EXPORT PIONEERS IN LATIN AMERICA



Edited by

Charles Sabel, Eduardo Fernández-Arias, Ricardo Hausmann, Andrés Rodríguez-Clare, and Ernesto Stein

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Editors

Inter-American Development Bank

David Rockefeller Center for Latin American Studies
Harvard University

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PREFACE

How do new, successful export activities emerge in developing countries? What type of challenges do export pioneers face on the road to success and how are they overcome? Under what circumstances would pioneers fail to emerge?

Nearly a decade ago, Ricardo Hausmann and Dani Rodrik identified a potentially serious problem facing export pioneers looking to "discover" new activities that may fit a country's comparative advantage. Self-discovery, the argument goes, requires costly experimentation. If successful, the pioneer will presumably be rewarded with market opportunities. But he will not be alone: others, inspired by his success, may hop on the bandwagon, free ride, and enjoy the benefits. Thus, the pioneer may not enjoy all the returns from his investment in exploration. Consequently, some would-be pioneers will be deterred from exploring, investment in self-discovery will be lower than what would be best from a social welfare point of view, and a country's export bundle will be narrower than what is optimal for development.

The discovery of advantages in blueberry production in Argentina is a case in point. Caffarena, the pioneer, had to learn about the suitability of the soil, the varieties that would grow best, the diseases that posed threats, the specific locations with the best climatic conditions as well as the international shipping and marketing requirements. In the process of experimenting, he made a striking discovery: the soil and weather conditions of the pampas allowed blueberries to reach the market one month before those from competing countries, allowing Argentine blueberries to command a much higher price. His discovery, of course, did not go unnoticed. Soon he had lots of company, which had adverse effects on the market price and on his ability to recover the cost of exploration.

Has this type of problem deterred other breakthroughs and left other exports undiscovered? How widespread and damaging are these obstacles to

appropriating the full return to self-discovery in practice, and how have successful pioneers managed to overcome them? Perhaps more importantly, are there other pressing problems pioneers must deal with in order to achieve success, such as the absence of a supportive environment for exploration and export development? How do these challenges depend on the type of product and the industrial organization of the sector involved? Is there a role for government intervention in supporting new export success?

This book reports and analyzes the findings of a research project on the emergence of new, successful export activities in Latin America. Nine research teams in seven countries—Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, and Uruguay—embarked on a quest of their own to identify leading examples of new export activities and reconstruct in detail their problems and their solutions. To help ascertain barriers to the success of new activities, the research teams also considered failed efforts to develop similar exporting activities. The comparison with these counterfactual cases helped isolate specific factors that may have made the difference between success and failure.

Altogether, the research project documents and analyzes the emergence of more than 30 new export activities in a rich variety of settings. Some of them are very recent and are still emerging, while others occurred decades ago and have become a staple of their country's exports. Some activities emerged on the basis of market forces, while others were helped by heavy doses of government intervention. While many of them refer to primary products, others involve manufactured goods and services. Some activities involve products of low technological complexity, while others are technologically complex.

As coordinators of this project, we guided the research teams in their investigation, with the help of Ricardo Hausmann and Andrés Rodríguez-Clare as academic advisors. The resulting working papers covering the full array of new, successful export experiences can be accessed at the following link: http://www.iadb.org/en/research-and-data/project-details,3187.html?id=89.

Fortunately, the papers caught the attention of Chuck Sabel, who joined the team and helped us convert this rich, extensive body of information into a readable book. He assisted in selecting a more manageable number of export cases, sharpened their focus, and wrote a first chapter that provided an overall framework for the book. The result is in your hands. The book comprises 11 cases of successful new export activities: blueberries and TV formats in Argentina; aircraft, pork meat, genetically modified soybeans, and wood furniture in Brazil; wine in Chile; fresh cut flowers in Colombia; avocados in Mexico; and animal vaccines and software in Uruguay. A strong message from

the book is that being rich in natural resources is no curse; every sector of the economy is open for fruitful exploration into new export ventures.

