

The Experience of Technological Collaborations by MERCOSUR Companies

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ABSTRACT *This paper examines some of the experiences in information and knowledge sharing involving MERCOSUR firms. It finds that while technological collaborations by MERCOSUR firms are relatively few, located in low-tech sectors and taking place in an environment of little innovation, they are motivated by the need to 'fuse' their own knowledge with that of partner or to improve available information. Modes of governance vary accordingly, with equity or contractual forms being used for new developments and informal agreements for improvements. Governments and business associations can be important facilitators of technological collaborations. The analysis of technological collaborations suggested that the better prepared a corporation entered an agreement the more successful it was likely to be. It also pointed out that where interactions were intense, well intended and transparent, included personnel exchanges, were properly assessed and involved receptive participants, learning progressed smoothly and partners were satisfied. Benefits of the collaborations included new patentable and non-patentable products, new factories, as well as building trust between partners. Premature termination of some collaborations was the result of financial limitations unrelated to the success of the collaboration.*

Introduction

This paper aims to examine some experiences in information and knowledge sharing involving developing country and especially MERCOSUR (Argentina, Brazil, Paraguay, Uruguay and Chile as an associated member) firms, trying to understand their rationale and development and the benefits they bring to the firms involved. A special concern will be the role of factors 'external' to the firm that seem to be particularly important in initiating technological collaborations in the developing country context. Much has been done in advanced countries to study technological collaboration agreements under the heading of strategic technological alliances, particularly with regard to firms' motivations in entering agreements, the evolution and learning processes involved in collaborations, and the effects and outcomes of the cooperation.¹ To our knowledge, however, there are few studies on technological collaborations involving MERCOSUR firms. The paper also suggests some public policies aimed at enhancing technological collaboration by companies in MERCOSUR countries.

Inter-firm cooperation agreements or technological collaborations are defined for the

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purpose of this work as understandings between corporations aimed at generating and exchanging information and knowledge for innovation. Technological collaborations involve a two-way flow of information, with each firm bringing into the relationship its resources and competencies. Thus, they do not include technology licensing agreements because they are mainly unidirectional, from licensor to licensee. They do include agreements made to address a common technological problem, as the resolution to the problem should eventually result in an organizational or process modification. Technological collaborations can be 'strategic' when they share common overall R&D objectives and approaches and are open ended in terms of time span, or 'specific' when the objective is a predetermined product or process and the collaboration only lasts until the objective is achieved. The intensity of coordination, consultation and interdependence, therefore, varies accordingly. Agreements can be put into effect through a variety of mechanisms, ranging from an informal agreement or a simple memorandum of understanding to a joint venture, and can involve two or more enterprises. Hence, they do not necessarily involve alternative organizational or contractual arrangements, or equity partnership.

The study is based on the analysis of 11 collaborations in nine enterprise-based case studies compiled over time by two of the authors and their colleagues at the University of São Paulo and existing research and available data.² The case studies were developed on the basis of interviews with main owners, presidents of companies, board members, production, R&D and sales managers and individuals responsible for the collaboration projects, mainly in the local firm involved (see Table 1).³

The paper consists of four sections. The next section sets the overall context of innovation and technical change in MERCOSUR, which tends to be very different from that in developed countries, where most of the collaborations are taking place. The third section examines the experiences of technological collaborations by MERCOSUR companies through the analysis of some of the key dimensions in their evolution. The paper ends with some conclusions and policy suggestions.

Innovation in MERCOSUR Countries

Innovation in MERCOSUR countries has three main characteristics.⁴ First, the total innovation effort is a relatively low, as suggested by the aggregate levels of R&D expenditure ranging between 0.9% of GDP in Brazil, 0.7% of GDP in Chile, 0.6% of GDP in Uruguay and 0.3% of GDP in Argentina. Second, the distribution of the innovation effort is relatively 'unbalanced' in terms of private and public efforts with the public sector accounting for around 80% of all the effort and in terms of manufacturing and experimental development expenditures. Third, while welcoming foreign direct investment, MERCOSUR countries have been growingly restrictive of foreign technology transfer as a means of protecting their own technological development.

The relatively modest effort at innovating is also reflected at the firm level. In 1985, out of the 59 994 enterprises selling over US\$40 000 per year that were involved in an economic census, only 3.5% of the firms had any R&D expenditure.⁵ R&D expenditure was concentrated on the largest, often public, firms and amounted to 0.4% of total sales, while average R&D expenditure over sales for the whole sample was 0.08%. Half of the firms that had any expenditure in R&D operated in mechanical engineering and chemicals. There are no accurate recent estimates as to how much private firms spend today on innovation, but a recent survey of 573 private and public firms that had R&D activities in Brazil in 1995, made by the National Association of Research Firms, found that expenditure on research, development and engineering was US\$2.7 billion of which

Table 1. Technological collaborations by MERCOSUR companies

Firm or firm grouping name	Collaborator	Nationality of partners	Size of partners by employment	Sector	Purpose of cooperation	Brokered by	Mode of governance	Approximate duration of partnership years	Benefits to MERCOSUR partner	Outcome of cooperation
Accelia	Sucralc	Brazil/Brazil	Medium/medium	Chemical	Improve quality and increase output	Sucralc	Informal agreement	2	Improved alcohol and solvent process	Possible merger
Americana	32 Partners	Brazil	Small	Textiles garments	Process improvement	SEBRAE, ACIA	Informal agreement	3	None yet	Continuing
BioBrás	Eli Lilly	Brazil/US	Large/large	Pharmaceutical	Development and production of insulin crystals	Brazilian Ministry of Health, BNDES	Joint venture	6	Plant for insulin crystals	Terminated
Biótica	Sementes Agroceces	Argentina/Brazil	Small/large	Agro-industry	Development and production of potato seeds	CABBIO	Contractual arrangement	5	Production of new potato variety	Terminated
CONFARMA	21 Partners	Argentina, Brazil, Paraguay, Uruguay, Chile	Medium and small	Pharmaceutical	Development of new products and process improvement	Both partners	Informal agreement	2	Process specialisation, improvement and problem-solving	Continuing
Freios Varga	Lucas	Brazil/UK	Large/large	Auto components	Development of new product and process	Freios Varga	Equity investment	15	New plants and brake technology	Production and regional restructuring
GAMDI	15 Partners	Brazil	Medium and small	Chemical, food and beverages	Process improvement	Both partners	Informal agreement	5	Problem-solving	Continuing
Metal Leve	Allen Bradley	Brazil/US	Large/large	Auto components	Product development	Partners	Joint venture	7	Automation on request by customers	Continuing
Metal Leve	Kolbens-schmidt	Brazil/Germany	Large/large	Auto components	Process development	Both partners	Joint venture	6	New plants	Continuing
Vallée	International Health Corporation (IHC)	Brazil/Europe	Medium/large	Pharmaceutical (veterinary)	Product development	Both partners	Contractual arrangement	2-3	None	Terminated
Vallée	Vetcorp	Brazil/Australia	Medium/medium	Pharmaceutical (veterinary)	Product development	Vallée	Contractual arrangement	1-2	None yet	Continuing

A firm is classified as small if having fewer than 100 employees, medium if over 100 but fewer than 500 and large when more than 500 staff are employed.

