IKD
Open University research centre on Innovation, Knowledge and Development

Diffusion of knowledge through migration of scientific labour in India

IKD WORKING PAPER NO. 17

Draft Prepared for
SPRU 40th Anniversary Conference,
The Future of Science, Technology and Innovation Policy,
September 11-13, 2006

November 2006

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Abstract

'Brain drain' is often viewed as a curse for developing countries like India and China but recent analysis suggests that in the current global competitive environment, the 'brain drain' may actually provide a crucial advantage to these countries. Over the years, these regions typically have been treated as low-cost production sites for multinational companies, but the ‘reverse brain drain’ of engineers or scientists educated and trained in the US or Europe can accelerate technological upgrading of these regional economies. Communities of such foreign educated scientists or engineers can provide the skill and know-how needed to help local firms shift to higher value added activities. However transfer of knowledge through human mobility is not a straight-forward process and knowledge diffusion by hiring scientists is a complex process. This paper presents important insights regarding the issues affecting diffusion of knowledge through migration of scientific labour, using case studies of innovative Indian pharmaceutical firms.

The analysis of firm level ‘assimilation processes’ reveals major issues such as generational differences of returnees, differences in working culture of Indian firms and western firms and importantly differences between the requirements of Indian firms and the skill sets of returnees, which have hampered effective diffusion of knowledge. We also show that Indian firms responded to these issues by adopting global R&D management practices. The findings also suggest that firms require government support policies to attract returnees.

1. Introduction

According to Saxenian, (2002), immigrant entrepreneurs and their communities provide an significant mechanism for the international diffusion of knowledge and upgrading of local capabilities – one that is distinct from, but complimentary to, global production networks. In some parts of the world, the “brain drain” has been effectively converted into “brain circulation” as talented engineers or scientists who have studied abroad returned to their home countries to pursue promising opportunities. There is evidence to suggest that mobility of foreign educated experts or scientists has played a crucial role in development of capabilities in South Korean and Taiwanese firms. In these countries, talented immigrants who have studied and worked in the US increasingly reversed the “brain drain”, which proved critical in shifting these countries from a peripheral source of cheap labour to global leadership in IT production. In extensive analysis of the “Asian miracle”, the World Bank (1993) emphasises that return of foreign educated nationals has provided significant transfer of best practices and state of the art knowledge to South Korean and Taiwanese semi-conductor firms. Saxenian (2002) argues that government policies and firms’ strategies played a key role in “reversing brain drain”. The examples of South Korea and Taiwan show that immigrant entrepreneurs, and their communities’ experience and networks, can accelerate the process of learning about new sources of skill, technology and capability in home countries.

However among those countries that have witnessed their best and brightest students move to US, China and India have only recently started benefiting from “reverse brain drain”. The Indian case is quite distinctive as over the decades, the pursuit of better academic and economic opportunities has resulted in massive “brain drain”, mostly in the form of migration of scientists and engineers from elite Indian engineering and scientific institutes to technologically advanced countries like the UK and USA. In the 1970s and 1980s, Indians were second only to Taiwanese as recipients of US PhDs in engineering and science. These emigrants have often achieved impressive professional and economic success abroad. Saxenian (2002) shows that in 1998 Indian engineers were running more than 775 technology companies in California’s Silicon Valley that accounted for $3.6 billion in sales and 16,600 jobs. Similarly, according to the American Association of Indian Pharmaceutical Scientists’ (AAiPS), around 15 – 20 % scientists working in US pharmaceutical R&D had Indian origin. Realising the potential of its diaspora, the

Indian government recently launched initiatives to motivate this strong resource to play a more active role in economic development.