The central finding of the book is that the problems of appropriability envisioned by Hausmann and Rodrik are secondary to coordination problems that must be solved on the road to success. Overcoming these problems is often difficult, if not impossible, for the pioneer alone. Effective public policy through the provision of public inputs in support of the activity can be a key ingredient of export success. Interestingly, the very diffusion from the pioneer to his followers that creates the expected problems of appropriability can also help create the critical mass necessary to overcome key coordination failures.

We hope that the information in this book will help guide governments in the region as they seek to boost their countries' exports, and serve as an inspiration to the many budding exporters across Latin America and the Caribbean.

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CHAPTER 1

Self-Discovery as a Coordination Problem

Charles Sabel

Economists agree that the price system is indispensable to the efficient coordination of economic activity, yet there is deep and persistent disagreement within economics as to how prices contribute to this end. In one view, prices offer a detailed, reliable, and nearly exhaustive survey of current constraints and opportunities, even reflecting the reactions of rational economic actors to the information provided. A rough analogy would be a road map showing not only current traffic flows, but also where, and at what terms, travelers without vehicles can rent vehicles, and the reaction of drivers on and off the road to the response to all this information. This augmented map would be much more than a convenient overview of the connections among places. It would provide an almost self-sufficient guide to the attractiveness of various routes and step-by-step instructions on how to traverse them. In this view, a chief goal of economic policy is to protect the price system from distortions on the assumption that, functioning properly, it will direct self-interested actors to endeavors serving their interests and the means to achieve them, while advancing the social interest in the efficient deployment of resources.

In the opposite view, associated with F.A. Hayek and the Austrian School, prices are seen as a necessary but far from sufficient instrument of coordination. Changes in relative prices, in this view, communicate crucial information about the availability of productive inputs and the expansion or contraction of markets for general classes of goods. But given that prices are statistical

aggregates, and thus of necessity abstract away the full variety and flux of market activity, economic actors must almost always make decisions by combining prices with highly detailed, local, or idiosyncratic information regarding inputs, production processes, or products.[1] Through this combination of local and general knowledge, economic possibilities are explored and revealed. The entrepreneur is the master of this art of combination, and thus becomes the agent of innovation, commonly doing familiar things by new methods—and less frequently, but regularly, producing novel things by recombining familiar means in surprising ways. The price system in this view is not a road map of possibilities and responses to them, but a language of cooperative exploration, sufficiently precise to make manifest the doings of others, so that we can take account of their actions in our own investigations, but open-ended enough to admit and require entrepreneurial decisions—a few of which prove successful and inflect the language of price itself (Hayek, 1949; Hayek, 2002).[2]

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[1] The kind of statistics expressed in prices, Hayek writes, "have to be arrived at precisely by abstracting from minor differences between the things, by lumping together, as resources of one kind, items which differ as regards location, quality, and other particulars, in a way which may be very significant for the specific decision. If we can agree that the economic problem of society is mainly one of rapid adaptation to changes in the particular circumstances of time and place, it would seem to follow that the ultimate decisions must be left to the people who are familiar with these circumstances, who know directly of the relevant changes and of the resources immediately available to meet them" (1949: 83–84). Hayek assumed that this local knowledge was inherently tacit—incapable of being articulated—and therefore unavailable for discussion or deliberate revision. He believed further that this feature of local knowledge severely limited the coordinating capacities of organizations of any kind, but particularly bureaucracies. There is a modern class of nonhierarchical organization that relaxes the limits on coordination precisely by devising routines for making local knowledge partially explicit for purposes of problem solving. Contemporary industrial policies rely increasingly on such organizations. For discussion, see Sabel (2006).

[2] The problem addressed by the price system "is precisely how to extend the span of our utilization of resources beyond the span of the control of any one mind; and, therefore, how to dispense with the need of conscious control and how to provide inducements which will make the individuals do the desirable things without anyone having to tell them what to do. The problem which we meet here is by no means peculiar to economics but arises in connection with nearly all truly social phenomena, with language and with most of our cultural inheritance, and constitutes really the central theoretical problem of all social science" (Hayek, 1949: 88–89). Hayek considered competition itself to be a discovery process in a sense closely related to the idea of discovery under discussion here: "It is useful to recall that wherever we make use of competition, this can only be justified by our not knowing the essential circumstances

When this view of the price system prompts policy interventions, the emphasis is naturally on supports to entrepreneurship and innovation broadly conceived: patent policy (to align individual and social returns to invention), venture capital and other programs to finance start-ups, public support for "basic" R&D, and to construction of national, regional, and international "systems of innovation," linking universities, public research facilities, and firms.