US\$1.9 billion was current expenses and the rest was on capital expenditure.⁶ These outlays amount to 0.4% of GNP, suggesting that, overall, private R&D expenditure may be growing but it may be concentrated in fewer firms.

As to the extent of domestic or international collaborations in MERCOSUR, there are no precise estimates. The share of developing countries and Eastern European firms in around 6700 international technological agreements averaged 6.2% of the total between 1980 and 1994, of which Latin American firms accounted only for 4.3%.⁷ This relatively low share of technological collaborations by Latin American countries overall, and MERCOSUR in particular, is confirmed by data on 23 802 technological collaborations on information technology between 1984 and 1994. Developing countries and Eastern European firms accounted for 9.9% of the total.⁸ Of them, agreements involving Asian firms, mainly from China, Hong Kong, Taiwan, South Korea and Singapore, accounted for 61.6%, Eastern Europe and former USSR firms accounted for 21.2%, while Latin American firms accounted for 15.5%. Within Latin America, Brazil accounted for 3.4% of the agreements and Argentina for 1.8%.

The Experience of Technological Collaborations

Sectors, Firm Size and Country of Origin Considerations

The case studies suggested that, unlike most of the experiences recorded in the literature, technological collaborations by MERCOSUR firms were concentrated in medium to low technology sectors or in relatively less advanced technologies, such as garments, mechanical engineering or at the lower end of pharmaceuticals and biotechnology. This sectoral pattern mirrors to a significant extent the aggregate pattern of specialization where most of the innovative effort focuses on the mechanical engineering and chemical industries.

Three collaborations involving Freios Varga and Metal Leve, perhaps among the most successful firms in the region in terms of technological achievement and international competitiveness, are vehicle component manufacturers. Yet it is not in the mechanical engineering industry but in biotechnology and information technology that the most significant technological advances and innovations are taking place worldwide. The mechanical engineering industry is increasingly resembling commodity producing industries, such as petrochemicals, steel and edible oils, where profitability depends on maximizing volume and there is, with a few exceptions, little scope for innovation or for heavy premiums to brand or quality differentiation.⁹ As far as information technology and the electronics industry are concerned, MERCOSUR's firms would seem to be passive recipients of knowledge. Where electronics industry joint ventures have been established between Brazilian firms and a foreign partner, they have been mainly aimed at obtaining market access by the foreign partner.¹⁰ In these partnerships, local MERCOSUR firms have played little role in creating new products and processes.

Technological collaborations by MERCOSUR firms in the biotechnology and pharmaceutical areas also seem to be few and apparently not in frontier areas. Judging by the overall small number of international technological collaborations involving MERCOSUR firms, even if all of them were in biotechnology, they would still pale in comparison with the number of collaborations by firms in advanced countries and in East Asian or East European countries. In our own sample, five of the case studies involved biotechnology-related collaborations. They included some of the most capable local firms in the field. Three of them, the collaborations between Sementes Agroceres and Biótica, between Biobrás and Eli Lilly and between Vallée and Vetcorp and Vallée and International Health Corporation (IHC), were in traditional areas of biotechnology,

such as micropropagation and use of living organisms for insulin extraction, i.e. they did not involve genetic manipulation. As for the other one—CONIFARMA, an agreement between pharmaceutical companies from all MERCOSUR countries—the collaboration was only beginning to engage in new product research which might eventually involve the use of genetic manipulation but at the time it did not.¹¹

Together with a sectoral pattern of collaboration, a pattern would seem to be emerging with regard to firm size. Five of the partnerships studied involved at least one large firm from MERCOSUR. Large firms normally entered technological collaborations agreements in order to produce completely new products or processes. For example, the joint venture in which Sementes Agroceres, a manufacturer of agricultural seeds and animal food, was involved aimed at researching and developing potato seeds which would later be put into large-scale production. Another collaboration, involving Biobrás and Eli Lilly, aimed at using Biobrás's production expertise internationally, developing and manufacturing insulin crystals and exporting them through Eli Lilly's distribution network. Freios Varga's collaboration with Lucas from the UK eventually developed new brake technology, while the collaboration between Metal Leve and Allen Bradley, a US manufacturer of electronic controls and factory automation, focused on designing and manufacturing automation adaptable to developing countries' conditions. Hence, it seems that the kinds of agreements in which large firms are involved in MERCOSUR are mainly of a knowledge-sharing nature, or, to put it slightly different, large firms tend to be part of partnerships where there is the possibility of using complementary competencies or unique knowledge. Large firms have the finance and technological capacity to be part of these agreements.

In the case of medium and small firms, the kinds of agreements entered into would seem to vary much more in their nature. At one end, there is the case of Biótica, where there was a clear sharing of knowledge with the much larger Sementes Agroceres. The small firm could offer specific vegetable micropropagation and new potato seed technology that could be used in the partnership for the development of new products. At the other end, there were two collaborations involving small firms, where the objective of the partnership was addressing specific problems or bottlenecks common to all. Americana, for instance, was a collaboration of 32 small and medium Brazilian textile and garment companies aimed at production process improvement, standardization of quality, machine sharing and introduction of computerized design. These problem-solving kinds of agreements would seem to be more important to small enterprises, as large enterprises normally have the capacity to deal with these kinds of problems by themselves.

Turning to the country of origin of the collaborations, the case studies suggested an important regularity. Where firms from advanced countries participated they were multinational corporations, often leading manufacturers of the products or processes under consideration, and much larger in size than their domestic partner. In addition to technical exchanges, multinational corporations were nearly invariably also seeking market access.¹² A case in point was the collaboration between Biobrás and Eli Lilly, the US transnational pharmaceutical company. The collaboration did not only involve knowledge exchange, but was Eli Lilly's entry point to Brazil's insulin market. Collaborations by Freios Varga with Lucas, at least initially, and by Metal Leve with Allen Bradley were as much about developing jointly manufacturing facilities and new automation and brake technology as entering the local market. A similar relationship was found in one of the two case studies where Brazilian and Argentinian firms were involved together. Indeed, it has been suggested that size and knowledge asymmetries and multiplicity of objectives were also characteristic of technological collaborations

between Brazilian and Argentinian firms, with the former normally being the largest and interested in both technology and market access.¹³

By contrast, where collaborations involved firms from the same country, there would seem to be a more exclusive emphasis on technology and knowledge exchange. In these circumstances, the assets contributed to the collaboration are equally used by all partners, as they are geared to the same market. This was the case for Americana, although geographical proximity would seem to have facilitated the collaboration between partners. The collaboration between Sucralc and Acetila, two Brazilian firms involved in manufacturing alcohol from sugar cane and alcohol-based solvents, was intended to increase the quality and volume of inputs and output in the Brazilian market.

