Public–private alliances in biotechnology
Can they narrow the knowledge gaps between rich and poor?

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Abstract

In the area of science and technology, the knowledge gap between rich and poor countries is wide and increasing. In the area of biotechnology research, a second gap has recently emerged between private life science companies and public research institutions. As a result, a gap is rapidly widening between cutting-edge research in the developed world and publicly sponsored research being undertaken in the developing world. An obvious strategy for narrowing this gap is to form public–private research alliances. To overcome intervening obstacles, public research institutions in the developing world need to adopt creative new approaches to the process of negotiating with their potential private partners. These approaches must focus on leveraging the complementarities and potential synergies between their knowledge assets and those of the private sector. Concurrently, institutional arrangements must be set in place that are geared toward managing the risks and dangers of greatest concern to their constituencies. © 2000 Elsevier Science Ltd. All rights reserved.

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Introduction

Currently, the diet of over 800 million people, who live mainly in developing countries, does not contain sufficient macronutrients. Micronutrient deficiencies are even more prevalent. For example, 250 million children are at risk of Vitamin A deficiency, which leads to learning disabilities; and 500,000 of the world’s children are estimated as suffering irreversible blindness from Vitamin A deficiency each year. Encouragingly, biotechnology has already shown that the expression of vitamins can be increased in basic seed oil. In addition to insufficient nutrients, diseases such as malaria, hookworm, sleeping sickness and schistosomiasis plague many tropical country populations. The only sustainable solution to these daunting societal problems is well-balanced economic growth combined with well-designed health safety nets. However, such solutions are not possible without directing, at least to some significant degree, the development of science and technology toward the poorest of the poor in developing countries.

As the rest of the world has learned, the development of technologies resulting from scientific innovation requires a partnership between the public and private sectors; rarely has a technology otherwise had some positive influence on public health, agricultural productivity or environmental quality. The scientific and technological potential of poor countries will not be realised without public and private institutions co-operating and collaborating. The marked imbalance between rich and poor countries in the production of knowledge (Sachs, 1999) will not be corrected by either public or private institutions alone. We cannot get from ‘here’ to ‘there’ without public–private research and development (R&D) collaborations.

In public health, the World Bank, the World Health Organisation and private companies in the pharmaceutical industry have recognised this basic perspective. Recent alliances have been formed between these public and private entities to promote research on affordable drugs for neglected tropical ailments (The Economist, 1999). Legislation is also under consideration in both the United States of America (US) and in Europe that will provide incentives for forming such alliances.

In agricultural biotechnology, mobilising and directing genetic engineering offers great hope for poor countries. This hope has been partially realised in the breeding of hardier plants that are more resistant to drought, salinity (Frommer et al., 1999) and pests. Genetically augmenting the fundamental nutrients in many staple foods may offer even greater hope (Gura, 1999). Unfortunately, activities in public–private agricultural biotechnology that these countries need have been, thus far, largely stymied.

Public–private research experience

Historically, the public sector in the developed world has played a major role in supporting R&D efforts, enhancing the fundamental knowledge base. Since the mid-1970s, however, US federal government expenditures for R&D have not grown in
real terms. In contrast, R&D efforts in the private sector have steadily expanded and over the last decade have exploded in the area of agricultural biotechnology.

These unfolding trends in public versus private sector R&D commitments have been felt most dramatically at US research universities. Developed country governments have held steadfastly to the conviction that basic science is a public good and that much of it should be conducted at research universities. Moreover, over the past decade governments have generally attempted to spare university support from cuts they have inflicted on their own research laboratories (David, 1997). These trends in private versus public research support, when coupled with the significant increases in the cost of scientific research (particularly modern molecular biology), have naturally resulted in public–private collaborations.

Implications for public-good research

Evidence was reported for the 1980s that many public–private agreements supporting R&D resulted in the ‘crowding out’ of public good research that would otherwise have taken place (Just and Rausser, 1993). This experience illustrated that without proper policy design and implementation, universities could become pawns of powerful private interests and that the unique contribution that land grant universities can and should make to the public good will be lost. As Just and Rausser (1993) warned: “Public–private partnerships cannot be allowed to leverage universities’ resources and divert research from public-good outputs not produced elsewhere.”