However at firm level the process of attracting non-resident Indian managers, engineers and scientists began with the opening of the economy from the beginning of the 1990s. The emergence of industrial success stories, like IT and pharmaceuticals, has changed the perceptions of Indian diaspora towards India and resulted in gradual movement of non-resident Indians back to India. According to the Nasscom 2003 report, nearly 35,000 IT professionals (a little under 10% of the total Indian IT workforce in the US) have returned since 2001. Similarly, Kale (2004) found that in the case of innovative Indian pharmaceutical firms, Indian scientists who studied or worked overseas form an important constituent in firm strategies aimed at developing competencies in innovative R&D. Firms are mainly trying to fill the knowledge gaps by hiring Indian scientists based in US/UK who work in the R&D laboratories of major pharmaceutical firms. However, Indian firms are realising that bringing in scientists is not enough; their knowledge must also be assimilated and made useful. This paper discusses issues that shape and affect the relationship between newly hired experts and firms, and shows the response of the Indian firms to facilitate effective diffusion of knowledge through migration of scientific labour.

The Indian pharmaceutical industry is chosen for the study as this sector represents an appropriate arena to study international technology transfer and the role of human mobility.

The remainder of the paper is organised in the following way. Section 2 briefly reviews the literature on transfer of knowledge through human mobility. Section 3 provides a brief background to the Indian pharmaceutical industry, noting the main features of the emerging phenomenon of scientists returning to work in Indian pharmaceutical firms. Section 4 presents the case studies of five established Indian firms and their R&D strategies and Section 5 discusses the major issues affecting effective transfer of knowledge faced by Indian firms and returning scientists. Section 6 concludes the paper.

2. Literature review

The experience of leading firms from developed countries and also newly industrialising countries shows that human mobility within or across firms has played a very important role in transferring knowledge and knowledge building capabilities (Ettie, 1980; Leonard-Barton, 1995). Few organisations generate internally all the knowledge required for continuous technological development. Firms therefore, often turn to external sources such as suppliers, buyers, universities, consultants, and competitors. However, given the tacit and complex nature of most valuable knowledge, its acquisition can be difficult (Kogut and Zander, 1992). A significant portion of knowledge that organisations seek to acquire is embedded in individuals. When these individuals move between organisations, they can apply this knowledge to new contexts, thereby effectively transferring knowledge across firms (Argote and Ingram, 2000). Thus human mobility can play an important role in the knowledge building processes of hiring firms, especially where knowledge tends to be "sticky" and remains localised within firms, regions and countries (Szulanski, 1996). Song et al., (2003) suggest that human mobility served as a crucial mechanism for the acquisition of knowledge for newly industrialising countries firms. In his case study investigating Samsung's entry into the semi-conductor industry, Kim (1997) cited Samsung's deliberate and successful strategy of hiring Korean scientists and engineers from US firms as a platform for acquisition of knowledge. Kim argued that the mobility of experienced experts can facilitate the transfer of capabilities permitting further knowledge building provided the host firm created the environmental conditions that would permit diffusion of knowledge from experts to other members of the firm.

The extent to which firms can assimilate externally sourced knowledge is determined, in part, by the nature of the knowledge to be sourced (Kogut and Zander, 1992) and by firm's absorptive capacity (Cohen and Levinthal, 1990). Even within-firm, tacit knowledge is "sticky" and does not necessarily flow easily unless the individual possessing the tacit knowledge also move (Szulanski, 1996). If the movement of within-firm tacit knowledge is difficult, its transfer across firms is likely to be even more challenging. Firms use several mechanisms to access external knowledge: like strategic alliances, co-location in technology intensive regions, and foreign direct investment. However these mechanisms have limitations in acquisition of tacit and 'non-codified' knowledge. Therefore the hiring of engineers or scientists can play an important role in acquiring tacit and complex “human embodied” knowledge (Ettie, 1980).