Motivations and Modes of Governance

As could be expected, the main motivations behind engaging in technological collaboration involved exploiting technological complementarities and obtaining specific technologies or knowledge available with the possible partners or that could be bought or developed jointly.¹⁴ There were two distinct types of motives. The first involved combining or 'fusing' each partner's knowledge so that a 'third' technology that is different from the inputs of both partners emerges. This was the case in most of the collaborations. Specific product knowledge was shared in four collaborations. In the case of Agroceres and Biótica, both companies brought a well established reputation and experience in new hybrid corn and potato seeds, which was then applied to the development of even newer types of potato seeds. Product and process knowledge was combined in three collaborations. This was the case for Freios Varga and Metal Leve, which, although having some new product design and development capabilities, had even more advanced brake or piston manufacturing capacities which were joined with their foreign partners' product technology. Some of this process knowledge was later used by foreign partners outside MERCOSUR. In one case, CONIFARMA, the collaboration involved exchanges of both product and process knowledge, although the emphasis so far has been on process technologies.

The second type involved each partner providing an input in which each one had a distinct advantage, but without leading into another product or technology but improving existing information and knowledge. This was the case for Americana and GAMDI, where process technology and knowledge were exchanged. In the case of the GAMDI collaboration, for instance, the 15 partners require a variety of scientific instruments for chemical processes, such as chromatographers and electronic measuring devices. The instruments are used only occasionally and it does not pay to have all but the most crucial ones in-house. The GAMDI partnership operates as a network of information on advances and availability of scientific instrumentation and as a clearing house for allocating time in a members' designated pool of instruments. Another case of collaboration aimed at improving operations was the partnership between Sucralc and Acetila. The former had an input, i.e. sugar-based alcohol, facing a dwindling market, while the latter had alcohol-based solvent formulae and know-how that it could not take into production for lack of funding and the appropriate type of alcohol. The agreement involved Sucralc providing the necessary alcohol and technical suggestions for its more efficient use, in exchange for Acetila's solvent formulae and an accord to produce jointly upgraded solvents in Acetila's facilities and distribute them through Acetila's marketing channels. There were no new products but Sucralc was able to increase alcohol output and 'match it' to solvents, while Acetila was able to survive and expand by producing better solvents.

The modes of governance used to cement a collaboration varied according to the type of exchange. Where exchanges involved process and problem-solving technology and knowledge, the main mechanism used by firms was informal agreements. The main reason for this was that collaboration occurred as and when a need arose or was not meant to be sustained, and therefore a flexible and informal approach was deemed to be more effective. This was the case, for instance, for the agreement between Sucralc and Acctila, as the partnership was sanctioned by a 'gentlemen's' agreement' backed by a 'confidential' memorandum, although later it will most likely turn into a fully blown merger, as will be seen later. Where the collaboration involved the exchange of product and process knowledge, the collaboration generally involved equity investment, a joint venture or a contractual arrangement. In these cases the exchange of information and tacit knowledge was more intense and sustained, and often it was necessary to have a clear distribution of the outcome. However, there was no apparent preference for either equity or contractual arrangements, even though short- and long-term agreements were involved, which contrasts with the experience in developed countries where equity and contractual arrangements are respectively linked to long- and short-term knowledge exchanges.¹⁵ At least one collaboration, between Freios Varga and Lucas, would seem to have evolved into a strategic cooperation.

It must be noted that in the establishment of the modes of collaboration there was an important role for 'external' influences, i.e. the terms of the agreement were mainly set by outsiders to the firm. In the case of Biobrás and Eli Lilly, which eventually took the form of a joint venture with 55% of the capital owned by the Brazilian partner and the remainder by the foreign company, Brazil's Ministry of Health had a significant role in determining the actual distribution of shares in an attempt to promote local capabilities in the field of insulin. In the case of Americana, the Brazilian Service of Support to Micro and Small Enterprises (SEBRAE) was involved in establishing and setting the terms of reference of the collaboration. Finally, the Brazilian-Argentinian Centre for Biotechnology (CABBIO), a joint government funded but privately run association of firms and individuals concerned with the development of biotechnology in Argentina and Brazil, and established in the context of MERCOSUR's biotechnology industry protocol, set the guidelines for the contractual agreement between Agrocercs and Biótica.

The Inception of Technological Collaborations

Most of the technological collaborations examined suggested that the decision to collaborate was taken in the context of making important strategic decisions. These decisions involved expanding into a foreign market or attacking the growing MERCOSUR market, a significant product diversification drive or a major attempt to recover a perceived loss of domestic or international competitiveness, all of which required strengthening their own technological capability and new technology. Only two collaborations would seem to have grown out of business opportunities that emerged in the context of normal operations. One of these cases was the collaboration between Metal Leve and Allen Bradley, which evolved into a fully blown collaboration following a successful installation in one of Metal Leve's plants.

Once the decision to collaborate was taken, the initial step to cooperate came from two main sources. The first source was the firm's own undertaking to enter a partnership. In these cases, beginning a technological collaboration required considerable managerial and financial search effort to determine whether and what to collaborate on, which of

the potential partners would be best suited for the partnership and ensuring the collaboration progressed smoothly.

Information about the potential and possible areas for technological collaboration was not always easy to obtain; nor was it free. The collaborations involving Freios Varga, Sucralc and Vallée suggested that the companies were not fully aware of the emerging trends in international technology development and partnership already evident to many firms elsewhere. In all three cases, it was only after commissioning reports from international consultancy firms that management was able to access the relevant information and to decide on the usefulness of a possible technological collaboration for the firm's strategies. In Sucralc's case, the partnership eventually materialized with a local firm, but by then the company had researched worldwide on possible new fermentation processes from sugar cane and on new sugar-derived products.

Searching for the right partner was another major task. Finding an appropriate partner seemed to be an issue, as the process of searching went well beyond spotting firms in the same industry or with apparently the same technologies and needs. In the partnerships involving Sucralc and Vallée, information was requested to enable management to assess technically and economically several potential partners, many of them from abroad. Special efforts were made to establish the precise technical competencies of the potential partner and how to mesh them with own competencies. Evaluations were also made on potential partners' organizational culture and on whether the companies would be able to work together.

