of FDI in R&D on Indian R&D and Production System

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Executive Summary

Summary of the Study

The objective of the study is to investigate the impact of the presence of foreign R&D centres on corporate R&D and the production system by assessing and evaluating the nature, type and mode of linkages that these R&D centres have with the Indian R&D and Production system. The study has two components-The first part is to identify and prepare a list of the firms bringing in FDI in India, and look at their R&D expenditure and activities. The second part of the study is to understand the impact of the FDI in R&D in the Indian production and R&D systems.

For the first part of the study

TIFAC report 2002 is the only reference and the task was to update the information on FDI in R&D inflow with all the details on the number of firms, their nature of R&D activities, R&D investment and job created. No systematic data source is available. Only authentic sources are DIPP and FIPB. The format of available data has been the main problem. The available data is on FDI and not on FDI in R&D. DIPP and FIPB as main sources, complemented, supplemented, crossed checked by using many other sources such as, DATAMONITOR database, Financial Times Database FDI Intelligence, Cygnus database, IBID database, CMIE Database, Global R&D report, Online search of EETimes Asia, Silicon India, Hindu Business line, Economic Times, Business Standards, etc, company websites and business news, OPPI, ABLE, SAI.

The most important spin-off of the report is extensive enumeration of flow of FDI which was to be undertaken to arrive at the estimation of FDI in R&D.

For the second part of the study

A Choice was to be made between a deterministic and holistic approach in understanding impact. Deterministic approach would require a set of clearly defined variables – dependent and independent and also testable hypotheses. Most of the deterministic studies are on Developed to developed countries flow of FDI, or FDI from Developed to small developing countries like Taiwan where FDI is targeted and closely monitored for strategic achievements and a few on FDI in R&D. Deterministic studies on impact or contribution of R&D is constrained with highly restrictive assumptions on proxies and relationships (uncertainty, nonlinearity, divisibility, and continuity issues ignored). The issue becomes more complex in case of FDI in R&D, especially in the context of large and diverse developing economies where FDI flow is hardly monitored and data generated. The holistic approach takes the complete system as perspective.

Available literature, mostly on China and a few on India, envisage impact through tracing linkages of MNCs' R&D with the actors in the domestic R&D system. As opposed to Developed to developed country FDI in R&D, where major hypothesis is 'Trojan Horse' effect, 'Island' kind of operations of the MNCs' R&D centres is observed as major trend for developing economies.

In available literature on FDI in R&D, impact has been measured in quantitative terms in three stages: a) direct effect on employment generation; b) tracing the types and nature of linkages; c) gains from MNCs' R&D in terms of R&D output, assessed through patenting activities. We have followed the same strategy to arrive at certain important insights that can help identification of variables and hypotheses of their relationships which are likely to be non-linear. The system approach adopted for the study focuses on the impact or benefits from MNCs' R&D in India, and not the firms' gains from such investment. The linkages study reveals that MNCs adopts various modes for accessing the resources – essentially human resources. As such linkages that could create gains for the host are rare.

Most of the MNCs are working in isolation, as far as their R&D activities are concerned. The scope of skill development and knowledge flow is negligible. The patent data also supports the absence of meaningful linkages. The IT sector has produced a few spin-offs by the employees of the R&D centres. A few such firms engaged in chip designing suggested that they cannot grow beyond a point because in the absence of the domestic market their survival and growth depends on the innovations in other countries. The impact can be understood as default or as strategic. The default impact is the trickled down positive impact – as has been observed in cases of a few educational institutes and firms becoming more technology conscious. Strategic impact requires close monitoring of FDI and FDI in R&D. The negative impact is through creating resource crunch. Resource crunch is mainly felt when the prices of resources (like qualified skilled manpower for R&D for domestic innovation system) increase because of higher demand conditions created through the presence of MNCs.

