



Canada-India firm collaboration in health biotechnology

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Abstract

Introduction

Strategic alliances are of critical importance to firms working in the health biotechnology² field. Collaborations can provide firms with significant competitive advantages, shape their economic performance and help minimize risks in development activities (Hagedoorn, 1993). Alliances in the biotechnology sector can be of various types. Biotechnology firms rely on alliances with pharmaceutical firms for successful development and commercialization of lead products. Alliances with universities and government research institutions can be a source of basic knowledge crucial for competing in patent races. Finally, alliances with other biotechnology firms can enable learning with regards to operating and thriving in the health biotechnology sector (Baum et al., 2000). It does not pay to be an island in today's health biotechnology landscape and collaborative arrangements have become dominant strategies by firms to gain innovative product and process ideas.

There has been a dramatic rise in biotechnology collaboration since the end of the last decade. Along with rising partnering in the field, there is also the growing globalization of the biotechnology industry; firms are increasingly aware that successful innovation requires partnerships not only nationally, but also with international players. However, until the early 2000s the propensity to internationalize was mostly by biotechnology firms in developed countries, particularly the triad of the US, Europe and Japan (Buctuanon, 2001). But transformations taking place in the global life sciences sector may prove to be disrupters to this

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² We have broadly defined 'health biotechnology' as "the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services" for human health (OECD, 1998). For the purposes of this study, we examined firms working in the human health field and those involved in areas such as biopharmaceuticals, pharmaceuticals, diagnostics, bioinformatics, regenerative medicine, laboratory services, clinical trials, contract research, natural remedies and nutraceuticals.

trend and collaborations in health biotechnology can increasingly include firms from developing countries³.

In recent years, developing countries such as India, China and Brazil have been investing into their local health biotechnology sector and encouraging growth of domestic firms in this field. They have been able to build substantial capabilities in face of steep barriers to entry (Thorsteinsdóttir et al., 2004; Frew et al., 2007; Rezaie et al., 2008). At the same time, the blockbuster drug development model dominant in North America and Europe is experiencing problems of maturity – including dwindling product pipelines and patent expiration (Chataway et al., 2007; Frantz, 2005). In view of these shifts, one response to promote future innovation in this field may be for northern firms to reach out to southern partners in search of novel technologies as well as to contract out development activities to minimize costs. Playing a larger role in global health biotechnology networks can benefit firms in developing countries to strengthen their own innovation potential (Chataway et al., 2007). Serious transformations are taking place globally in the pharmaceutical industry and as a result, firms in developed and developing countries have to reconsider their roles in the sector.

Although the potential benefits of north-south collaboration in health biotechnology are significant, there is relatively little known about such types of partnerships and how to best encourage them. The aim of this paper is to help fill this gap by presenting results from case study research of Canada-India firm collaboration⁴ in health biotechnology. Velho suggests that for international collaboration to have impact, the collaboration initiative has to be appropriately linked to innovation systems⁵ of both partners' countries (Velho, 2002). In our study, we analyze Canada-India firm collaborations by considering how interactions between various innovation systems actors – for example, universities, research institutions, government agencies, financial institutions – in the two countries influence the partnerships. We examine the reasons for collaborations, the outcomes of collaborations thus far and the roles of the partners. We also consider whether systemic misalignments have been barriers to initiating and sustaining

³ We follow The World Bank's classification of countries and define high income countries as developed countries and low and middle income countries as developing countries. We use the terms 'north' and 'south' to mark socio-economic and political divisions that exist between developed and developing countries. Developed countries are collectively known as the 'north' whereas developing countries are known as the 'south'. The term 'north-south collaboration' refers to partnerships between developed and developing countries.

⁴ Jane Maienschein proposed a definition of 'collaboration' which stresses that it should minimally involve individuals working together toward a common product, and that they have come together in pursuit of a common goal (Maienschein, 1993). For our study, we follow a broad definition of 'collaboration' considering it to be any work jointly undertaken by firms and organizations which contributes to the production of knowledge, products or services in health biotechnology.