Ensuring the collaboration eventually ran smoothly was not free of effort either. After having had a negative experience with one of its collaborations, Vallée invested heavily in consultants and lawyers and in own management time to prepare for other agreements and to ensure they yielded the expected results. A number of dimensions were looked into. The first dimension was the mode of cooperation, e.g. whether and what type of equity or non-equity agreement should be established. The second dimension was financial, and involved making accurate valuations of the assets and human resources to be contributed and estimates of potential benefits that would accrue to the partnership. This also included defining ways of protecting and appropriating the benefits of the partnership. The third dimension was managerial and involved establishing the management procedures and practices that the partnership would have to follow. The fourth dimension was developing negotiation and communication skills of the partnership as the eventual success of the partnership was partially determined at the negotiating stage. Finally, given that sometimes foreign firms were to be involved, there was the need to examine national business culture diversities, such as financial disclosure rules and styles of human resource management, which, if very different, could have become a very real impediment to the partnership.

The second source for initial impetus was 'external'. In these cases, the collaboration was initiated or promoted either by the government or by a business association, although it always fell on 'good ears' because there was a prior decision to find a partner. In the collaboration between Biobrás and Eli Lilly, Brazil's Ministry of Health played a key role. It first provided information to Eli Lilly, already a major worldwide producer of insulin, about Biobrás's research on and intention to manufacture that product and its technological capabilities. It then got involved in the technical negotiations between both parties, which allocated the manufacture of the main raw material or insulin crystals to a joint venture between Biobrás and Eli Lilly and insulin to Eli Lilly. Finally, it gave the joint venture a monopoly of the production of insulin crystals in Brazil, and Eli Lilly the possibility of selling directly to chemists and to the Ministry of Health diabetes programme. Brazil's official development bank, BNDES, in turn provided the financing

for the venture. Another case of government programmes initiating technological collaborations was Americana. In this case, SEBRAE was jointly involved with researchers from the local university in bringing together partners to the collaboration.¹⁶

The managers of a number of firms involved in collaborations pointed out that the government could in addition contribute to technological collaboration through ensuring overall economic and political stability. The previously murky economic and political conditions were also a major limitation to technological collaborations because of the large risks involved. Foreign partners, in particular, did not want to add another major source of risk to an already very risky undertaking. It was mentioned that the recently found stability in Brazil and Argentina since 1990 had allowed those firms that had been able to weather the adjustment process successfully to plan better their investments and to invest long term. To the extent that R&D is a long-term investment, it benefits from stable conditions. Stability was also felt to draw resources into productive rather than financial activities, as there was no need for quick profits to compensate for high uncertainty. This is not a factor raised in the literature, because developed countries normally do not face the conditions faced elsewhere,¹⁷ but it is crucial for MERCOSUR countries, which have gone through a period of intense economic instability. Stable economic and political conditions, when accompanied by high and sustained growth rates, could increase even further the potential for innovation and technological collaboration.

Equally important in initiating technological collaboration agreements have been business associations. This was evident in the cases of Sementes Agroceres and Biótica and Americana. In the case of the former, CABBIO brought the partners together, supported the collaboration through organizing meetings and discussions on the potential for new potato variety consumption in the region and financed the initial contacts and work required to get the agreement off the ground. In the case of Americana, it was partially the initiative of the local small and medium enterprise association (ACIA) which made it possible for firms to collaborate. Other research has pointed out the positive role business associations, such as those of sugar/alcohol (COPERSUCAR), shoes, leather and ceramic products manufacturers, have had in initiating technological collaborations.¹⁸ These associations initially acted as a political lobby but then turned into the promotion of information exchange and improving the technological capabilities of their members.

The Implementation of Agreements

The collaborations studied suggested that the implementation of agreements involved significant learning for the MERCOSUR partners.¹⁹ The learning process was not limited to the technology itself, but also required developing an understanding of the partners' methods and idiosyncrasies. During the implementation phase, three key prerequisites for learning were identified, including the degree of interaction and exchange of ideas, the extent of personnel movement and training, and the adoption of methods of assessment and monitoring.

As far as interaction was concerned, in most partnerships discussion teams involving all levels of management and relevant operational staff were created to implement the collaboration. In the case of collaborations organized as joint ventures, personnel needed to be allocated, which in the case of Biobrás and Eli Lilly's joint venture involved more than 100 staff from administration, R&D, production and marketing from both companies. Biobrás, which had been producing enzymes for a number of years, had been successfully researching the extraction of insulin crystals from pork pancreas, as the

technology was not far from enzyme extraction, although its main strength lay in manufacturing. Eli Lilly, which was a world leader in the extraction of insulin from living organisms, brought its own approach to extraction. Although there was some friction over extraction methods, the discussions would seem to have always been candid and in the end Eli Lilly's formulae and Biobrás's production methods were eventually chosen. As a result, there was a continuous flow of information and knowledge according to both partners, both within the joint venture and between Biobrás's and Eli Lilly's management, and an industrial plant was built after around two years.

With one exception, communication and exchange of ideas was intense between partners in the studied collaborations, although it seemed to be slightly higher in situations where there was a strong personal relationship or a clear commitment to the partnership at top management level. Information seemed to flow better between companies where a combination of formal (called by management) and informal meetings (called by any staff member), together with collegial personal relationships, emerged. The more often the discussions took place, the more the partners seemed to learn from each other, although some managers complained of the inordinate amount of time spent in meetings and preparations.

It is perhaps the two collaborations of Vallée that best illustrate the opposite directions that interactions and the flow of information can take in a partnership. Vallée is a Brazilian manufacturer of pharmaceutical products for cattle, including vaccines, therapeutic drugs and parasiticides. In the early 1990s, the company entered collaborations with IHC, a European company world leader in poultry and pork vaccines, aimed at developing poultry vaccines for the Brazilian market, and with Vetcorp, an Australian local manufacturer of bovine vaccines beginning its expansion abroad, aimed at developing new bovine vaccines and diversifying product range, also initially for the Brazilian market.