Ricardo Hausmann and Dani Rodrik have recently called attention to the relevance of this Austrian perspective on the price system, and policies in support of entrepreneurship in the Austrian sense, in a provocative essay on what they call cost-discovery or self-discovery, or "learning what one is good at producing" (Hausmann and Rodrik, 2003). Their foil is conventional development economics, which, as they put it, reduces the formula for growth to "good institutions" (a well-functioning price system) plus "foreign technology" (currently efficient know-how embedded in machinery and available on world markets—the vehicle rentals indicated on the map of efficient routes). But as they observe, three well-documented circumstances of development cast doubt on this rational expectations view.

First, within very broad categories, such as "labor-intensive" manufactures, the exports in which a country specializes are often determined by happenstance—who meets whom—or, in what amounts to the same thing, by the results of an idiosyncratic and costly search process. Thus, Bangladesh exports large quantities of "hats and other headgear, knitted or from textile material not in strips" to the United States, but hardly any "bed sheets, pillowcases and bed linen (incl. sets)" (Hausmann and Rodrik, 2003: 615–16). Pakistan, meanwhile, despite similar endowments, specializes in bed sheets but not hats.

Second, even in the case where the search points to the use of available (foreign) technology, the imported equipment must be substantially altered, at additional cost, to adapt it to local circumstances. It is as if the user's manual of a rental vehicle advises that the transmission, fuel injection, and brakes have to be reconfigured or rebuilt, at unknown expense, to account for the altitude and road conditions the driver will actually face.

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that determine the behavior of the competitors. In sporting events, examinations, the awarding of government contracts, or the bestowal of prizes for poems, not to mention science, it would be patently absurd to sponsor a contest if we knew in advance who the winner would be. Therefore, as the title of this lecture suggests ("Competition as a Discovery Procedure"), I wish now to consider competition systematically as a procedure for discovering facts which, if the procedure did not exist, would remain unknown or at least would not be used" (Hayek, 2002: 9).

Third, the costs of search and adaptation may well not be recoverable by the pioneering entrepreneurs who bear them because once the feasibility of an export has been demonstrated, imitators crowd into the market, competing away rents.

It follows that without some protection of those rents—the equivalent of patent protection for inventors of new products in advanced countries—potential entrepreneurs will be discouraged from searching in the first place, and developing economies will miss important opportunities because of curtailed cost-discovery or self-discovery. A formal model buttresses the intuition that the "laissez-faire" regime produces too little entrepreneurial investment (as measured against the results obtainable by a social planner also ignorant of "true" local prices ex ante). It is, of course, difficult to estimate the cost of the opportunities lost through this underinvestment (assuming that it is indeed a key obstacle to developing exports), but in related work Ricardo Hausmann, Jason Hwang, and Dani Rodrik show that countries tend to "become what they export" (2007).

Countries that export goods typical of those produced in high-productivity, rich countries become richer themselves and more productive.[3] This results in part from the revenues that high-productivity exports earn, but more fundamentally through the learning or capacity-building possibilities they afford. Thus the gains of self-discovery are multiplied by the subsequent learning that it enables, and the costs of its curtailment in any one period are multiplied by the costs of opportunities later lost.