The key findings of the study are as follows:

- 706 firms have been identified as having brought in FDI for R&D activities in India during 2003-2009
- In comparison to the total FDI inflow, the Inflow of FDI for R&D is miniscule (0.01%)
- There are large number of small investments for R&D activities in comparison to few large investments
- Of the total 706 firms bringing in FDI for R&D only 74 firms have patents and of these, 63 firms have less than 5% share of Indian patents vis-à-vis their global patents.
- FDI in R&D is basically for the IT sector followed by Auto and pharma sectors.
- A cluster-wise classification shows that about 88% of R&D investments were made in 5 clusters – Bangalore, Hyderabad, Chennai, Delhi-NCR, and Pune-Mumbai.
- Of the total 706 firms only 117 firms have formal linkages with the Indian institutions, indicating that most of the firms operate in isolation
- Linkages with educational institutions is the most prominent one and it is basically for recruitment of manpower and also for training and skill development
- Linkages with national research institutions are rare and with Indian firms it is for contract research

Scope and Objective of the study

Scope: In India, the foreign R&D centres are growing in number and these centres are clustering around centres of excellence, engineering, institutions, universities etc. They have established linkages with the scientific institutions, universities and the local firms, which gives them access to the human resource and the other scientific and technological infrastructure. There is a need to assess and monitor these R&D centres for their linkages with the Indian Institutions and the outcome of such linkages.

Objective: The objective of the study is to investigate the impact of the presence of foreign R&D centres on corporate R&D and the production system by assessing and evaluating the nature, type and mode of linkages that these R&D centres have with the Indian R&D and Production system.

Importance of the topic: In the new and emerging trend of R&D internationalization, the world leaders in high-tech areas are targeting Asian developing countries, for setting up their dedicated R&D centres. China and India are emerging as the most preferred destinations for MNCs. The resource scarcity in developed countries, due to escalating demand on S&T infrastructure and the prohibitive cost of highly skilled manpower has triggered this new trend. The skilled human resource and the reasonably developed S&T infrastructure of both, China and India have been drawing the MNCs to their shores for setting-up R&D centres. In India, the foreign R&D centres are growing in number and have various types of linkages with the Indian production and R&D system. It is necessary to assess and monitor the foreign R&D for their linkages and outcomes to study their implications on Indian innovation system. Is there any direct or indirect benefit to the host country by having foreign R&D?

Internationalization of R&D has emerged as an important mode to access global pool of knowledge. Types and ways of establishing linkages with the resource centres in the host countries varies from contract research to setting up dedicated R&D centres. Although there is considerable number of research articles from the perspective of the business strategies of the MNCs, not many rigorous studies are available on the issue of the benefit for the host countries. The issue is important for framing appropriate policy packages so that presence of foreign R&D becomes a win-win proposition for both the host countries and the MNCs.

The proposed study would therefore look into the impact of the presence of foreign R&D centers on Indian R&D and Production system. The study would focus on the linkages that the foreign R&D centers have with the Indian production and the R&D system and to evaluate the impact of such linkages on Indian R&D and production system.

Methodology

The study has two components

- ✓ The first part is to identify and prepare a list of the firms bringing in FDI in India, and look at their R&D expenditure and activities.
- ✓ The second part of the study is to understand the impact of the FDI in R&D in the Indian production and R&D systems.

The most important spin-off of the report is extensive enumeration of flow of FDI which was to be undertaken to arrive at the estimation of FDI in R&D.