Vallée's collaboration with IHC contemplated a first stage where IHC products would be registered by Vallée in the Ministry of Agriculture, and if registration was obtained quickly the products would be sold in the Brazilian market. In the meantime, a fully blown technological collaboration would begin to be negotiated and implemented. Registration is a long and cumbersome process which normally takes years, and modifications over existing registrations are easier to process, so it made sense to have a marketing agreement while 'fine tuning' the technical side of the agreement. The agreement began in 1991, with Vallée allocating two managers and four employees to IHC activities, submitting product registration papers to the Ministry of Agriculture and launching a market study for selling poultry vaccine in Brazil. Up to this stage, communications had been between Vallée's and IHC's top management in Brazil and occasionally with managers from IHC's headquarters, and had been formal and professional. Soon after the beginning of the agreement, Vallée approached IHC for discussions on exchange of technical information and the establishment of joint production facilities, particularly since IHC's product prices were 50% higher than those available for similar products in Brazil. Suggestions were also made for the involvement of technical personnel in the discussions. To Vallée's surprise, however, IHC always avoided to engage in a substantive discussion on technical exchange, something that was compounded by the continuous change of IHC's management in Brazil. Moreover, IHC established its own subsidiary in Brazil and asked Vallée to transfer authorized products to the newly established subsidiary. Eventually, contacts broke down and the dispute had to be settled through arbitration. Vallée argued that IHC did not really want to collaborate with it, but only wanted product registration. IHC pointed out that Vallée was using its power of registration to exact technology and money from it, and was not interested in selling IHC's products.

Vallée, however, was not deterred by its experience with IHC and, as has been pointed out, engaged consultancy companies and lawyers to devise ways of being more successful with future collaborations. It is in this context that the collaboration with Vetcorp began. In this case, initial negotiations were longer and protracted, and although they also involved initially a local market distribution agreement, as products needed to be registered at the Ministry of Agriculture, the more technical issues were bought up-front and clearly specified in the initial agreement. They had been much more vaguely referred to in the agreement with IHC. Vallée also made the point of immediately raising any doubt it had about the collaboration at whatever level was necessary, discussed at length with Vetcorp its expectations of the agreement and explained to its counterpart about local accountancy and business practices. At present, both companies are beginning joint research on new products and examining the possibility of establishing new joint production facilities, first in Brazil and later in Australia. There have been several visits by Vallée's technical and production personnel to Vetcorp's laboratories and production sites in Australia.

It is complicated to make a judgement on the intent of Vallée and IHC when entering the collaboration. While clearly Vallée intended to extract as much information and knowledge as possible from its partner, it is not clear that IHC was not willing to provide the necessary knowledge, as it could well have been the case that it wanted to see some concrete results in registration and marketing of its products prior to moving to a more advanced stage of collaboration. Whether IHC felt it had something to learn from Vallée beyond marketing is a different matter, as this was never put on the negotiating table. Potential learning in this partnership would seem to have been blocked by the lack of transparency and receptivity to the concerns of each other, another key factor to ensuring collaborations run properly.²⁰ On the one hand, IHC avoided discussing the technical aspects of the collaboration and established its own subsidiary, apparently without informing its partner. On the other hand, Vallée may have not made enough efforts to identify markets that might have been willing to pay a premium price for IHC's products, and therefore was not receptive to IHC's marketing concerns. Neither the partner believed that the partnership was adding any value to it, that it was being fairly treated by the partner and that the partner was accommodating in its demands. In sharp contrast, Vallée's collaboration with Vetcorp would seem to have met all the requirements for a sustained process of learning, and Vallée would seem to have learnt considerably from its first failed experience. Doz's initial conditions regarding the preparation of the agreement and a clear definition of modes and procedures would seem to have been achieved.²¹ The firms would seem to have a similar interest in learning, partially accounted for by the fact that they are similar in size and in status in their domestic markets. Discussions seem to be taking place slowly but frankly and at different levels within the companies, partners would seem to accommodate for each other and both companies have expressed a positive attitude to each other and a feeling of achievement.

The other prerequisite for learning was exchange of personnel and training. In five of the technological collaborations studied, all of them involving at least one foreign firm, study and training visits to the foreign partner's headquarters or offices elsewhere were often arranged, as was the exchange of personnel between R&D centres. The Biobrás-Eli Lilly partnership, for instance, involved training of personnel in the US and Argentina for up to eight months. In both the Metal Leve partnerships, with Allen-Bradley and Kolbenschmidt AG, there were regular exchanges of researchers between Metal Leve's technological centres in São Paulo and Ann Arbor, Michigan, and the research facilities of its counterparts in the US and Germany. Indeed, Metal Leve not only had

regular professional contacts with its foreign partners but had established research links with the universities of Stanford, Batelle and Michigan in the US, and the universities of Leeds, Aachen, Delft and Copenhagen in Europe. Often the researchers involved in the partnerships had links with the universities.

Turning to assessment and monitoring procedures, they were present only in the five collaborations that had training schemes. Hence, none of the partnerships involving only MERCOSUR firms had established assessment procedures, although some informal evaluations may be taking place. In the case of the three joint ventures studied, the assessment involved analyzing the usual operational and financial indicators in addition to monitoring the progress of the collaboration. The advance of the collaboration was evaluated once a particular stage in its evolution was completed or meant to be completed. The technical and economic achievements as well as the quality of the relationship were examined, i.e. the efficiency, fairness and adaptability of the collaboration in Doz's formulation, and the decision to move forward or to terminate the collaboration followed.²²

It is instructive to examine the collaboration between Freios Varga and Lucas, as it seems to have progressed successfully through most of the learning cycle. The partnership had its origins in the early 1980s as a marketing and technology transfer agreement for Lucas to enter the Brazilian market. A few years later, Freios Varga assessed its performance and decided to expand initially into Argentina and later into the US. Freios Varga approached Lucas to join it, this time as a partner. Lucas would continue providing its brake technology, while Freios Varga would contribute with some initial knowledge of the US market, considerable knowledge about the Argentinian and other Latin American markets and, especially, very strong brake manufacturing capabilities. Freios Varga had improved its process technology significantly through minor adaptations and 'capacity stretching', had become known as one of the most efficient producers in the region and was beginning to develop its own brake technology. Lucas assessed the situation and concluded that the progress made over the years in product and process technology by Freios Varga was significant and that it was worthwhile entering the partnership. As a result, joint production facilities were opened in both Argentina and the US. But the collaboration did not end there. After further working together, Freios Varga and Lucas engaged jointly in developing, manufacturing and marketing a special kind of anti-lock brake technology for the US, Canadian and Latin American markets.

The learning process in the collaboration between Sementes Agrocerec and Biótica was much more bumpy and rather incomplete. The former was a large company with 2500 employees, while the latter had only 28 employees and was strongly research oriented. Communications between owners and top management were cordial but vague in terms of technology. Indeed, the decision to collaborate was taken by owners alone on the basis of the potential financial benefits. Technological specificities were always left to lower levels of management and operational levels, and there were continuous conflicts between both firms arising from different understandings of what the aims of the collaboration were, and the more rigid and structured business culture of the larger enterprise and the more relaxed and informal approach of the smaller one. There was no report of personnel exchange, something that might have eased tensions, and there were differences in evaluation methods, with management from the former focusing on financial results while staff from the latter were more concerned with technical advance.