In the highly stylised model of public–private collaborations (Lyons et al., 2000), the bargaining process between research administrators and private industry representatives was investigated with a focus on the potential for ‘crowding out’ and/or ‘crowding in’ of public-good research. In this model, the university produces two kinds of research: theorems and mousetraps. Theorems are public goods that cannot be appropriated for direct commercial benefits. In contrast, mousetraps are private goods (e.g. technologies) that the private sector can fully appropriate. The results demonstrate that ‘crowding out’ and/or ‘crowding in’ depends critically on the structure of the bargaining problem between the two parties and on the amount of external public sector funding. Specifically, if the bargaining problem is structured appropriately in terms of benefits, cost and performance, the ‘crowding in’ of public good research is possible.

Alternative paradigms

In structuring public–private research collaborations, we must confront the typical distinction between public- and private-good research. In particular, should innovation be modelled as following a linear process from basic research (conducted largely at public institutions) through applied R&D (conducted mainly by private industry)? The simplicity of this perspective allows analytically tractable representations. The presumption that innovation processes follow a straight line from basic research through applied R&D is attractive to governmental policy makers and university administrators and, some would argue, self-serving. Private firms truly need
a continuous stream of basic research from public institutes and universities to provide a foundation for applied research and product development. By providing these inputs, public institutions serve the mission of making research publicly available. The complementarities in this exchange are apparent. The linear model of R&D, however, does not adequately represent the research process. Empirical evidence has contradicted brick-by-brick models for the advancement of knowledge.

An alternative paradigm is one that admits non-linearities and recognises the chaotic nature of R&D processes. Many analysts have documented the meandering path of innovations into the wider economy and have demonstrated that innovations emerge through a circuitous route (Ruttan, 1982), which cannot be codified and many would argue is impossible to measure. Kealey (1996) proposed an extreme variant of this view, going so far as to argue that innovation tends to drive basic science, not the other way around. Regardless, this alternative paradigm blurs the distinction that governments often make between basic and applied science.

The path from innovation to the market-place is circular, not linear. Innovation generates economic growth; quality research required for innovation does not happen with top-flight faculty and public researchers without adequate research funding. Just as the economic course of innovation is circular, available evidence shows that the process of generating knowledge is itself a series of feedback loops. In many cases, curiosity-driven investigation may be the product rather than the progenitor of a technological adaptation developed in the marketplace.

The Berkeley–Novartis research alliance

The question is not whether public universities and other public research institutions must deal with the outside world, but how effectively they will do so. In this respect the Berkeley–Novartis agreement provides a unique model for maximising the benefit to the public sector. Typically, a university and its faculty wait passively until they receive Requests for Proposals (RFPs) from governmental agencies or private companies, and then generate a response on the other party’s terms. Thus they must live with, and never dictate, the critical terms of the relationship. By contrast, we at Berkeley staked out our strategic advantage, took the central position in the bargaining process, and inverted the typical process. The relevant faculty generated the RFP, allowing private companies with R&D interests in plant biotechnology to respond, guided by our principles and on our specific terms. Contrary to prior practice, Berkeley structured the alliance and the corporate candidates were asked to compete among one another to meet its conditions. The faculty established principles that included finding an optimal fit between our research objectives and the private research goals and established intellectual capital of our partner; maintaining absolute faculty freedom and autonomy; obtaining otherwise cost-prohibitive technological resources for our faculty; and maximising discretionary resources for our infrastructure and graduate programs.

Four companies responded with written proposals to our structured approach. After lengthy negotiations, Novartis was selected from the field of candidates partly because of its R&D strategy and because of its cultural compatibility. The size of the
A dollar commitment was a major factor, but far from the only consideration. Academic freedom, ownership of discoveries and Novartis’ adherence to university professional standards were all key components of the negotiations.