⁵ The innovation systems framework is a systemic approach that helps in the understanding of complex factors and conditions that shape technological innovation. Innovation systems are made up of institutions – including firms, universities, research institutions, financial institutions, government agencies – that are held together by a web of linkages and synergies, and contribute to the creation, diffusion and use of new, economically useful knowledge. Firms at the core of innovation systems; they integrate various types of knowledge to be able to develop new products or processes. Knowledge creation, diffusion and use are integral to innovation systems and the process involves nonlinear, multidirectional knowledge flows among the various actors. The behaviour of an innovating agent is influenced by a range of influences which include cultural and social norms, regulations, technical standards, etc (Edquist, 1997).

collaboration between Canadian and Indian firms. Our research on the characteristics of existing Canada-India health biotechnology firm collaborations and the factors that influence these partnerships can help inform policy options aimed at further encouraging collaborations in this area.

We chose to study health biotechnology collaboration between Canada and India because the two countries have expressed interest in partnering with each other in such high technology fields (DFAIT, 2005). Also, they may have complementary assets that can encourage their collaboration. Researchers note that international technological collaboration may derive from the complementarities of knowledge and capabilities embedded in firms due to differences in their national contexts (Bartholomew, 1997). Canada is one of the leading countries in the health biotechnology field. As of 2003, Canadian health biotechnology firms had more than 10,000 products and processes in the development pipeline and the country consistently ranks high in terms of the number of scientific papers published in this field (van Beuzekom et al, 2006; Thorsteinsdóttir et al., 2006). Although Canada is knowledge-rich in this field, its commercialization record is weak. Only 10 firms account for 70% of the market capitalization of all Canadian biotechnology firms (Ernst & Young, 2004). Despite Canada having a comparable number of firms, equivalent capital investment, similar number of patents and greater number of products in the approval pipeline than the UK, its European peer makes double the amount of revenues (van Beuzekom et al, 2006; Raoub, 2005). Also, the majority of Canadian health biotechnology firms are small and have to rely on foreign partners to help them take their most promising projects forward (Niosi, 2003). In face of these challenges, analysts suggest that looking to global partners and global markets, including large, emerging economies such as India, may be an opportunity by which Canadian firms can sustain their innovation capacities and increase revenues (Dufour, 2002; Munn-Venn et al., 2005; Rao, 2008). In contrast to the scenario in Canada, India has a strong domestic pharmaceutical industry with capacity in generics and process innovation. Successful generics sales in India and abroad have enabled Indian pharmaceutical firms to grow rapidly and some of these firms are looking to compete with western multinationals (Chataway et al., 2007). India's accession to the World Trade Organization's (WTO) agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) in 2005 has triggered Indian firms to improve their capacities in discovery research and some are venturing into health biotechnology as a growth strategy. However, India's product pipeline when considering novel health biotechnology products is still very young and India has yet to develop a new to the world innovation in this field. To fulfill their global aspirations, Indian firms may benefit from alliances with knowledgeable partners, such as Canada, to enhance their expertise in the health biotechnology field. Thus, the strengths and weaknesses of the Canadian and Indian health biotechnology private sectors may position them well for mutually beneficial collaboration.

Both the Canadian and Indian governments have taken steps to forge stronger bilateral cooperation in science and technology (S&T) fields (DFAIT, 2005; ISTPCanada), but they are still looking for ways by which to strengthen their ties. In our study, we analyze existing Canada-India health biotechnology firm collaborations to learn from their experiences and to elicit information regarding their potential, thus gaining a greater understanding on how to further promote successful collaborations.