The ability of mobile engineers or scientists to leverage their knowledge bases in new firms may vary substantially depending upon the attributes of both hiring firms and mobile engineers or scientists. As organisations experience success, their routines and products become more standardised, and this may make it more difficult to assimilate external knowledge (Nelson and Winter, 1982). Hence path dependence impedes a firm’s receptivity to external knowledge by reducing motivation and ability to seek, recognise, and assimilate knowledge that differs from current practice. In the case of mobile engineers/scientists, an individual with stronger innovative capabilities is likely to have more knowledge to transfer than one with weaker abilities. The expertise stemming from individual experience is an important source of power. However long years of experience also shapes behavioural practices or processes and builds routines for individuals as well as organisations – which can act as potential barriers to knowledge transfer. In such conditions successful knowledge diffusion requires change and often adjustment from firm and individuals. Therefore for the newly hired expert, effective transfer or diffusion of outside knowledge knowledge within the firm is hard. However, much existing research on human mobility has focused only on investigating the factors influencing mobility, neglecting other core internal firm level factors affecting knowledge diffusion. So, the fundamental issue is to identify the challenges and conditions under which human mobility is most likely to result in knowledge transfer or diffusion of knowledge. Some researchers like Song et al (2003), suggest that mobility is more likely to result in inter-firm knowledge transfer when hired and hiring firms possess different technological expertise, and when the hired engineers work in non-core technological areas in their new firm. However, it is also important to analyse how the knowledge possessed by these hired scientists is socialised at an organisational level. These important behavioural issues remain unattended in studies of human mobility and diffusion of knowledge. Therefore, as Argote and Ingram (2000) suggest, further research is needed to assess and understand how people transfer knowledge.
Thus, in spite of the voluminous literature on international transfer of technology, the challenges involved in knowledge acquisition or transfer through cross border human mobility has received surprisingly little formal attention or rigorous analysis.

3. The Indian Pharmaceutical industry

Indian pharmaceutical firms’ approaches to developing competencies in innovative R&D as a response to Trade Related Intellectual Property (TRIPS) laws provides the ideal setting to explore issues involved in acquisition of knowledge through human migration. The TRIPS agreement severely affects the pharmaceutical industries in developing countries like India, which have grown on the basis of weak patent laws through its requirement of strong patent laws. To survive in an era of strong patents, Indian pharmaceutical firms must develop competencies in innovative R&D. Kale (2004) found that Indian pharmaceutical firms are filling knowledge gaps in innovative R&D by hiring US-based Indian scientists, who have experience of innovative research in multinational pharmaceutical firm R&D. These scientists are not only valuable source of knowledge but also provide firms with entry into technology networks in advanced countries.

Some Indian firms are using links with Indian universities and institutes to identify and attract scientists, specifically experienced post-doctorate and recent PhDs. An ex-R&D president of DRL explains:

> “the mentors of post-docs were known to me, known to some of us, they were also valuable and it was relatively easy. But to attract somebody who worked in a MNC in US was difficult and is indeed still difficult today”.

He further explains issues that creates barriers in attracting senior scientists based in overseas MNC firms:

> “people who have settled jobs in big multinationals must have stayed there more than 8-10 years. They are used to the American style of living and enjoy all the major benefits of a multinational work culture, scientific environment, physical comfort and attractive salaries. For them to leave all that and come with kids can be a problem because if kids were born there and are going to those schools it will be major displacement for them to return. Also their spouse is also working there, all these factors add up”.

Senior scientists who have returned from overseas point out their main concerns regarding returning back to India and working in the Indian firms. The Chief Scientific Officer of NPIL describes some of the concerns,

> "There were 2-3 main concerns; one, working for an [Indian] family owned company is very different than working for a company in the US, mostly a public company. So that certainly was a concern; I had a friend who was working here in a company in India and he had disagreements with the chairman and was fired the next day. So I had heard those kinds of stories. The other concern was whether drug discovery research could really be done in India. First, I have already alluded to you earlier how quickly can you change direction and implement your ideas and how quickly can you execute them - because pharmaceutical R&D is very competitive and medical knowledge changes and based on that you may have to stop what you have been doing for 2 or 4 years and quickly take a left turn or right turn, whatever is necessary. I was very concerned about the hierarchical system that I knew existed in India. Then of course the man-power; how well trained would scientists here be in terms of drug discovery".

Thus, Indian firms attracting and retaining senior scientists from overseas face an enormous challenge. Indian firms are trying to achieve that by giving independent charge of drug discovery projects to returning scientists and thus provide opportunities to learn leadership and R&D management skills. The ex-R&D president of DRL explains,

> "They are there at director level, we are giving them leadership positions, we are giving them a position which is going to lead into the management of the organisation, management of the scientific programme, not just running a small lab and all that, supervising few people but they are participating in decision making. Such a thing is not possible there".