The initial $25 million commitment of Novartis comes to the participating faculty within the College of Natural Resources without restrictions. It is allocated to meritorious research proposals through a faculty peer-review process. This approach differs radically from most privately sponsored university research where funds may be used only for projects selected by the corporate donor. Even taxpayer research funding comes with some strings attached. Faculties almost never receive open-ended grants to indulge their curiosity; they receive limited funding for specified projects.

The beauty of the Novartis alliance is that it places the choice of research projects under faculty control, rather than leaving critical decision-making to legislators, bureaucrats or corporate employees.

For its $25 million contribution Novartis receives the right to negotiate to acquire at fair market value a percentage of discoveries that may result from research it helps fund. That is, if no marketable discoveries are made, or the University does not accept Novartis’ offer to license discoveries, Novartis will receive no commercial rights at all. Even without this agreement, Novartis—as a member of the business community—could approach the Office of Technology Transfer to negotiate licenses on any of the University of California’s (UC’s) proprietary rights. On the other hand, the UC will be a winner regardless of outcome, having obtained not only needed resources and possible intellectual property ownership but, perhaps most important, access to Novartis’ proprietary genomic databases, which are essential to Berkeley’s cutting-edge research in plant and microbial biology.

Other country experience

The gap between developed and developing countries—in income and quality of life—is well documented. This inequality in income is exceeded by inequalities in R&D expenditures. Developed countries are conducting scientific research and focusing on generating products for developed markets (Sachs, 1999). Considering agricultural research specifically, increased relative rates of research expenditure in developed countries are associated with higher agricultural production and higher country incomes (Lee and Rausser, 1992).

At the heart of the commercialisation process in developed countries is the prevalence of public and private sector partnerships. Recently, these relationships have evolved further, with commercial firms often taking the lead over public research organisations (Brenner, 1996). A recent study provides an explanation for this evolution. Theodorakopoulou and Kalaitzandonakes (1999) compare the knowledge networks in the US and Europe and find that networks in Europe, where universities and public institutes play a more central role, are less effective than the US industry-dominated networks.

Collaboration between private firms and public researchers in developing countries, however, has been limited—the private sector, particularly, has provided only limited financial and proprietary resources (Brenner, 1996; Pray, 1999). In a study
of R&D in six developing countries, Brenner found that research is conducted primarily in public institutions with universities playing a leading role. Generally, private firms operate independently—they are able to freely access germplasm and other public resources available in developing countries, bring these resources home and use them as inputs for commercialised products.

In developing countries, those public–private partnerships that do exist take many forms. One type of collaboration involves individual firms or groups of firms, primarily motivated by profits, that fund public research. For example, Quaker Oats funds an oats crossing program that focuses on developing varieties suitable for developing countries. Universities in the US work co-operatively with oats breeding programs in Brazil, Argentina, Chile and in other countries. Further examples include the Potash and Phosphorous Institute of Canada (PPIC), which receives funding from both private firms and governments and has research programs at universities in the US and Canada and also in Latin America, China, India, Sri Lanka and most of South-East Asia. The PPIC is interested in promoting ‘precision’ agriculture that will increase the demand for fertilisers (Pray, 1999). In addition, collaboration has emerged between a Japanese company, Plantek, and selected Consultative Group on International Agricultural Research (CGIAR) Centres; the result is the first Bt cassava plants being produced in the laboratory. Partnerships that serve a more localised community have also been designed—e.g. the partnership between the MT Foundation, a private organisation of seed producers in Brazil, and EMBRAPA, a Brazilian public agricultural research system (Nassar and Zylbersztajn, undated).

Some private foundations, such as the Rockefeller, have been actively engaged in biotechnology research. The Foundation is focused on making research more efficient in developing countries with programmes similar to the International Program on Rice Biotechnology. This programme co-ordinates the efforts of universities, government research institutes, international centres and private research programmes.