Methods

To gain an in-depth understanding of Canada-India firm collaboration in health biotechnology, we carried out qualitative case study research on actual collaboration initiatives between firms in the two countries. Interactions are difficult to examine and a promising strategy is to rely on insights from those who are involved in collaborations. We conducted semi-structured interviews with representatives from the firms in Canada and in India and asked them about their experiences of working together. These collaborations were identified from results of a survey exercise our team previously conducted where we asked Canadian health biotechnology firms about their collaborations with low and middle income countries. Input from the Canadian Department of Foreign Affairs and International Trade (DFAIT) also enabled us to identify Canada-India health biotechnology firm collaborations. We chose seven Canada-India firm collaborations to study in depth. We selected collaborations across a range of activities - R&D, clinical trials, manufacturing, distribution, contract research - in order to allow for an analysis of the diverse types of collaboration and collaboration strategies. We interviewed both Canadian and the Indian firm partners involved in the collaborations. Interviewees were CEOs, Heads of R&D or Heads of Business Development in the firms.

We also conducted interviews with key informants from relevant government agencies in Canada and India that play a part in supporting international S&T collaboration. These included ministries of trade, funding agencies, regulatory agencies, venture capital firms, biotechnology industry associations and intellectual property experts. Knowledgeable individuals at these agencies were identified through website searches and 'snowball' sampling. We interviewed thirteen institutional actors in Canada and nine institutional actors in India. By analyzing Canada-India firm collaboration from an innovation systems perspective we are able to examine these partnerships in terms of the wider linkages that support them.

We supplement this discussion of the Canada-India case study research with our findings from the survey we conducted of Canadian health biotechnology firms. We also include data from a survey our team conducted of health biotechnology firms in India about their north-south collaborations. A range of reports and policy documents were consulted, including published papers and books on different aspects of the Canadian and Indian health biotechnology sectors, government reports and other government documentation (for example, policy briefs and descriptions of legal and regulatory arrangements), as well as websites of firms.

Results

Motivations propelling Canada-India firm collaboration in health biotechnology

Our interview data reveals that Canada-India health biotechnology firm collaborations are driven by a complex mix of reasons including access to markets, novel technologies, cost-effective development and financing. In many cases there are several reasons motivating the initiation of a single collaboration initiative.

Access to markets was emphasized by interviewees as a driving force for Canada-India firm collaborations. Canadian firms express interest in not only the Indian market with its large

population and increasing spending power, but they also view India as the entry point into the wider south and south-east Asian market. We learned of a small Canadian biotechnology firm which entered into a partnership with an Indian pharmaceutical firm with the purpose of utilizing its distribution channels in India and in seven additional neighbouring Asian countries. On the other hand, Indian firms express interest in the Canadian market, but they are also keen to access lucrative opportunities present just south of the Canadian border in the US – the world's largest pharmaceutical market (Business Wire, 2006). Indian firms consider Canada to be a cost-effective launch pad for their health products in the US. We noted Indian pharmaceutical firms contracting Canadian clinical trial organizations that have subsidiaries in the US or are knowledgeable about US regulatory affairs in order to help file their products with the US FDA. Thus, collaborative arrangements with strategic partners enable Canadian and Indian firms to gain entry into desired markets. Firms in both countries are not only interested in the potentials that lie in each other's markets, but also those in the countries neighbouring their partners.

Indian firms also seek collaborations with Canadian firms and organizations because they view their institutions to be better aligned to new to the world innovation than their own. As relative newcomers to the health biotechnology field, Indian firms rely on Canadian institutions, which have over the decades built internationally reputable governance standards, to confer their work with greater legitimacy. For example, it is the good governance and transparency of Health Canada, the Canadian regulatory system, which makes Indian firms trust it more so than the still-maturing Indian regulatory agency. As a result, some Indian firms are noted to run their health products' trials in Canada even though, as one Canadian interviewee speculates, they already have local clinical data on their products.