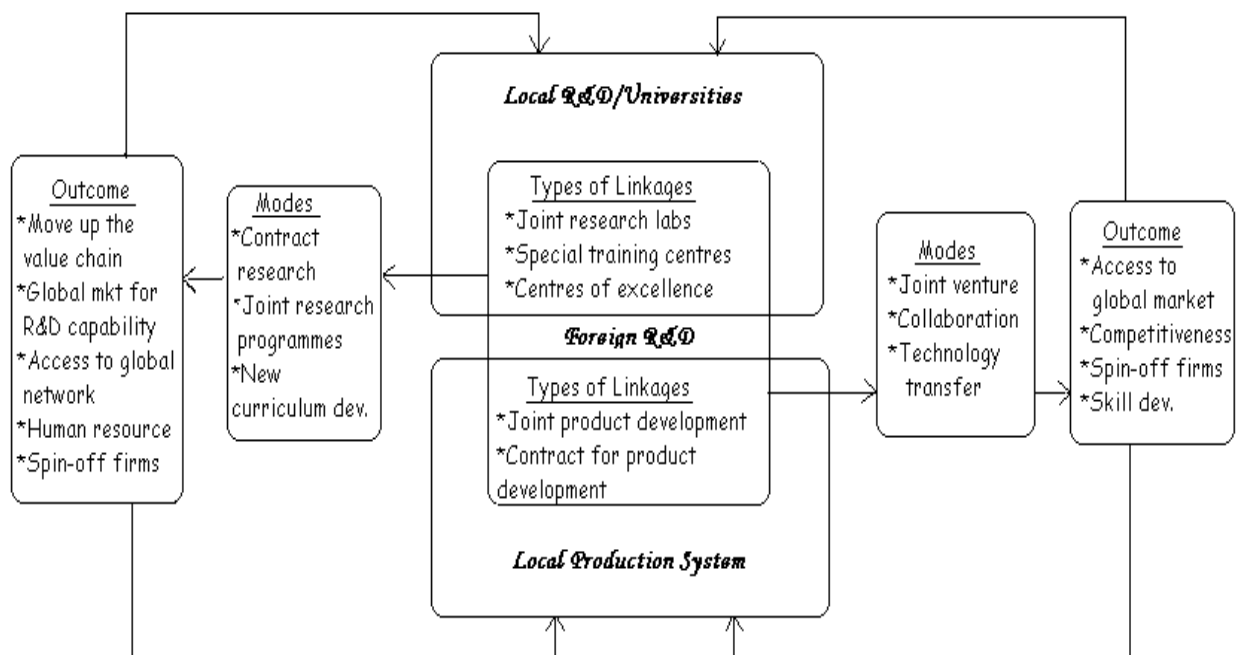
For the first part of the study

The main source of information on FDI flow in India is FIPB and DIPP. These sources were, however, partially useful. DIPP information is not in the form of database, and available as and when reported on daily basis. Processing of such information for a period 2003-2009 turned out to be quite difficult. For the present study, therefore, DIPP(SIA)/FIPB information has been extensively supplemented by other sources (The details about all the sources that we had accessed for information and data for this study are given in Part 1 of the report) like DATAMONITOR database, Financial Times Database FDI Intelligence, Cygnus database, IBID database, CMIE Database, Global R&D report, Online search of EETimes Asia, Silicon India, Hindu Business line, Economic Times, Business Standards, etc, company websites and business news, OPPI, ABLE, SAI. A wide range of sources have been used for arriving at a list of foreign companies investing in R&D in India. We collated information from all these sources, compared them to arrive at a count of MNCs bringing in FDI in R&D in India to be 706.

For the second part of the study

- ✓ Choice between a deterministic and holistic system approach was to be made

- ✓ Deterministic approach would require a set of clearly defined variables – dependent and independent. Also testable hypotheses.
- ✓ Most of the deterministic studies are on Developed to developed countries FDI, or FDI from Developed to small developing countries like Taiwan where FDI is targeted and closely monitored for strategic achievements. There are very few studies on FDI in R&D.
- ✓ Deterministic studies on impact or contribution of R&D is constrained with highly restrictive assumptions on causality among proxies. The issue becomes more complex in case of FDI in R&D, more so, in the context of large and diverse developing economies where FDI flow is hardly monitored and data generated.
- ✓ The holistic approach takes the complete system as perspective as shown in the following diagram that traces the various courses that lead to impact of FDI in R&D, much of which is unknown for forming hypotheses.



By taking the holistic approach, for the second part of the study, the impact has been articulated as an outcome of the interactions and linkages of the MNCs with the Indian production and R&D systems. Such linkages could be only at the level of recruitment of manpower, which would have minimum potentiality of any substantial impact, to joint product or process development for joint innovations; an area of linkages with maximum potentiality of impact in the system of the host country.