Certain public research centres in the developing world are highly active in forming partnerships; the International Centre for Tropical Agriculture (CIAT, its Spanish acronym) has collaborated with the private sector on a number of projects. For example, CIAT and Novartis are collaborating on testing transgenic maize lines for resistance to the corn stem borer. Also, CIAT has entered into collaborations with the expressed goal of reducing pesticide applications in rice for both environmental and competitiveness goals. And recently, CIAT filed for a patent on the genetic modification protocol for Brachiaria, a critical tropical grass. This is a joint patent application with EMBRAPA. This patent is expected to be licensed to private sector, Brazilian, grass seed companies.

Although assessments of current public–private partnerships beg for formal analysis, R&D conducted by the public sector alone will probably be inadequate in meeting the needs of developing countries. This perspective led to the formation of the Regional Fund for Agricultural Technology (FONTAGRO, its Spanish acronym) in 1997. The principal goals of FONTAGRO are “to promote the competitiveness of the rural sector, poverty alleviation and sustainable resource use” by funding transnational, public goods—generating research through broad-based partnerships. Problems with existing public research institutions in Latin American countries (LACs)
include limited mandates, not focusing on the competitiveness of the rural sector, and unwillingness to enter collaborative efforts (Hertford, 1998).

If properly structured, co-operative agreements allow public agents to capture a greater share of the benefits resulting from research and innovation while preventing the free flow of research assets to foreign multinationals. Many collaborative arrangements are possible. For example, the Plant Sciences Research Programme of the Overseas Development Administration (ODA) has funded a private company, Agricultural Genetics Company (AGC), to produce transgenic germplasm expressing insect-resistant genes. In return, AGC has granted ODA a non-exclusive, royalty-free license to this technology, allowing ODA to distribute the germplasm to breeders in developing countries. In another agreement, Monsanto provided a royalty-free non-exclusive license to the Kenyan Agricultural Research Institute (KARI) for virus-resistant technologies and trained Kenyan scientists. In exchange, the KARI is developing the technology in sweet potato grown and marketed in Africa (Brenner, 1996). Another example involves a partnership between EMBRAPA and the MT Foundation, a private organisation of seed producers, focused on developing and commercialising new varieties of soybean and cotton (including disease-resistant varieties). While EMBRAPA, which has the largest bank of soybean and cottonseed in Brazil, shares basic seed, the MT Foundation provides technical expertise, information about seed clients and knowledge about distribution networks. Royalties are divided equally between partners (Nassar and Zylbersztajn, undated). To continue advancing science, the public sector in developing countries must seek out and carefully evaluate opportunities to engage in co-operative research efforts with the private sector.

Structuring the decision problem

The question of how public research organisations should strategically position themselves in co-operative research relationships with private interests is complex. To advance with these relationships, some issues must be understood and ultimately resolved.

Fig. 1 schematically represents the nature of the decision problem that faces a public research institution and a private R&D company. The parties must negotiate over two kinds of decisions—front-end and back-end. The former determines the nature and scope of the research activities that the partnership will undertake; the latter determines how any benefits generated by the partnership will be distributed. Benefits may be pecuniary (e.g. intellectual property portfolio) or non-pecuniary (e.g. public-relations image).

Front-end decisions

Front-end decisions include specification of research priorities, commitment of resources and determining scale of operations. To negotiate over these decisions, the objectives and assets of the respective parties must be considered.
Fig. 1. The decision problem facing a public research institution and a private research and development company.
Public and private objectives

Private and public organisations have different objectives—by design. Private firms are driven to maximise profits and, in doing so, are concerned with any aspect of a co-operative partnership that affects profits. Given this objective, private firms are inherently interested in developing products that can be commercialised or in developing inputs that can be used in commercialised products. Once they have developed a product, firms seek to secure their global position by gaining access to foreign markets. Firms are also concerned with public relations, hoping to build a positive public image and foster goodwill, especially overseas.

Public organisations attempt to maximise social welfare as defined by their doctrine or mission. Agricultural research institutions are interested in advancing agricultural research and technology to serve many goals, including increasing crop productivity and ensuring food security for growing populations. Both these goals contribute to poverty alleviation. Public institutions may also seek to protect farmers’ rights, produce and make available research (i.e. produce knowledge as a public good), protect the environment and biodiversity, and generate monetary resources.