Motives related to the advancement of knowledge and technology drive Canadian and Indian firms to collaborate. Canadian firms are interested in working with Indian partners who have expertise in highly specialized fields such as bioinformatics. For example, Canadian firms requiring laboratory information management solutions can turn to Indian firms that offer software tools specifically tailored to meet their research goals. Canadian firms also look to Indian partners for novel technologies. One Canadian health biotechnology firm acquired an early therapeutic candidate from an Indian public research institution and went on to successfully take it through further development and early phase clinical trials. Technology transfer is seen to occur both ways. Our Indian firm interviewees consider research conducted in Canadian laboratories to be of world class caliber. We observed an Indian firm in-license vaccine technology developed by scientists at a Canadian public research institution to further develop in their own laboratories. Several Indian interviewees suggest that Indian pharmaceutical firms, which are looking to expand their product portfolios, are now coming from a relatively strong financial position and can afford to license cutting-edge technologies from abroad. When they expand their product portfolios, they consider nascent technologies in small Canadian firms and research laboratories to be great candidates. Thus, Canadian and Indian firms seek collaborations with each other to access complementary expertise as well as novel technologies with which they can successfully compete in the industry.

Canadian and Indian firms collaborate with each other to minimize their product development costs. Facing the threat of recession (IMF, 2008) and a five-fold increase in drug development costs since the 1980s (Chataway et al., 2007), firms in developed countries are being forced to

look abroad for cost-effective options. In our research, we observed Canadian contract research organizations consider setting up their own research units in India. We came across examples of Canadian firms having established subsidiaries to carry out research and development (R&D) as well as manufacturing activities in India. Indian firms are also looking for ways to reduce expenses from their drug development initiatives. Aiming to target lucrative markets such as the US, and to take advantage of the experienced regulatory frameworks in developed countries, Indian firms turn to clinical trial organizations (CTOs) in developed countries. However, they look for cost-effective alternatives within developed countries to run clinical trials of their products. Canadian clinical trial organizations are a good partnering choice, not only because of their experience with the US regulatory environment as was discussed earlier, but also because the Canadian publicly funded universal healthcare system absorbs some of the costs of conducting clinical trials. The Canadian-US dollar exchange rate can also be of benefit to Indian firms contracting Canadian firms when the Canadian dollar is weaker against the US currency.

The development of health biotechnology products is an expensive venture requiring sustained financing over lengthy periods of time. Our research shows that Canadian and Indian partners work together to access financing. We observed a Canadian startup firm approach an Indian pharmaceutical for investment when it faced difficulties obtaining financing from venture capitalists in North America. In exchange for equity stake and joint R&D pacts, the Indian firm invested in the Canadian firm. Although the financial environment has improved in India, there is still a lack of risk capital to support health biotechnology ventures. Smaller Indian firms look to foreign venture capitalists not only for financial investment, but also for managerial expertise. One Indian firm we interviewed secured financing from venture capital in North America and credited having Canadian partners for helping in gaining knowledge about foreign financial sources. It is interesting to note capital flowing from the north to the south and vice versa.

Canadian firms are attractive partners to Indian firms because they are drawn to the strong multicultural aspects of Canada. Several of our interviewees discuss how multicultural the workforce was in Canadian organizations and how well that reflected in their senior management. An Indian firm interviewee, for example, stressed that she was impressed when a high-ranking Canadian government official of Indian descent and with Indian business culture knowledge came to visit her firm to promote Canadian business opportunities. Canadian key informants also note that their diaspora communities are valuable as facilitators of collaboration with emerging economies such as India.

Outcomes of collaboration

Although Canada-India firm collaborations in the health biotechnology field are relatively young, with the majority of them being initiated in the early 2000s, some have already led to positive outcomes for both parties.

Economic gain is the key marker by which firms judge the success of a collaboration initiative. We noted Canada-India firm collaborations lead to a number of impacts – expansion of services, income generation, job creation - that further the economic interests of the partners. For example, in a case where an Indian firm acquired a Canadian firm, the two parties were able to combine their assets - research experience of the Canadian firm with the cost advantages of the Indian

firm – and thus expand the array of services they could provide clients. This increased their client base as well as their income. Canada-India firm collaboration can result in job creation in both countries. For example, equity investment by an Indian firm into a financially struggling Canadian startup kept the firm alive and retained jobs of its employees. In another case, a Canadian firm which set up R&D and manufacturing bases in India has been successful in creating jobs there as its subsidiaries are entirely staffed with local Indian scientists. Thus, our research reveals that collaborations between Canadian and Indian firms in health biotechnology have the potential to result in economic benefits for the partners.