Benefits

The primary objectives of technological collaborations are to create new products or

production processes or to improve on existing ones. Of the 11 collaborations examined, five resulted in new products and processes. The collaboration between Sementes Agroceres and Biótica developed a new variety of potato seed which was then planted and scaled up to industrial production levels in Argentina four years after the initiation of the project. The first trial batch of the new potato amounted to 35000 boxes of 30 kg and accounted for around 2% of the Brazilian market. The new potato began competing successfully with imports from Europe, which is the main source of supply of the Brazilian market. The joint venture between Biobrás and Eli Lilly led to the development and manufacturing of insulin crystals which are sold to Eli Lilly for distribution to chemists and the Ministry of Health. The collaboration had the monopoly of insulin crystals in Brazil and has been able to export remnants via Eli Lilly. In the cases of the collaborations of Freios Varga and Metal Leve, four new plants were built, two of which were in the US, and several patentable new brake and piston products developed.

In addition, in three other collaborations process improvements were achieved. Apart from the already mentioned case of Sucral an Acetila, there are some concrete examples arising from the GAMDI collaboration. One of these examples relates to Lord SA, one of GAMDI's members. The company often needs to make chromatographic analyses. Under normal conditions, the company resorts to the University of São Carlos and State University of Campinas for the service, but it is always difficult to get time allocated in the instrument as it is in great demand by university researchers and other companies. To address this issue, Lord plans with some anticipation its requests for the service. Lord SA, however, often also faces urgent chromatographic analysis requests. While some of these requests can be postponed, many cannot, which could result in large payments to 'jump the queue'. It is in these cases that GAMDI members are approached and information is obtained as to where a chromatographer is available. The company having the equipment is then contacted and normally by the next day the analysis is completed. While the individual impact on time saving may be large or small depending on the type of emergency, there is no doubt to GAMDI members that having available the necessary instrument or tool in the case of an emergency repair will have a significant cumulative time saving impact on the production process. The Pablo Casará pharmaceutical company, a member of the CONIFARMA partnership, has been able, thanks to technical exchanges with other members, to rationalize and improve the production process of anti-asthmatic devices and odontological and ophthalmologic products, and as a result make available financial resources for R&D which would not have been possible prior to the collaboration. Marketing capabilities have improved for all CONIFARMA members.

It was difficult to obtain data on the financial implications for most of these technical achievements. In the case of Sementes Agroceres and Biótica, however, the cost of the initial batch of new potatoes was US\$90 000 per hectare, which was reduced to US\$10 000 per hectare after the first year of full production. Given that there are further process improvements to make, and as the company moves down the learning curve, it is expected that the cost per hectare will be reduced to US\$6000, a figure that will make the collaboration a leading player in the Brazilian potato market. Since the collaboration Biobrás sales rose from US\$2 million to US\$10 million in the early 1980s, doubled to US\$20 million by the early 1990s and increased again to US\$40 million in the mid-1990s. Unlike before, since the partnership the company has been profitable every single year. Finally, a possible merger between Sucral and Acetila could result in a 30% production and administration cost reduction.

As for the other collaborations, two of them, Americana and Vallée-Vetcorp, are still in progress, so no tangible output can be expected yet. None the less, Vallée's

management has pointed at a number of advantages that are already emerging. Regarding technology, the collaboration is already providing the knowledge inputs required and is forcing Vallée to make efforts to match the knowledge received with some new knowledge of its own. Concerning human resources, the agreement has resulted in an increase in motivation of the people involved in it, thus increasing their performance. The agreement with Vetcorp had also taught Vallée how to integrate a partnership into its own organization. Even in the collaboration with IHC, the management of Vallée found some advantages, particularly in the field of poultry vaccine marketing, as the firm collected considerable information about customers and competitors. Vallée has now started negotiations to collaborate with an Israeli manufacturer of poultry vaccine, and is expecting to enter this market soon.

One important unintended benefit of collaborations was the building of trust. In the specialized literature trust is normally seen as a prerequisite for collaboration.²³ Our case studies, however, suggested that trust is more an outcome of the collaboration as it was built over time, from an apparently initial very low base. Following Humphrey and Schmitz, three types of trust were identified: contractual, competence and goodwill.²⁴ Contractual trust involves partners obeying what is stipulated in the agreement. It would seem to have developed in the cases of CONIFARMA and GAMDI, as partners have always complied with the terms of their cooperation even though there is no contractual or other means of enforcing it. By contrast, the relationship between Vallée and IHC would seem to have been built on the basis of suspicion and distrust. Competence trust refers to the confidence in each other's ability to perform at its best. Vallée's relationship with Vetcorp would seem to have resulted in competence trust, as at least the Brazilian partner was making every effort to match and improve on the Australian's partner knowledge. Goodwill trust is related to mutual expectations of open commitment to each other, implying that partners are dependable and can be endowed with great discretion. This would seem to have appeared in the case of Freios Varga and Lucas. It allowed partners not only to collaborate in technical developments but also to engage in even more advanced forms of cooperation.

The Outcome and Consolidation of Collaborations

The outcome of the eight collaborations that had achieved intended results varied greatly. Two of them, Freios Varga-Lucas and Sucralc Acetila, had travelled or were considering travelling towards higher stages of 'collaboration'. From the mid-1990s Freios Varga and Lucas began engaging in a process of production and organization integration involving production restructuring and relocation, and coordination of production between factories in different countries. For Freios Varga, this meant access to advanced technologies in all fields of brake manufacturing and a much higher level of output, partially arising from economies of scale due to factory specialization. It also meant access to Lucas's traditional markets in Europe and eventually in the Far East. In the case of Sucralc and Acetila, there are clear technological and economic advantages from a merger between both companies. The 30% cost reduction referred to can only be achieved if alcohol and solvent production is concentrated in a single plant. Jointly, the new merged company was able to free resources for R&D and to combine knowledge of sugar fermentation and alcohol-based solvents. The only doubt on the horizon is whether alcohol-based solvents can in the long run compete with petrochemical-based ones. Negotiations are at an advanced stage: the distribution of management and functions in the new company and the amount of shares to be exchanged between companies have already been agreed.

There were three collaborations that were consolidating at the present level of activity. Metal Leve's agreement with its German partner was going well in terms of sales and there was no intention of upsetting it. The process improvement nature of GAMDI's and partially of CONIFARMA's collaborations meant that, in principle, they should be an on-going affair and therefore no major change should take place. In the case of GAMDI, there were some discussions to formalize the collaboration so that more regular use of the pool of equipment could be made, but that was as far as the consolidation stage went.