However, these efforts from Indian firms are not enough, as the ex-R&D president DRL explain concerning social infrastructure:

"they expect first a good scientific environment, it is very important. The second thing is that their kids get a good education and the third thing is of course salary; combination of these three things. They expect to live decent life, enjoy all the corporate benefits and this is it".

4. Firms under study

The primary data was collected through interviews with scientist working in four innovative Indian pharmaceutical firms. Interviews were conducted with various stake holders within the firm (such as the R&D president and hired scientists), and outside the firm (presidents of Indian pharmaceutical associations, pharmaceutical consultants).

Name of the firm	**Year of establishment**	**Focus Area**
Ranbaxy Laboratories	1962	Generics NDDS NCE
Dr. Reddy's Laboratories Ltd	1984	Speciality generics NCE
Nicholas Piramal (I) ltd	1988	Contract research NCE
Lupin Laboratories Ltd	1968	Herbals Generics NCE

4.1a Ranbaxy laboratories Limited

Ranbaxy, India's largest pharmaceutical firm, is ranked amongst the top ten generic companies in the world. Ranbaxy's initial forays into research and development activities began in the late 1970s.

In the 1990s Ranbaxy gradually began to change focus from process R&D to new initiatives in New drug discovery research (NDDR) and NDDS. In 1999 Ranbaxy registered its first success in innovative R&D with the development of once-a-day dosage for the Ciprofloxacin molecule.

Despite having a few molecules in clinical and preclinical trial stages, Ranbaxy reached a critical stage by 2002 as the bulk of its R&D was still in generics. Ranbaxy needed more scientists with experience in state of the art drug discovery technologies. To fill those knowledge gaps Ranbaxy started hiring Indian scientists based in US/Europe, working with multinational R&D laboratories.

Ranbaxy's R&D size and infrastructure and success of Ciprofloxacin helped the company in its efforts to encourage 'reverse brain drain'. In 2003, Ranbaxy hired Dr. Rashmi Barbhaiya, who was vice president of drug discovery in Bristol Mayer Squib (BMS) as its R&D President. He was closely involved in many contemporary drug discovery technologies in BMS. After Dr. Bharbhaiya, Ranbaxy hired Dr. Batra from Schering Plough Research Institute in the US, as a new Vice-President, Pharmaceutical Development to lead the development of new chemical entities and new drug delivery research.

In 2003, under the leadership of Dr. Bharbhaiya, Ranbaxy took some key decisions regarding its future R&D direction. In 2004 Dr. Rajinder Kumar, previously global head of clinical psychiatry R&D at GlaxoSmithKline (GSK), took charge of Ranbaxy's R&D with responsibility of accelerating company's drug discovery effort. However Ranbaxy faced difficulties in retaining returned scientists as Dr. Bharbhaiya left the company after 3 years and Dr. Rajinder after 11 months. An ex-R&D President of Ranbaxy explains,

> "first, the people they brought in were specialised in one subject. R&D consists of multiple disciplines and one should bring men who understand almost every discipline. One person came here with pharmacokinetics background. Pharmacokinetics is not even 1% activity of total R&D, and other thing he has never done generic R&D in his life so there was a total vacuum. Another man came with clinical research background. But Ranbaxy hardly does clinical only may be they have one compound. So it was a mismatch actually".

4.2b Dr. Reddy's Laboratories Ltd

Dr. Reddy's Laboratory (DRL) has emerged as the first Indian pharmaceutical company to discover a new chemical entity and license it to a MNC pharmaceutical firm. In the last decade it has consistently ranked amongst the top ten pharmaceutical firms in India. Recognising the importance of innovative basic research in post-2005 India, DRL built the Dr. Reddy's Research Foundation (DRF) in 1992. DRF is exclusively dedicated to research in the area of new drug discovery and became the first organisation in the Indian pharmaceutical private sector to take up basic research.

Within three years of starting innovative research DRF discovered one of the most potent glitazones, Ragagltizar. Soon, DRF began evaluating its R&D capabilities and started hiring scientists to fill knowledge gaps.