Indeed, Hausmann and Rodrik conjecture that costly limits to self-discovery could play an important part in explaining why Latin American economies performed poorly in the 1990s, despite having rigorously implemented orthodox reform programs that increased the "goodness" of their institutions, as measured by the most reliable indexes. As their modeling shows, the textbook, laissez-faire regime to which the reforms aspired leaves the private

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[3] For each product in international trade, Hausmann, Hwang, and Rodrik define a measure—PRODY—reflecting the (implied) productivity of the countries exporting it. The PRODY of a product is the weighted average of the per capita gross domestic products (GDPs) of exporters, where the weight given each country is determined by its revealed comparative advantage in the product. For each trading country, they construct a measure—EXPY—to express the level of (implied) productivity corresponding to its basket of exports. A country's EXPY is thus just the export-weighted average of the PRODYs of its products. Hausmann, Hwang, and Rodrik show that a country's EXPY is "a strong and robust predictor of subsequent economic growth, controlling for standard covariates" (2007: 3).

return to entrepreneurship significantly below its social return. So general improvements in the quality and coverage of property rights, or in the overall ability of investors to appropriate returns, did not automatically improve conditions for investors in entrepreneurship, and may well have worsened them. The reforms could have produced this perverse effect directly by removing barriers to entry in new markets, thereby making it easier for imitators to benefit from pioneers' efforts, thus discouraging pioneering. The reforms also may have produced indirect perverse effects by creating new opportunities in traditional export sectors, further reducing the entrepreneurial resources available for exploring new markets below the (insufficient level) fixed by the laissez-faire regime. From this perspective, the reforms unintentionally—but at great social cost—traded a short-term improvement in market efficiency for a long-term impairment of innovative capacity.

Like any useful and plausible challenge to orthodoxy, the argument about the centrality of self-discovery to development is at once analytic and heuristic, combining both precise and narrow assertions with a general but distinctive approach to exploration and problem solving in a particular domain. Here the analytic claims concern the deterrent effect of imitation on cost-discovery in developing economies, and the need to adjust accordingly the conditions of appropriation—the terms governing the ownership of returns to an economic activity. The heuristic is the emphasis on the centrality to development of learning and exploration, as opposed to the efficient combination of resources according to known recipes or blueprints. The heuristic can prove fruitful when it is conceptually at odds with the analytic claims, or even when the latter fail. Thus it could be, as Hausmann and Rodrik suggest, that appropriability problems limit self-discovery, and the remedy is a developing economy analogue to patent protection. In that case, identification of the obstacle to development would depend on some "heterodox" conceptual elements —because self-discovery as an activity or process is not easily cognizable with the "orthodox" ideas of rational expectations economics. But the remedy—a modification of property rights to protect export discoverers against expropriation of the returns on their efforts—would be congenial to the most orthodox economist.

Or it could be that self-discovery is both central to development and difficult to accomplish, but that the difficulty has much less to do with problems of appropriation than with those of coordination: for example, supplying industry-specific public or club goods the actors need, such as technical assistance in meeting phytosanitary requirements, but that they do not supply themselves because of coordination failures. In that case, heuristics and

analytics would be (more) consistent, and both would be, in the broad sense intended here, heterodox. Economists are not accustomed to thinking that the appropriate response to market failure is the construction of an institution to provide club goods in the form of highly specific services. Only careful empirical research—focused on testing the analytic assertions, yet searching enough to detect the large features to which the heuristic points—can guide us in deciding how, if at all, to put this provocative setup to use.

The research project on the emergence of new, successful exports in Latin America, whose results are presented in the following chapters, has these features. The project was conceived as an exploratory test of the claim that impediments to self-discovery play an important role in the process of development. Research teams in each participating country were asked to identify leading examples of new export activities, and to reconstruct in detail the problems on the way to success, and how they were overcome. A new activity was defined as involving a good "that was not produced two decades ago (even for the domestic market) but has recently emerged and experienced strong growth, going from basically zero to becoming a 'major' export." To help ascertain barriers to the success of new activities, the research teams were also asked to consider a "counterfactual" case: a failed effort to export a good ideally identical in all ways but one to a product that was successfully exported and revealing, in this difference, a (possibly general) constraint on self-discovery.