- ✓ *The diagram is the stylized presentation of the impacts of FDI in R&D, as reflected in literature. Why a firm chooses one mode of linkages and how it leads to the outcome are unknown territories. By outcome we mean outcome in favour of the host countries, which happens only when it ensures MNCs' own benefits, which is not known.*
- ✓ *Available literature, mostly on China and a few on India, envisage potential impact through tracing linkages of MNCs' R&D with the actors in the domestic R&D system.*
- ✓ *Impact has been measured in quantitative terms in three stages: a) direct effect on employment generation; b) tracing the types and nature of linkages; c) gains from MNCs' R&D in terms of R&D output, assessed through patenting activities.*

With this understanding we have identified three distinct orders of impact. The first order is only at the recruitment level, the second order is in terms of various types of linkages with the educational and R&D organisations and production organisations; and the third being the productivity gains in the production and R&D systems.

The study, therefore, required an a priori understanding of extent and nature of linkages of the MNCs bringing in FDI in R&D in India. A search of information from a wide range of sources on various kinds of activities of MNCs in the list of the first part of the report help us short listing of 117 out of 706. A representative samples (38) from 117 firms supplemented with study of 25 Indian firms and 4 important institutions of excellence where MNCs have more linkages and interactions were studied to understand the three distinctive orders of impacts.

Limitations of the study

- TIFAC report 2005 is the only reference available for the study.
- No systematic data source on FDI flow into R&D is available

The information on FDI inflow into R&D had to be collected and verified from various sources. Such endeavour can never be called final, and leave further scope of improvement.

The second part of the study is based on the field visit and interviews with the MNCs and Indian partners. Initially planned to be a questionnaire based study of the selected firms, it was realised later that in very few cases structured responses in the form of a questionnaire was up to the level of requirement of a rigorous analysis. The alternative was to visit the relevant person in a company. The process is time consuming because it requires several rounds of contacts for appointments. Such visits are useful for understanding the finer aspects of the strategies and operations of the MNCs, but not much for the hard data as envisaged in the questionnaire.

Even such responses are also not uniform from all the firms, in all sectors and clusters. In general, firms in Bangalore from all three sectors found to be more responsive than their counterparts in other clusters. The study, therefore, had to bank heavily upon responses received from the firms in the Bangalore cluster.

Major Observations

Highlights from the Part I of the study

- ✓ *Total 706 MNCs were identified with detailed of the investment for R&D during 2003-2009*
- ✓ *Together they invested US\$29.44 bln. During 2003-2009.*
- ✓ *Total job created during the period of 2003-09 is 2,47,403.*
- ✓ *Software and IT sector has a share of 74.17% of the total employment created. Among other sectors, Auto industry has a share of 5.29% and Pharma Biotechnology has a share of 3.31%.*
- ✓ *The Software and IT sector has a share of 50.30% of the total FDI in R&D, followed by the Auto industry 9.88% and Pharma- biotechnology sector 9.24%.*
- ✓ *Data related to job creation includes all kind of jobs – as it was claimed by the company during investment and in subsequent press briefs. Could not be independently verified.*

1. The study has identified 706 firms bringing FDI in India for R&D during the year 2003-2009.
2. FDI in R&D is insignificant compared to total FDI flowing into the country from 2003 to 2009. It is generally believed that FDI follows the host country's growth trajectory. The truth in this belief is reflected in the nature and extent of flow of FDI in Indian production and R&D activities. The reference year is the year of high growth in the real estate and construction sector and also the metal and mineral sector. Both these sectors attracted highest flow of FDI. These sectors were followed by the software and IT sector which again is the fastest growing industrial activities in India.
3. When classified in terms of size of investment it is found that there are large number of small investments (below US\$ 50 million) and very small number of large investments. Since R&D in the frontier of high technology areas requires very high investment, the size of FDI in R&D in India suggests that India is still not considered as the destination or land of high-end R&D.
4. Sector-based classification of investment showed that major part of the FDI in R&D was flowing to Software and IT sector, Auto industry being poor second, closely followed by Pharma Biotech sector. The rest of the sectors had insignificant FDI in R&D.
5. Again it is to be noted that share of FDI in R&D in total FDI in India is only 0.01%. Software and IT sector has a share of 13.79% of FDI and investment in R&D is 0.03% of total FDI. This sector, again shares 50.36% of the total FDI in R&D.
6. A cluster-wise classification shows that about 88% of such investments were made in 5 clusters, namely, Bangalore, Hyderabad, Chennai, Delhi-NCR, and Mumbai-Pune. Of these sectors Bangalore is the main centre of FDI in R&D in India.
7. For understanding the impact of FDI in R&D on Indian innovation system the top three sectors were chosen. The impact was studied for jobs created through the investment, linkages with the Indian entities, and to assess the gains in the productivity in the R&D and production system.
8. A total job created during the period of 2003-09 is 2,47,403 on an investment of US\$29.22bln. Software and IT sector has a share of 74.17% of the total employment created. Among other sectors, Auto industry has a share of 5.29% and Pharma Biotechnology has a share of 3.31%. The Software and IT sector has a share of 50.30% of the total FDI in R&D, followed by the Auto industry 9.88% and Pharma-biotechnology sector 9.24%. Employment created per million US dollar invested