DRF focused on hiring fresh scientists to work in drug discovery R&D and so identified Indian students studying abroad on doctoral and post doctoral courses as a main source of talent. DRF's former R&D president elaborates recruitment strategy adopted by the firm:

> "We accelerated our plans to do drug discovery research and at that time we certainly wanted to recruit top-notch talent. Fortunately there was no competition in India. Nobody else was looking for scientists for drug discovery. It was relatively easy for us to attract the talent given the world class infrastructure we created. Every scientist returning from US was visiting us or corresponding with us asking about our plans. So we recruited really top notch talent".

After establishing discovery research in Hyderabad, DRF wanted to introduce modern skills such as drug discovery based on genomics and proteomics. It wanted to move from analogue research towards target based discovery or rational drug design but struggled with this change. The former R&D president described the situation:

> "we could not recruit the requisite skills because it's not the one scientist, you need a whole team and we could not do this quickly. We located scientists, 1 or 2 may be willing to come out, but they had inhibitions and they needed lot of time and they were unable to take decisions. Then we decided there is no point in waiting. We cannot bring people here; we will move our lab there".

Therefore in 2000, DRF set up a lab in Atlanta, US dedicated to discovery and design of novel therapeutics. The lab is called Reddy US Therapeutics Inc (RUSTI) and its primary aim is to conduct drug discovery for next generation drugs using molecular genomics and proteomics approaches. DRL recruited Dr. Uday Saxena as CSO of its Atlanta subsidiary and within two months RUSTI built a team of 12 scientists.

4.3c Nicholas Piramal (I) Ltd

In 2003 Nicholas Piramal India Limited (NPIL) emerged as the 4th largest Indian pharmaceutical firm with 4.4 % market share. NPIL is part of the Piramal Enterprises, one of the India's largest diversified business groups.

Innovative R&D forms an important constituent of NPIL post-2005 strategy. It is based on the idea of developing product patented molecules to Phase II and then licensing them to multinational firms. With this aim, in 1998 NPIL forayed into innovative R&D by acquiring the research centre of Hoechst Marion Russell located in Mumbai, India.

In 2002 NPIL hired Dr. Somesh Sharma as Chief Scientific Officer to lead its innovative R&D effort. He was the Vice President of the Monoclonal Antibody and Vaccine Unit at Anosys Inc, US. Dr. Sharma was in the USA from 1967 where he obtained a Doctorate in Pathology from the University of Maryland's School of Medicine. He has co-founded companies like Anergen, Wizard Laboratories, S2 Pharmaceuticals and Calyx Therapeutics.

In 2004 NPIL hired Dr. Maneesh Nerurkar from Merck as head of formulations and new drug delivery systems to strengthen company's new drug delivery efforts. In NPIL, between 20-25% of scientists have experience of working abroad.
In 2005 NPIL opened a state-of-the-art R&D laboratory totally dedicated to the development of innovative pharmaceutical R&D.

4.4d Lupin Laboratories Ltd

Lupin is a dominant leader in the anti-TB segment in the Indian domestic market with 42% market share in 2003.. Lupin exports to more than 50 countries and 41% of Lupin's sales in 2003 came from exports; although mainly in the form of bulk drugs or active pharmaceutical ingredients to semi-regulated markets.

In 2001 Lupin decided to engage in innovative R&D and built a state of the art R&D laboratory in Pune, India. Lupin is a new entrant to innovative pharmaceutical research which is reflected in small but increasing R&D intensity. Lupin hired Dr. Himadri Sen as Executive Vice-President of Pharmaceutical R&D and Dr. Sudershan Arora as Executive Vice-President, to lead the company's effort in innovative R&D. In Ranbaxy Dr. Sen had been in charge in NDDS (new drug delivery research) while Dr. Arora was in-charge of new chemical entity research.

Lupin has adopted a different strategy for hiring scientists; rather than going abroad and scouting talent, firm is focusing on hiring talent already returned to India to work in other Indian firms. Lupin's R&D vice presidents for new drug delivery systems and new chemical entities are returnees but first they joined other Indian firm and then Lupin.

The hiring of these scientists proved successful in building the core team with expertise in drug discovery as other scientists working with them in Ranbaxy also joined Lupin.

5. Discussion and Analysis

The research has revealed important insights regarding issues affecting the diffusion of knowledge through the migration of scientific labour in India.