Identification of candidate cases required a wide and thorough review of export performance, and uncovered a great variety of products, many of which would have gone unnoticed in a conventional survey of exports: In Argentina, for instance, the list of successes included light pleasure boats, bioengineered vaccines, and television "formats"—plot lines designed to be customized for particular markets. Some research teams searched more broadly still, relaxing the definition of a "new," successful export activity to include the "reinvention" of products established on the domestic market—pork, GMO soy, and regional aircraft in Brazil, for example, or wine in Chile—to make them competitive in international trade. As the authors of one of the Brazilian studies noted, this made it possible to observe whether prior knowledge of local production costs reduces the difficulties of meeting the quality and phytosanitary requirements of world markets. Because the case studies—a selection of which are included in this volume—sweep broadly while attending to the counterfactual clarification of causality, taken together they provide an important first test of the analytic claims of the self-discovery argument regarding appropriability, and the relevance of its heuristic claim that learning is central to development.

With what results? The first finding is that problems of appropriability, while plausible given the theoretical gap between social and private returns to entrepreneurship in a laissez-faire regime, emerge in the case studies as clearly secondary to problems of coordination—in the rough and general sense of difficulties in determining what export markets will accept, and actually delivering such products. The reason is that in solving coordination problems, innovators frequently mitigate problems of appropriation. One way solutions to coordination problems reduce risks of appropriation is by creating barriers to entry, which keep imitators out. Another is by creating fluid industrial structures that offer potential rivals more to gain from specializing in complementary activities than from competing directly. Both mechanisms will be examined in some detail below.

That successful coordination helps address problems of appropriation does not mean that achieving it is easy. A second key finding of the case studies is that it is anything but. Even with regard to products with relatively short supply chains and well-established, fully open markets—cut flowers, for example—the accumulation and linkage of the capacities needed for export production is arduous, and typically time-consuming—often taking years, and in the case of the "reinvention" of established products, a decade or more. The "world market" as revealed in these studies (and as suggested by the reference to the particular exports of Bangladesh and Pakistan) is not a market for things the whole world wants, but rather an institution for connecting very particular consumers with producers specialized in the particular things those consumers (come to) demand. The process of simultaneously exploring what should be made and how to make it—with (shifting) constellations of partners and collaborators in other firms, and often with public entities—is fraught with uncertainty, as the case studies document in cogent detail.

Essentially all the cases involve the creation of various industrial structures for generating continuous product and process innovation, not the discovery of one viable export. In order to find at least one successful export, it is necessary to coordinate construction of an engine capable of searching among many possibilities. To continue succeeding in export markets, that engine must be continuously refurbished so that it can search under changing circumstances. Self-discovery, in other words, is not a single, culminating act, like sighting and taking possession of some much-sought territory. It is, rather, like the discovery of a vocation or calling, a persistent exploration. Moreover, this process of exploration seems to be the same for the development of "wholly" new exports as for the reinvention of existing products for export. Adapting the system for producing pork for the domestic Brazilian market to

suit the needs of Japanese customers does not appear to be fundamentally different from entering the field of vaccine production or cultivating new fruits for export. It will never occur to a reader of these studies that export success results automatically from the combination of good institutions and foreign technology. Nor will it occur to the reader that export success, once obtained, is self-perpetuating. The Hayekian view of economic decision making as depending on the continuing fusion of general knowledge of prices and local knowledge, and the Austrian emphasis on entrepreneurship will, on the contrary, seem nearly self-evident. In this sense, the studies fully support the heuristic value of self-discovery.

These two findings point toward a preliminary policy conclusion whose thrust differs from the one suggested by the initial formulation of the self-discovery idea. The emphasis on problems of imitation and appropriation in the Hausmann-Rodrik view led naturally to the idea of protecting investments in entrepreneurship in developing countries by some analogue to the patent protection afforded inventors in the advanced economies. But to the extent that the central problems of self-discovery concern coordination rather than appropriation, this suggestion may be misplaced. Very generally speaking, the policy response to coordination problems is industrial policy, understood broadly as the ensemble of public supports—ranging from agricultural and industrial extension services, to publicly supported research, to venture financing arrangements—that make it easier for entrepreneurs to locate and collaborate with the public and private partners they need to define and execute their projects. There are important traces of such policies in the cases of Brazilian GMO soy and aircraft, and in animal vaccines in Uruguay, as well as wine in Argentina and Chile. Current research on the development of new products in Latin America underscores the importance of this kind of intervention. Notice that such policies have an analogue in the advanced economies too, where they are typically referred to not as industrial policies but as measures to support innovation. That innovation policies or, more grandly, national systems of innovation, are commonly regarded as necessary complements to patent regimes is an indication that the coordination problems inherent in self-discovery persist, and require systematic attention, even when problems of appropriation are addressed either by explicit policy or in the course of solving other problems (Fong, 2000).