In assessing different potential partners and negotiating collaborative relationships, prospective partners should identify and exploit incentive alignments among their common objectives. Often, however, some objectives of potential research partners will conflict. For example, a focus on publicly available, basic research fulfils most of the public sector’s welfare goals and can improve the public image of a private firm, but directly conflicts with profit maximisation by both agents. In this case, it may be best for the public sector to identify which objectives are vital—which areas cannot be compromised—and to leverage their bargaining position to achieve these goals. The assets held by each agent of course determine the relative bargaining position of the potential partners.

Assets

Assets can be characterised as tangible, e.g. financial assets, or intangible ‘knowledge’ assets. In co-operative relationships, constructing agreements for sharing and generating knowledge assets is especially challenging. Unlike more tangible resources, the value of knowledge assets is difficult to define and relies on many factors such as the nature of the assets and the potential for complementarities.

Knowledge is not homogeneous, but a differentiated asset. Moreover, as Polayni (1966) recognised, drawing the familiar distinction between tacit and codified knowledge is useful. Generally, tacit knowledge cannot be articulated in any meaningful or complete framework. Such knowledge draws upon skills and techniques that are acquired experimentally and are transformed by demonstration, apprenticeships, personal instruction and the provision of expert services. Such knowledge is slow and costly to transmit. This is not the case with regard to codified knowledge, which is reduced and converted into messages that can be easily communicated. The more codified are the components of knowledge assets, the more economically can knowledge be transferred.
Knowledge assets assume the form of a non-rivalled good; i.e. sharing information will not reduce the amount of information the originator possessed. Knowledge can be possessed and used jointly by as many as care to do so. This joint use, of course, satisfies a key feature of a public good. This category of knowledge, however, is not necessarily a pure public good because once it is produced, access by others may be excluded. This is certainly true of patents, copyrights and trade secrets, because various agents can be excluded. To be sure, exclusive control over some specified set of knowledge assets and vehicles for its transmission creates rents for selected agents.

An important distinction or characterisation of assets, particularly knowledge assets, is generic versus specialised (Teece, 1986; Vonortas, 1991). Generic assets, e.g. financial assets or infrastructure, are useful for most efforts. Generic knowledge assets are basic scientific knowledge that can be applied in many circumstances and are readily available, such as germplasm or general knowledge of transgenic processes. In contrast, specialised assets are suited to a narrow set of specific applications—in the arena of agricultural biotechnology these assets are often characterised as input- or output-trait assets. An input-trait asset is related to increased efficiency of the production process. For example, technologies for producing pesticide- or herbicide-resistant transgenic seed are assets that help to reduce farmers’ use of these chemicals. An output-trait asset is related to improved final performance of a research product. These kinds of assets could help to produce (or could be) crops with higher vitamin contents or a longer shelf-life.

Complementary assets

As with different objectives, the different assets held by the public versus private sector provide opportunities to exploit complementarities in assets, both within and between sectors. Although each agent may have both basic and applied research assets, their respective asset portfolios are likely to be different. Private firms’ assets include financial resources for funding long-term research; specific, state-of-the-art scientific research resources such as EST sequences; enabling technology and tacit knowledge about how to work with technologies (e.g. gene guns and agribacterium); and greater commercialisation and marketing expertise. In return, public research institutes can share their research assets (e.g. banks of elite germplasm).

Given the alternative paradigm, the innovation process is not restricted to the linear model of one-way flows of basic public research to private firms conducting applied research. Public institutes are just as interested in gaining access to private firms’ specific technological processes and data to serve as inputs into research. The process of generating knowledge is itself a series of feedback loops, which are a primary source of complementarities between research partners. Even the differing research styles of public and private scientists can be a source of complementarities, with private researchers generally being more directed while public researchers tend to pursue less directed and innovative activities.

Complementary assets in agricultural R&D also include, inter alia, research capacity, scale-up experience and access to seed research stations. As Graff et al.