Another major outcome of Canada-India firm collaboration in the health biotechnology field is that the initial business relationships provide firms with a springboard to explore further business and growth opportunities. Successful collaborations can confer foreign firms greater ties to their partner's local business community from where further partnerships may be formed. We note cases where Canadian and Indian firms are exploring opportunities with additional partners in each other's countries after forming their first alliances. Often these further linkages are facilitated by the initial local partner. Collaborations can also enable firms to gain greater perspective of their niche and thus enable them to strategically position themselves in the context of the global life sciences sector. This is best illustrated by the example of a Canadian custom manufacturing firm that was acquired by an Indian pharmaceutical firm. Through this arrangement, they are able to provide North American clients with access to both the specialized expertise and project oversight of the Canadian arm, as well as the cost advantages provided by the Indian partner. The Canadian firm is now in a position where it can link clients, mostly North American biotechnology startups, with the manufacturing and distribution capabilities of its Indian parent or the parent's multinational firm partners, thus helping to take promising leads further along the product development route.

Roles of partners

In our research, we observed the Canadian and Indian firms to be playing various roles in their collaborations. One on hand Indian firms are service providers to Canadian firms. On the other hand, they play the role of financier to Canadian firms. Indian partners are able to provide Canadian firms with cost-effective services in specialized fields, clinical trials, manufacturing and R&D activities. Indian firms are noted to leverage strengths in software and information technologies to provide bioinformatics services to Canadian firms. Large, drug naïve patient populations in India make it a lucrative location to conduct clinical trials (Padma, 2005) and we note Indian and Canadian partners seeking collaborations to take advantage of this. Finally, in harnessing the capabilities of India's large, skilled, English-speaking labour force, Canadian firms are able to conduct manufacturing and R&D projects in a speedier manner as well as complete a more expansive workload.

While service activities are crucial in earning revenues, it is limited in enabling Indian firms to gain intellectual property or patents. The financial environment in India – both in the context of the Indian pharmaceuticals as well as the Indian S&T funding agencies – have increased in a dramatic way in recent times (Chataway et al., 2007; Singh, 2006). So disparity in financial circumstances is not viewed as a major hindrance in pursuing collaborations with northern partners such as Canada. Indian interviewees express that their main expectation of collaboration

with Canada now is the opportunity to work with and learn from partners they consider to be knowledgeable, fair and trustworthy. If financial investment will buy them entry into such partnerships, then it is a worthwhile expense for them. Indeed, we noted one Indian pharmaceutical firm having significant, extensive and long-term investment into several Canadian firms and organizations. However, our interviewee at the Indian firm expressed that their future goal in partnering with Canadian firms is to be able to throw in their intellectual weight in the collaborations.

Our case study research reveals that Canadian firms have a strong role as knowledge providers in their collaborations with Indian firms. The majority of our Indian firm interviewees cite Canadian technological expertise as a being the main reason for wanting to collaborate with Canadian firms. In addition to valuing Canadian firms for their technological expertise, Indian firms also respect Canadian firm executives and consider them to be experienced business managers. For example, we observed an Indian pharmaceutical firm, after it acquired a Canadian firm, recognizing the management expertise of the Canadian firm to the extent that now the Canadian manager not only continues to manage the Canadian arm, but is also in charge of overseeing operations at the Indian sister unit. The Indian firm encourages leadership from the Canadian side because it hopes to gain from Canadian managerial expertise.