Still, this conclusion remains tentative, not least because of the qualification to the findings alluded to above. As Hausmann and Rodrik anticipated, it is hard, for two reasons, to test their key assertion concerning the importance of appropriation. The first is that in cases where problems of appropriation *do*

doom an export activity, the failure leaves few traces, and no direct ones in a sample of successful, new exports. The presence of the cause, in other words, skews the evidence in ways that misleadingly suggest its absence.

The second reason is that where problems of appropriation are especially serious, the only successful exporters will be those who have managed to protect themselves against imitation: for example, by devising technologies or differentiated products that are hard to imitate—or both, as illustrated in many of the case studies. "After all," Hausmann and Rodrik write, "a direct implication of our argument is that only investments that provide such protection will be undertaken in equilibrium" (2003: 614). Here the effects—successful adaptations to the problem of appropriation—misleadingly suggest the irrelevance of the difficulties to which they are a response. The attention to counterfactual cases in this volume and the level of detail achieved in the case studies go some way toward attenuating the problem of a censured sample: If problems of appropriation are pervasive, they can be expected frequently to play a role in explaining near successes and near failures. But the qualification remains and it is hard to know, in the absence of near-experimental research that is unlikely to be obtained in this domain, how empirical evidence can be generated to evaluate its significance.

Additional reflection suggests that these confounding effects—by which causes work in ways that cover up their own tracks—are unlikely to be severe when self-discovery is a serious and general problem. Self-discovery is problematic and an obstacle to development only when foresight is limited. With limited foresight, agents will not be able to avoid miscalculations about the imitability of their actions, any more than they can avoid miscalculations in estimating production costs. So if appropriability (as contrasted with coordination) really is a central problem in such a limited foresight, self-discovery world, there should be cases where first movers are surprised and overcome by imitators, and other cases where they are surprised but beat back the followers. There is some evidence, but not much in the case studies, suggesting again that the problems of discovering new exports have more to do with coordination than with appropriability.

But we are hardly out of the methodological woods yet. It is just as reasonable to make the contrary assumption that the risks of imitation are easier to anticipate correctly than other aspects of self-discovery. Estimating them, after all, involves local knowledge—expectations about what friends and colleagues will do—rather than guesses about the response of distant others. In that case, the sample will still be censured in a way that conceals important information, leaving the findings as inconclusive as before. This guessing game

about what is reasonable for entrepreneurs to expect can be extended, but it will remain inconclusive.

To sidestep this kind of methodological problem, it is assumed here, on the basis of the evidence presented in the cases rather than conjectures about evidence they might have missed, that the solution to the appropriation problems of self-discovery is a by-product of a solution to the coordination problems, and the focus of the discussion is on the latter. This leaves open the question of just what burden, if any, appropriability by itself imposes on self-discovery. But it has the great advantage of focusing attention on what can be learned from the case studies rather than on what cannot. The next section details the links between industrial organization as a solution to the coordination problem, on the one hand, and barriers to appropriability, on the other. It groups the cases under three organizational rubrics: *clusters*, or groups of small and medium-sized firms that both compete and collaborate with one another to produce a range of specialized products; *platforms*, or common architectures or operating systems that link complex and changing subsystems; and large *vertically integrated firms* adopting some form of Toyota-style, lean production to obtain economies of scope as well as scale. Each of these organizational types is seen to address the problem of coordination in a characteristic way, and to create correspondingly specific barriers to appropriability.