(1999) note, among the crucial complementary assets are research or process technologies for plant transformation, access to traits and elite germplasm enhancements, capacity to produce non-biological agricultural inputs (herbicides), distribution network for seeds and other inputs and legal and regulatory competencies.

As agriculture becomes more ‘information intensive,’ complementarities will develop between marketing networks and clusters of research-related assets. A seed sales force can collect soil samples and other farm-specific information to aid recommendations about the package of varieties and chemicals that will be optimal for a local growing environment. A research organisation, in turn, can utilise these data to help develop the next generation of technologies. Moreover, traits can be engineered into germplasm that confer tolerance to specific chemicals. These traits then increase the value of any R&D investment to produce a complementary chemical.

Spillovers, intellectual property and back-end options

Public institutes have traditionally pursued more basic, generic research that is publicly accessible. This kind of research generates many spillovers—benefits that accrue to groups not taking part in the research effort. For example, consumers in other countries can benefit from higher production in the host country that translates into lower prices elsewhere. Consumers and producers in other countries can benefit when the research product can be used outside the country of origin. Many groups benefit when the research produces technology that serves as input into other research (Schweikhardt and Bonnen, 1991).

Spillovers do not directly conflict with most public agency objectives, which in fact are served by the dispersion of technology. However, spillovers do reduce the incentive to invest in R&D because others are able to appropriate the technology, reducing its value and the return to investors. To encourage innovation, many countries have developed intellectual property regimes that allow the holders of intellectual property to restrict access.

The strength in intellectual property regimes has provided the foundation for more active technology markets. To some degree, this has spilled over to markets for scientific knowledge, which should not be surprising. Over the last decade, with the rapid liberalisation of markets and the creation of many types of ‘intermediate’ products, what is tradable has expanded significantly. This is especially true in security markets where derivatives, index futures, securitisation, exotic options, barrier options and an array of put and call options on both listed and non-listed assets are actually traded. Developments in computer and information technology have aided the sudden burst of such markets.

Obviously, however, the resulting information becomes unmarketable to the degree that the output of science knowledge is publicly shared. Generally, science is viewed as a non-market-oriented activity. As Navaretti et al. (1998) note, “Precisely because it is a non-market institution, science had to rely heavily for its self-preservation and reproduction upon elaborate riches and codes of behaviour, norms which are distilled into its members through the educational process.” The natural incentive scheme is one of priority that serves to elicit public disclosure of new
discoveries. But even here, the new institutional assignments have been structured to provide limited rights (e.g. rights of first refusal) to facilitate a market for yet-to-be-discovered scientific knowledge. Although the knowledge discovery R&D process takes place under considerable uncertainty, options can be designed on the back end (Dixit and Pindyck, 1994).

Risk, uncertainty and public perception

Sharing knowledge assets in collaborative research efforts exposes the parties involved to different kinds of risks. All parties must follow jointly developed procedures for research that are likely to restrict their freedom to operate. In some cases, intellectual property rights and benefits-sharing issues have been resolved through costly litigation. The loss of privacy is also a concern, especially on the part of private firms sharing proprietary data.

These concerns give way to broader risks associated with research output. For example, the returns from research are highly variable—only a few research efforts result in high payoffs (Barry et al., 1997). Of great concern recently, however, are the risks of unintended consequences. Specifically, genetically modified agricultural crops and their potential health and environmental impacts have come under intense scrutiny. These potential risks are the primary reason for the public’s slow acceptance of transgenic crops (Serageldin, 1999).

The source of concern over agricultural biotechnology originates largely with perception-based rather than objectively-based risk. Nowhere is this truer than in Europe, where the term ‘Frankenfood’ has entered the lexicon, although no scientific evidence exists that foods containing genetically modified crops are unsafe to eat. As numerous studies have shown, the public risk perception and views of potential health hazards from food consumption differ significantly from the views of experts (Antle, 2000).

Much attention has been paid to the potential environmental impacts from the agricultural production of transgenic crops—focusing on agricultural producers’ concerns about resistance build-up and the general public’s concern about possible impacts of releasing genetically modified species into the environment. Public and private researchers must carefully sort through these contentious issues, focusing on science to guide research agendas.