shows that the Software and IT sector is the highest employment generator at 12.83 ratio; whereas, Pharma and biotechnology sector (2.97) and Auto industry sector (4.55) are more capital dependent investment.

Highlights from second part of the study

- ▶ *Out of 706 firms, only 117 (16.57%) firms have various forms of linkages with the actors in Indian innovation and technology/knowledge generation system, namely, educational institutions, R&D institutions and domestic firms.*
- ▶ *Out of 117 firms 96 (82.05%) are from the three selected sectors, i.e., Software and IT industry (62, 13.84% of the total FDI in R&D firms), Pharma and bio-technology industry (29, 33.72% of total FDI in R&D firms) and Auto industry (5, 19.23% of the total FDI in R&D firms).*
- ▶ *Linkages with educational institutions is the most prominent one and it is basically for recruitment of manpower and also for training and skill development*
- ▶ *Linkages with national research institutions are rare and with Indian firms it is for contract research*

9. Linkages were studied for the firms that had established linkages with Indian entities. Of 706 firms, only 117 firms had some kind of linkages with Indian counterparts. Out of 117 firms having formal linkages, 96 firms were from the clusters. The study had chosen 38 firms for in depth study through interviews and questionnaire. Also studied were 25 Indian firms to understand the views of the Indian counterparts. MNCs had more interactions with educational institutes like IITs and IISc. The study had included these institutions to understand the nature of linkages with the MNCs.
10. Linkages with various IITs, IIITs, IISC or other universities are more in the IT sector. Availability of skilled human resource has been seen as the major attraction of the MNCs' R&D. This is also a problem because highly skilled manpower required for high-end R&D activities are very much short in supply. The linkages are of various types, ranging from new curriculum development, collaborative projects, Students sponsorship, fellowships, PhD programmes, training etc. Such linkages are created to develop the required manpower from these institutions.
11. In the case of Pharma Biotech sector, human resource was not pointed out as an issue of concern, except in the area of medicinal chemistry and pharmacology (basically for drug designing). Hence linkages with the domestic institutions are not considered very important. MNCs are mainly in the clinical trial activities. They contract out part of

their research activities, not the initial phases but at some later stage, to some of the Indian firms.

12. In the IT sector, the MNCs started off with subcontracting certain services to the Indian firms. The Indian firms had the opportunities to develop their expertise as service providers, and they have moved up in the value chain in their field of operations.
13. Human resource is stated as an asset by most of the people. The problem which is generally felt is the employability of the people who are recruited from universities and institutions other than IITs, IISc or the regional engineering colleges. The lack of industry orientation was again pointed out as one of the major problems with the people.

Points of importance

1. The impact of FDI in R&D is not realised up to its full potential. MNCs in IT sector face serious human resource crunch, and most of the linkages are geared to ensure a steady flow of quality manpower. It has been also said that large IT firms find it difficult to take up high end R&D projects because of inadequate availability of quality skilled manpower. This could be the reason behind poor share of India in the global patents of the MNCs.
2. The Pharma-biotech sector on the other hand has several contract research organisations engaged in the type of work which basically is for discovery research, data management, clinical trials, etc. This type of activity does not benefit us in terms of intellectual rights while firms' capabilities are exploited. Interestingly what one comes across is that MNC tie-ups are with Indian firms that have secured patent rights. However, this highly R&D intensive sector has failed to produce significant R&D outputs such as patents from these centres and any significant outcomes in terms of achieving high order strengths or outputs is uncertain. Mumbai/Pune has emerged as the largest in terms of investments.
3. In the automotive sector FDI R&D has followed FDI in manufacturing. Indian market has seen the entry of major auto manufacturers in the last fifteen years through manufacturing and R&D has followed later. However, at this juncture it is Indian design capabilities which are being harnessed. Indian firms in this sector suggest that the R&D activities of the foreign firms have actually made the domestic firms also to take up innovation activities to match the needs of the MNCs which are very active in

product improvement, new product development in an order of very high standard of quality and standards.