Barriers to collaboration

Lack of bridges

In our research, we detected that although the health biotechnology sectors in Canada and India are beginning to wake up to the potentials that lie in working with each other, they still experience a lack of awareness regarding one another's capacities and strengths. This prevents them from finding a suitable partner. We have identified a number of systemic obstacles in Canada and in India that have contributed to this lack of strategic intelligence on both sides.

Political relations between Canada and India have gone through periods of ebb and flow in the past, and the periods of strain have had a negative spillover effect on activities between the two countries in many areas, including diplomacy, trade and S&T. Scientific ties between Canada and India received a blow when India tested nuclear explosive using plutonium from a research reactor donated by Canada in 1974, and then again when India tested nuclear devices during the late 1990s (Parent et al., 2003). It has only been since the early 2000s that Canada started taking steps to renew its relationship with India. Thus, concerted efforts to re-invigorate Canada-India relations at the diplomatic level on which economic and S&T partnerships can be built are still in their infancy.

Canadian and Indian firms are not on each other's radar at this time because both countries' health biotechnology sectors have prioritized collaborations with other more traditional, 'natural' partners thus far. Based on survey results we conducted of Indian health biotechnology firms about their northern partners, India's international collaborations in this field are by far the strongest with the US, which has the most successful biotechnology sector in the world (Buctuanon, 2001). Their second strongest ties are with the UK. As India is a former British colony, its scientists have had a long history of education-related ties with the UK and this

influence may have carried over in high technology fields such as health biotechnology. On the other hand, the Canadian biotechnology sector has primarily focused on forming alliances with its largest trading partner in the South, the US (Traore, 2001; WTO, 2007). As a result of these previous ties based on strong historical and trade legacies, neither Canada nor India have emphasized looking for novel international collaborators. However, our interviewees recognize that global economic dynamics are dramatically changing with rapidly growing emerging economies presenting developed countries with what could be the “shock of the future.” Thus, the onus is on Canada to catch India’s attention.

Dufour argues that countries that intend to compete successfully in today’s knowledge-based global economy have to link their ‘international’ trade policy with their ‘domestic’ science policy and develop them in a synergistic or “intermestic” manner (Dufour, 2002). Currently, there is a lack of synchrony with regards to the Canadian government’s policy approach to India; although India is deemed to be a priority market by the Canadian Department of Foreign Affairs and International Trade, there is little mention by the Canadian National Science Strategy of India as being a serious partner for Canada in high technology areas (Singer, 2007). Such lack of policy coherence inhibits Canada’s role as a serious partner to India.

Vying for India’s attention against its peers is a challenge Canada faces when trying to build S&T linkages with India. India is now being viewed as a “hot partner” and being aggressively courted by delegations from several developed countries to be their preferred partner in S&T fields. Countries such as Germany, France, UK and the US, which already have had decades’ worth of collaboration experiences with India, are continuing to renew and deepen their bilateral partnership with India. Relative newcomers such as Australia are also committing significant resources to foster collaboration with the Asian giant. In comparison to their ambitious initiatives, Canada’s efforts to partner with India are viewed to be meager, foot-dragging and disorganized. Several Canadian interviewees worry that current federal initiatives to encourage Canada-India collaboration in high technology fields are not enough to convey a sense of seriousness towards working with India. Despite Canada’s strengths in health biotechnology, its highly regarded national institutions and its being able to benefit from diaspora communities that can act as facilitators of Canada-India relations, there is a danger that Canada will be upstaged by its more aggressive competitors in its efforts to win India’s favour.

Lack of an appropriate brokerage service may be a barrier to Canada-India firm collaboration in health biotechnology. At this time Canadian and Indian government agencies such as trade commissioners are involved in helping to initiate partnerships. However, while they are crucial in raising the awareness and profile of their country’s firms internationally, the trade commissioner’s role may not be specialized enough to provide the due diligence necessary for firms working in the health biotechnology field - particularly the smaller firms with resource constraints - to make partnership deals.