Public perception of genetically modified crops may be closely tied to the timing of output trait commercialisation. Until now, as we all realise, the commercialisation spotlight has been on input traits (Bt, Roundup Ready). These transgenic commercial products have proven to be ‘low-hanging fruit.’ Public concern can be reasonably expected to shift dramatically as new output trait technologies are commercialised. The subset of traits that consumers can feel and touch can be expected to significantly transform public alarm about genetically modified foods. In this respect, output traits that focus on enhancing processing efficiency are not sufficient.

If we could start with a clean slate, the optimal sequencing would begin with nutraceuticals or prescription foods that solve serious human health problems, especially those of the poor in developing countries. This would change the direction
of current public fears about genetically modified plants and food. From this platform, widespread public and consumer acceptance of agricultural biotechnology research could more easily emerge. With such developments as background, the general public and most consumers could embrace the other benefits of agricultural biotechnology, e.g. better tasting foods, more productive and disease-resistant plants, as well as products with improved shelf life and enhanced processing efficiency. Breakthroughs on this front could provide significant societal and moral benefits.

**Bargaining and negotiations**

In formalising the public–private bargaining problem the challenge must be examined at two levels. The first involves identifying in a systematic way, and (where possible) quantifying, evaluating and ranking the full range of potential complementarities and gains-to-trade that exist between the potential collaborators. A bargaining model is an attempt to set out some of the possibilities (Rausser et al., 1999). Obvious candidates include complementarities both within input classes (e.g. between domestic and foreign germplasm banks) and across input classes (e.g. between domestic germplasm and foreign transgenic process technologies). More novel candidates include potential gains-to-trade arising from the two partners’ objectives. For example, the primary goal of the public institution may be to acquire certain portions of the private sector’s generalised tacit knowledge base and enabling technologies: in exchange, the institution may be able to trade some of its specialised expertise and elite germplasm. To assemble this array of complementarities, significant intelligence-gathering resources will be required: who are the potential private partners, what do they want most, what do they have to offer and what can the public institution offer in return?

The second challenge focuses on strategic positioning. To address this task effectively requires a specific model of the actual negotiation process. Only when equipped with such a framework can the public institution systematically explore the implications of alternative negotiation strategies. The range of strategic options available to the institution include: specifying the negotiable set of variables; specifying admissible ranges of values for these variables; creatively adding novel dimensions to the bargaining space with a view to exploiting gains-to-trade (e.g. constructing options); and determining flexibility parameters (i.e. deciding how prepared one is to trade objectives). For example, LAC research institutions may be concerned that in the process of commercialising a partnership’s research product their private partner will exercise monopoly power in local markets. This concern can be mitigated by negotiation for public control over license allocation within the region. The private party will need to be compensated for giving up this control. A route for obtaining a compromise may be to segment market control, so that the private partner has carte blanche to develop the product in other regions of the world. Alternatively, if in the public institution’s assessment the primary risk factor is the potential adverse environmental consequences of genetically modified products, a dimension could be added to the bargaining space relating to experimental testing. Using a bargaining
simulation model, the robustness of such alternative strategies can be determined over the range of relevant parameter values.

Conclusions

In the area of science and technology, the knowledge gap between rich and poor countries is wide and increasing. In the area of biotechnology research, a second gap between private life-science companies and public research institutions has recently emerged. A compound, rapidly widening gap then exists between the cutting-edge R&D in the developed world and the publicly sponsored research being undertaken in the developing world. An obvious strategy for narrowing this gap is to form private–public research alliances based in the developed world.

Obstacles to the formation of such alliances are gathering momentum. To navigate paths around these obstacles toward successful public–private collaborations, public research institutions in the developing world need to adopt creative new approaches to the process of negotiating with their potential private partners. These new approaches must focus on leveraging the complementarities and potential synergies between their knowledge assets and those of the private sector, while simultaneously setting in place institutional arrangements geared toward managing the risks and dangers, both objective and perceived, that are of greatest concern to their constituencies.

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