4. There are perceptible overall changes in the institutions in the education and production system having linkages with the R&D centres of the MNCs. Many of these institutions have become proactive in promoting innovations. Institutions like IITs and IISc have come up with schemes for promotion of ventures with the home grown technologies. Many of the domestic companies in IT, Pharma and Auto sectors are seeking active collaborations with the premier Indian institutions.
5. The IT sector has produced a few spin-offs by the employees of the R&D centres. A few such firms engaged in chip designing suggested that they cannot grow beyond a point because in the absence of the domestic market their survival and growth depends on the innovations in other countries.
6. It is true that the R&D activities of MNCs do have significant impact on the Indian innovation system. The impact can be understood as default or as strategic. The default impact is the trickled down positive impact and creating resource crunch as the negative impact. Resource crunch is mainly felt when the prices of resources (like qualified skilled manpower for R&D for domestic innovation system) increase because of higher demand conditions created through the presence of MNCs.
7. There is no systematic information on flow of FDI in R&D. Hence monitoring and directing the flow for any planned or desired benefit of the country is not possible. Both FDI and FDI in R&D have to be closely monitored to direct the inflow in the desirable sector, and locations.
8. The study has revealed that MNCs R&D centres have rare linkages with national laboratories. Human resource-wise and also infrastructure-wise national laboratories are better equipped to leverage the benefit from the linkages with foreign R&D centres. There is a need to have adequate incentives both for national laboratories and foreign R&D centres for joint and collaborative research activities.

Recommendations

1. There has to be systematic management of data of FDI and FDI in R&D. An appropriate agency has to be identified for maintenance and easy access to the data for policy purposes. A system similar to DSIR information base for in-house R&D of the Indian industries can also be thought of for the FDI in R&D. It can be made compulsory disclosure for getting clearance for FDI in India, and compulsory registration of FDI for R&D centre. Critical information that is to be collected can be designed in the line of DSIR information bank.
2. Both FDI and FDI in R&D have to be closely monitored to direct the inflow in the desirable sector, and locations.
3. At present, flow of FDI in R&D is essentially what MNCs thought Indian system could be used for. A close monitoring can decide about the priorities of the Indian industries and innovation system. For example, Hyundai is investing in India for developing its global R&D centre. The company has already created a manufacturing base and market presence in India. However, its R&D activities have negligible interactions with the Indian systems. The long term technological gain for India if anything at all, therefore, will be only by default.
4. The main gain from FDI in R&D is to be realised through the spin-offs and start-ups by the employees of these R&D centres; or by the people who were involved in the joint /collaborative activities with these R&D centres. There has to be special incentive structure for encouraging such start-ups and spin-off ventures.
5. Gain from R&D would be through innovations. Such innovations are likely to be in high technology areas where any venture involves substantial risk. The incentive package for promotion of spin-off/start-ups should have in-built risk cover for such ventures.
6. The study has revealed that MNCs R&D centres have rare linkages with national laboratories. Human resource-wise and also infrastructure-wise national laboratories are better equipped to leverage the benefit from the linkages with foreign R&D centres. There is a need to have adequate incentives both for national laboratories and foreign R&D centres for joint and collaborative research activities.
7. The flow of FDI and setting-up of R&D centres by MNCs have created demand for the skilled manpower. This has exposed certain weaknesses of our education

system. It has been widely shared by Indian institutions as well as the MNCs R&D centres that the education system lacks the culture of innovation, and it is more oriented towards getting employment. The study reinforces the need for revamping the education system, an action which is already in place under the initiative of the ministry of Human Resource Development.