There were three collaborations that terminated, perhaps prematurely. One of the collaborations that ended was between Biobrás and Eli Lilly. In the mid-1980s, six years after the collaboration had started, Eli Lilly approached Biobrás to terminate the joint-venture. The reasons why Eli Lilly took such a step are not clear, but are probably related to Eli Lilly's growing success in obtaining insulin through genetic engineering, which would eventually reduce the cost of the product substantially and implied that insulin crystals made through traditional methods would be phased out worldwide. Termination meant for Biobrás buying back the 45% share holding of Eli Lilly and more importantly, losing its main distribution channel. But the termination was on friendly terms and Biobrás obtained a two-year extension of the cancellation of the distribution agreement, giving it time to build its own distribution channels and move on to the production of insulin rather than only insulin crystals. It also obtained backing from BNDES for the buy back of shares. Initially, Biobrás controlled 90% of the insulin market, but since liberalization that share has fallen to 70% and is continuing to drop, so the company is now considering using genetic engineering techniques. One of its main competitors is Eli Lilly.

The two other collaborations that terminated were Metal Leve-Allen Bradley and Sementes Agroceres-Biótica. In the case of the former, the reasons would seem to be financial and strategic. In the early 1990s there was a sharp drop in the demand for vehicles and therefore for vehicle components, prompting Metal Leve to restructure its operation. Initially, Metal Leve stopped financial support for the joint venture, but it soon realized it had to divest in order to strengthen other parts of the company. Metal Leve assessed its diversification strategy and concluded that its main competencies were in manufacturing vehicle components, not in selling the equipment that produced those components, so the partnership with Allen Bradley made no longer sense. The reasons were well understood by Allen Bradley, which bought Metal Leve's shares in the joint venture and now operates as an independent company.

Similarly, the termination of the Sementes Agroceres-Biótica partnership was prompted by financial strictures although in this case there were other 'external' factors too. Like Metal Leve, at the beginning of the 1990s Sementes Agroceres and Biótica faced a severe financial crunch due to an overall reduction in demand which affected consumption of corn seeds and human health diagnostic kits, the main products of the two companies. Two additional factors led to the termination. First, as mentioned earlier, the running of the partnership had not been easy and had been marred by conflict. Second, a number of health and import regulations were passed in Argentina and Brazil which made difficult the trans-border trade of trans-genetic seeds and the equipment used in their manipulation. The upshot was that Agroceres closed its R&D unit dedicated to plant biotechnology, which was in charge of new potato seed development, and transferred the know-how to Biótica in case it wanted to continue with the project. Agroceres does not sell new potatoes in Brazil any more. Despite its difficulties, Biótica has been able to recover financially and, given that the actual production of potatoes is done in Argentina, it has been able to continue



production and to export to Brazil again. Indeed, part of the research team previously located in Brazil is now in Argentina. Unlike the previous two terminations, however, this one terminated on an acrimonious note, as there were several misunderstandings and accusations of foul play towards the end.

On the whole, the learning cycle from inception to implementation and then to consolidation was completed in eight collaborations, while another two remained at the implementation stage. Only one collaboration, between Vallée and IHC, actually failed at the implementation stage, although two of the collaborations that terminated after achieving specific results may have done so prematurely, not so much owing to achieving the objectives set initially, which they did, but because of financial and government policy limitations beyond the collaboration themselves. The termination of Biobrás's collaboration also suggests that despite collaborating firms, in developing countries and MERCOSUR, particularly those involved with multinational corporations, must also be able to develop in-house technological capabilities to keep abreast of advances in their field and to avoid being 'dropped' by their more technically competent and rapidly learning foreign partners.

Main Conclusions

MERCOSUR firms' proportion of technological cooperation agreements is to date very small and concentrated in low- and medium-technology industries. Furthermore, there is no clear source of potentially significant expertise in the new high-technology areas. This results from their modest efforts to innovate. Yet MERCOSUR firms' collaborations share a number of features with even the most advanced collaborations elsewhere.

The motives underlying MERCOSUR firms' collaborations involved exploiting technological complementarities and obtaining technology and knowledge unavailable to them. The 'fusion' of own and partner knowledge was a chief aim in most collaborations, although, unlike perhaps the experience in developed countries, where the emphasis of both collaborators is product knowledge, it was found that particularly where a collaboration with a multinational corporation was involved, the local firm mainly provided marketing and process knowledge. Thus, main competencies in many local firms still remain in local market information and efficiently adapting technology to local production conditions and local customer requirements. Another major objective of MERCOSUR firms' collaborations was improving available information and knowledge and solving specific technological problems or bottlenecks, particularly in the case of small enterprises. The modes of governance would seem to be related to the type of collaboration, with those involving product and process knowledge requiring contractual or equity arrangements, and those involving only process technology being based on informal agreements.

In analyzing technological collaborations by MERCOSUR firms, it was found that the better prepared a corporation entered an agreement the more successful the collaboration was likely to be. It was a matter not only of finding the right match technologically, which in itself was a difficult task and required screening locally and internationally the advances taking place in the field of interest, but also of identifying the correct institutional match, as corporations had to coincide in their expectations and the means to achieve them, and should be able to combine their national and business culture with that of their partners. A casual approach to collaboration can very quickly turn into conflict and termination without any concrete benefits, as the case of Vallée-IHC showed.

The case studies revealed that it was not only a solid preparation that guaranteed success in collaborations. It was also necessary during the implementation of the cooperation to engage in a learning process or learning cycle, as the case of Freios Varga illustrated. This learning cycle required intense technical interactions and exchange of ideas with partners, exchange and training of personnel and the adoption of methods of assessment. Where technical interactions were well intended, transparent and participants were receptive to each other, the collaboration would seem to have progressed smoothly and partners felt that the relationship had been fair and accommodating to their interests. The flow of information and knowledge was greatly enhanced where interactions took place at different levels of the firm and had been mediated by a combination of formal, informal and personal relationships. Exchange of personnel and training brought an even better understanding of the technical and institutional differences between partners, while continuous assessment provided the partnership with a sense of achievement both in terms of the fairness and adaptability of partners and in terms of output. The trajectory followed by Freios Varga and Lucas suggests a cumulative and mutually beneficial pathway of learning for firms entering and being successful with even the most basic kinds of collaborations, but that quickly and accurately assess their technical and economic performance and capitalize on previous success by moving on to the next stage.

Most of the collaborations studied were successful in terms of achieving product or process innovations and improvements. In technological terms, the partnerships yielded new patentable and non-patentable products and new factories. There were also some non-tangible benefits, as in the case of Vallée-Vetcorp, where the local partner was forced to improve its own knowledge in vaccine technology to keep up with the knowledge being provided by the partner. Biobrás, in contrast, was eventually 'dropped' by Eli Lilly because it was not able to move into genetically engineered insulin. Market information that otherwise would not have been obtained was another benefit in several collaborations. Some process improvement experiences were described, as in the cases of Americana and GAMDI. Yet an important benefit not often highlighted in the literature as such was the building of trust between partners, which allowed most collaborations to move forward.