A. There are major generational differences in return migration; one returning group is at post-doc level and other group comprises senior scientists who are close to retirement age.

Return migration is happening at two levels; at senior scientist and post-doctorate levels. This two-level migration has implications for firm strategy as each group has different requirements and expectations from firms. At the post-doctorate level a scientist is mainly concerned about learning new skills and finds it comparatively easy to be assimilated in the firm. At senior scientist level concerns were focused on the long term future of firm and the role a scientist can play in creating that future. An ex-R&D president of DRL explains that for senior scientists important issues concern the long-term commitment of the firm to innovative R&D,

> “the guy who has worked there for 10 years in a MNC and is a US citizen, things like long term growth plan of firm and other things matters. But for post-docs who were only abroad for 3-4 years; they have advanced skills, are enthusiastic and energetic. For them immediate landing in a research position is more important than long term things. It is important for them that the first five years go well for them because there are so many R&D centres they can switch job to after that”.

B. Relation between technology and people in pharma is not like software

In software, people can be more hands off and can manage work by travelling between India and US but that is not really possible in the case of pharmaceutical R&D. Many Indians working in Silicon Valley contributed to the growth and knowledge of the Indian software industry by setting up units in India whilst working in the US. They were based in the US but could utilise Indian skill sets and thus contribute towards the development of Indian industry. In the case of pharmaceutics, scientists working overseas cannot operate hands-off. The nature of technology and work requires relocation.

C. There is a mismatch between requirements of Indian firms and skillsets offered by returning scientists

Indian firms are still new to innovative pharmaceutical R&D. Thus they require scientists who have knowledge in all pharmaceutical R&D areas whereas returning scientists are mainly specialists. Thus a mismatch between the requirements of firms and scientists skills has emerged as a main issue in effective diffusion of knowledge in Indian firms. R&D president of an Indian firm elaborates on differences in skill sets:

> “we are seeing a significant number of people who are interested to come back to India. They are coming. But if you look at a person who is working in a Glaxo or Pfizer, the typical applicability of that type of talent to India is not exactly correct. There is mismatch because they work in highly specialised subjects and specialised departments in places like Glaxo. So the guy who is doing specific molecular biology work, even within molecular biology he will be doing only one type of cell line. But that type of specialisation at this early level is bad for

> Indian companies. So they are picking up people from post-doc level rather than senior. In a Glaxo, doing something at 10-15 million dollars is nothing. In a typical Indian company they will try to complete entire project in 15 million dollars. Skill sets from start-up biopharmaceuticals companies may be much better suited to India rather than people from the big companies.”.

D. There are differences in working culture in Indian firms and western firms

Indian firms are family owned businesses and have mainly grown on the basis of reverse engineering R&D capabilities. The R&D intensity of Indian firms has grown steadily in the last 10 years but is still less than multinational firms. R&D investments in real terms are a lot less and scientists who have worked overseas in senior positions for many years find difficulties in adjusting to budget.

According to one of the returned scientists:

> “Over here the mentality has to change big time because people are still with old mentality and especially for people like us who are young, we have very different mindset. I think we have to try really hard to change that. So unless and until we have a group of people of our age who go up to much higher positions, it is very difficult to change the mentality”

E. Motivation of returning scientists specifically those coming back at postdoctoral level

Scientists returning at post-doc level view working in an Indian firm as a good opportunity to learn leadership and management skills. Indian firms are offering returning post-doc scientists positions in middle management, allowing them to gain experience of managing and leading projects.

Finally, the research also shows the importance of social infrastructure on the decision-making of US based Indian scientists to return, suggesting that there is an important role for government policy in providing and establishing adequate physical and social infrastructure.

6. Conclusion

The research has revealed important insights regarding the issues affecting diffusion of knowledge through migration of scientific labour. The analysis of firm level 'assimilation processes' revealed major issues included: generational differences of returnees, differences in working culture of Indian western firms and, importantly, that differences between requirements of Indian firms and skills sets of returnees hampered effective knowledge diffusion. It also shows that Indian firms responded to these issues by adopting global R&D management practices. Findings also suggest that firms require support from government policy in attracting returnees.

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