Lack of regulatory ties

Canada-India collaboration in health biotechnology may be hindered by a lack of collaboration between the two countries’ national drug regulatory systems. In our research, we note that in cases of successful collaboration, partnering firms in the two countries try to exchange and share

operations in a seamless fashion; different stages of laboratory tests, manufacturing activities, clinical trials may be shipped back and forth to be conducted in one partner firm's site or the other's to take full advantage of the best of both worlds. However, drugs are among the most tightly regulated consumer products and, understandably, national regulatory systems tend to be reluctant to surrender their historic control over drug approval (Vogel, 2002). To comply with different regulatory systems can be a challenge for drug development of firms that collaborate internationally and have dissimilar components of the drug development process in the different countries. Mutual recognition in the drug regulation process and/or increased harmonization is called for in order to simplify the regulatory process and lower the development cost without compromising safety assurances in any way.

Discussion

Our research reveals that Canadian and Indian firms are driven by similar types of motivations to seek collaborations with each other. This reflects that Indian firms have matured in a short period of time and are partnering with Canadian firms as peers. Canada-India partnerships in the health biotechnology are young and not marked by any form of path dependence. Thus, the relationships can take on any form and there is a sense of excitement from both sides regarding this. The collaborations we examined are diverse and we observe firms from both sides often entering into numerous partnership arrangements.

Canada-India health biotechnology firm collaborations are characterized by knowledge and capital flows that run both ways. It is interesting to observe significant level of financial investment flowing from a developing country to a developed one. We note greater knowledge flows from Canadian firms to Indian firms. Despite the knowledge flows, we have not come across too many cases where Canadian and Indian firms are working on joint basic research projects. It may be that although India is now compliant with the WTO TRIPS agreement, Canadian firms are still concerned about intellectual property infringement when working with Indian partners. What we are seeing may be a trust building phase where Canadian firms are testing the waters in less risky partnership alliances before embarking on deeper R&D relationships with Indian partners.

We note that even though Canadian firm representatives and policymakers are aware that there are extensive opportunities available for Canadian firms in India, they are having difficulties making the transition from an innovation agenda that is predominantly focused on the US to now include the Asian giant. Canadian key informants feel that although Canada has a number of features – good quality science, diaspora communities, strong public institutions – that could make it an ideal partner to India in fields such as health biotechnology, there is a risk that it will be overshadowed in its efforts to gain India's attention by its more proactive competitors.

Early experiences of fruitful collaboration are attuning the Canadian and Indian health biotechnology sectors to the value of collaborating with each other. But smaller firms on both sides experience difficulties in carrying out the due diligence needed to identify a suitable partner. They express the need for assistance in brokering partnerships. One way to encourage collaboration involving early stage firms or research groups in Canada and India is to consider a joint brokerage services provided by industry experts belonging to the Canadian and Indian

biotechnology industry associations. However, as young ventures tend to need financial assistance, it may be worthwhile to consider involving venture capitalists in both Canada and India in brokering arrangements. Such non-traditional programs may help to set Canada apart from its other developed country rivals.

While it is important to consider ways by which to improve Canada-India firm collaboration in health biotechnology, policymakers also need to think about how these collaborations fit into the wider global life sciences sector. A pattern that is developing is that as drug development costs rise, firms in developed countries are increasingly being forced to outsource activities such as manufacturing, clinical trials and even R&D to developing countries such as India. However, firm executives point out that these savings can be realized only when foreign firms provide appropriate oversight to activities conducted in India, at least while the country's health biotechnology sector is still maturing. Canadian firms, with their long experience in the health biotechnology field, strong reputation and long-enduring links to the industry sectors in the US as well as the EU, are well suited to mediate the interface between firms in developed and developing countries if they are able to strengthen their relationships with firms from emerging economies such as India. If Canada chooses to go this route, it will have to invest more in encouraging science and technology collaboration and start to systematically address barriers that limit its collaborations with developing countries. The global life sciences sector is changing fundamentally, and the Canadian health biotechnology sector needs to consider how to best situate itself, and its collaborations with developing countries may be an important factor in defining that role.

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