As far as the termination of collaborations was concerned, the case studies suggested that while financial reasons had not been a prime motive in their inception, they had been a key factor in their premature termination. Termination seemed particularly premature in the case of Sementes Agrocereas and Biótica, where, despite poor relationships, the financial benefits of the collaboration were not far from being achieved, but the short-term pressures on the companies would seem to have been so acute that substantive benefits two or three years down the line were just too far always. This rather premature ending would seem to highlight further the role of a stable political and economic environment, as the first activities to be cut in a financial crisis, despite their potential, are those that are riskier and tend to yield results in the longer run.

An important finding that deviates even further from the literature has to do with the role of 'external' factors, notably the role of government and business associations. It was clear from the case studies that some of the more restrictive government policies would seem to have partially hampered the continuation of one of the collaborations studied. Yet they had a key role, especially, although not exclusively, at the inception of collaborations. Government policies, programmes, institutions and business associations brought partners together by providing information and acting as a forum for discussion, as in the cases of Americana, Biobrás Eli Lilly and Sementes Agrocereas.

Biótica; provided the conditions for the successful operation of the partnerships, as in the case of the Ministry of Health and Biobrás; granted financial support for the creation of and at crucial junctures in partnerships; and established the mechanisms or modes of governance in some of the collaborations analysed. Governments' and business associations' effectiveness in initiating technological collaborations would seem to be related to the specificity of the associations and programmes—the closer to the sector or the technology the greatest their effectiveness—as the needs of firms vary widely from one sector or even subsector to another, something that has been pointed out by research on the role of government programmes and business associations in Brazil.²⁵

Policy Recommendations

Expanding technological collaborations will be no easy task for the majority of MERCOSUR firms. It requires major investments in capital goods, scientific instrumentation, new organizational techniques, R&D and R&D personnel. It also requires unremittingly engaging in all the phases of the innovation process. But the government could play a key facilitating role too. Indeed, there are a few areas where public policy could be quite effective in propitiating further innovation and technological collaborations.

The first area for policy intervention is increasing the efficiency of existing government programmes aimed at innovation. At present, there are a number of programmes or institutions, such as PACTI or SEBRAE, which are promoting technological collaboration and innovation with varying degrees of success.²⁶ The efficiency of these programmes could be increased by incorporating a number of interrelated ideas arising from the field of economics of asymmetric information.²⁷ One idea refers to the use of incentive contracts. These are basically contracts that introduce incentives to achieve a particular objective without taking all the risk away from the beneficiary. Existing co-sharing agreements go some way in this direction, but a fixed proportion of co-financing, as most of the existing promotional mechanisms have, does not address the specificities of the risks involved in each project. A related idea is a change in the criteria for eligibility ('signalling') in government programmes. The experience of use of government programmes shows that only those firms that are more advanced technologically are the ones that use those programmes. Human resource requirements, such as having a number of holders of PhDs for research, contribute to that, as most firms have never seen a PhD holder. A switch to criteria that better reflect the objectives or results being sought would further increase the efficiency of programmes. A third idea refers to the use of insurance contracts, which would reduce the risk of failure to firms and as a result prompt them to enter high-technology sectors. All these contracts and programmes can be easily adapted to include technological partnerships.

Public policy could also have a direct impact on the growth and quality of technological collaboration agreements. Obviously there is a need for more systematic research and data on the extent and impact of technological collaborations in MERCOSUR. Meanwhile, however, there are a number of concrete policy initiatives that could be useful given the present state of knowledge. One first policy initiative refers to making information on the potential of technological collaboration and on possible specific cooperations more widely available. This would be of particular use to small and medium-sized firms which do not have the resources to hire external consultants. More extensive awareness and publicity campaigns, like those already initiated in Chile, could be quite effective too. The second policy initiative refers to allocating specific funds or loans for technological partnering, particularly between firms.²⁸ Funding

could go to brokering or consultancy services to identify possible partners and assist negotiations or to financing specific aspects of an agreement, especially in high-technology fields. A third policy initiative would be to introduce specific funding mechanisms for upgrading partnerships which involve only marketing agreements. One final, rather bold, policy initiative would be to support strictly technical collaboration agreements with firms that have no presence in the MERCOSUR region, particularly with regard to information technologies, biotechnology and new materials. Preferably, this should be done with small and medium enterprises from developed countries or equivalent firms from developing countries, to avoid possible size and knowledge asymmetries, as the collaboration between Vallée and Vetcorp illustrated. This would have the advantage of bringing new knowledge into the region and should result in the emergence of new high-technology businesses.

Another area for public policy is complementing supply with demand-oriented incentives. Although a more general justification for demand-driven programmes is still pending, it does seem reasonable to say that they could be a good complement to supply-driven ones. The impact of government procurement policies in countries such as the US, Korea or Taiwan has been extremely positive in developing local productive and technological capabilities and technological partnerships in high-technology areas. But demand-oriented policies need not limit themselves to government procurement. Promoting the sale of new products to foreign markets or promoting agreements between local partners or between local and foreign partners for exports of new products could be an effective way of linking technology and trade policies. Egan and Mody point out that these kinds of export agreements reduce barriers to entry to foreign markets and provide information about markets that otherwise would not be available.²⁹ Policies promoting export-oriented partnerships would not contravene any of the current international trading regulations.

There is also a role for public policy intervention in the simplification and flexibilization of rules and institutions, and in creating homogeneity in technological collaboration regulations across MERCOSUR countries. Given the repeated complaint by business 'clients', there does seem to be a clear-cut case now for simplifying the cumbersome and bureaucratic procedures for accessing innovation and technological partnership programmes.³⁰ Universities' 'liaison' offices would seem to be an appropriate model, and perhaps a similar approach could be used by other government agencies. Whatever institutional solution or approach is chosen, it has to be vested with great flexibility and discretion. Only if the new or modified institutions and approaches have those capacities will they be able to tailor programmes, incentives and contracts to the specific needs, and perceptions, of users. Regarding homogeneity, there seems to be ample scope for the promotion of intra-MERCOSUR partnerships. Collaborations are already taking place and they are only likely to increase as integration expands. But sustaining growing partnerships will require more commonality in legislation and incentives between MERCOSUR countries in order to avoid unnecessary costs and misunderstandings. More interaction between local firms and individuals will help to address the problem of differences in business cultures. Exchange and mobility programmes between professionals, technicians, researchers and students should also help to reduce differences.

Finally, the experience of our case studies has suggested that involvement of other organizations such as universities or business associations has had a positive impact on promoting technological collaborations. Public policy, therefore, should consider channelling some of their incentives or contracts through these organizations on a more sustained basis.

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