The distinctions are, of course, analytic. In practice, various types of industrial organization can overlap and co-occur. The software cluster in Uruguay, for example, groups a number of firms that are themselves platform producers, while the underwear and swimwear cluster in Colombia includes firms that vertically integrate several stages of production while organizing others as subcontracting systems that could well develop into platforms. For purposes of this volume, it is simply important to note that this fluidity of forms creates additional possibilities for individual producers to find places suited to their (changing) capacities in complex production systems. None of these forms is typical of, much less limited to, developing countries. On the contrary, platform and cluster production are widely thought to provide flexibility and agility in responding to shifting markets—features that give them competitive advantages today over the vertically integrated firm. This is one of the reasons that vertically integrated firms are moving in the direction of lean production. A significant contribution of the research project on new exports is thus to begin documenting just how adaptively "modern" the industrial structures emerging in Latin America are becoming.

The third part of this discussion looks at the exceptional cases where industrial policies—particularly agricultural extension services, but also support

for platform building in aircraft production—played an important part in the discovery of new exports. These cases are in a sense historical accidents: the relevant policies were put in place in the 1960s or earlier, well before the period surveyed in the project begins, and before enthusiasm for the laissez-faire policies associated with the Washington Consensus severely restricted possibilities for new initiatives aimed at supporting particular economic activities (rather than improving the general investment climate, or the functioning of, say, financial markets). The survival of some of the early industrial policies and their manifest contribution to significant innovative activity provide important clues about the kinds of public interventions that can help private actors address the coordination problems associated with self-discovery.

The fourth part connects the discussion of self-discovery and the broader problem of the diversification of exports to the earlier debate in Latin America, associated with Raúl Prebisch, regarding the possibility of structural limits on development rooted in the division of labor between advanced and developing economies. It suggests, on the basis of the study's findings, that the developmental contribution of (reinvented) primary goods to the fundamental task of diversifying and augmenting the capacities of an economy is not as inherently limited as the structuralists took it to be. It asks, provocatively, whether an important avenue of Latin American progress could lie in the productive interchange between agriculture, industry, and science that proved a path to growth in countries such as Denmark, Finland, and Malaysia in the last century.

How the Solution to Coordination Problems Mitigates Appropriation Problems in Clusters, Platforms, and Vertically Integrated Firms

Clusters

Clusters are geographically compact agglomerations of small and medium-sized firms, competing and cooperating with one another in an industry characterized by volatile or rapidly shifting demand, with each firm specializing in a particular phase of production or in a production process. Finished goods are produced by groups of firms collaborating in rapidly shifting constellations.[4]

[4] Up to some limit, the more firms in a cluster, the easier it is for each firm to find the partners it needs, and the lower its costs of production. Up to the size limit, therefore, firms in a cluster constitute positive externalities for one another. The attraction of these positive externalities is (part of) what draws firms to the cluster in the first place, causing agglomeration (see Hoover and Vernon, 1959; Krugman, 1991).

By recombining and thereby augmenting fragmented, specialized, and local knowledge, a multiplicity of cooperative firms in a cluster adapts rapidly to changes in the economic environment.

Agglomeration—clustering—results from positive returns or network effects arising from two sources. First, the more firms with complementary capacities in a locale, the more attractive that locale becomes for suppliers of inputs used by all, but too specialized and costly for any one firm to provide. The improvement in supply conditions in turn attracts new producers of end and intermediate products. In this way, growth (up to some limit) of the agglomeration reduces the production costs of the individual components.

Second, the greater the number of firms (again, up to some limit), the more likely each will find complementary collaborators—with the same result. Clusters of this kind played an important role in the industrialization of parts of Europe and the United States from the late eighteenth century onward (Sabel and Zeitlin, 1997). Variants are common in more recent industrializers ranging from Japan to Taiwan, Brazil, Kenya, and Italy, and in the development of Silicon Valley.[5] Since the turbulence in the markets for mass-produced goods in the mid-1980s made valuable the ease with which clustered firms could recombine as conditions changed, clusters are a microcosm of the "new" economy, able to prosper in much more volatile conditions than the vertically integrated large corporation (Gilson, Sabel, and Scott, 2009).

If self-discovery is threatened by appropriation problems, it seems at first blush that this threat will be most acute, and most easily observable, in clusters. Clusters originate, after all, in acts of self-discovery that combine strategic search and serendipity in ways that can seldom be kept private for long. An enterprising spirit in a village with a tradition of weaving straw baskets sees that straw hats are all the rage in the city, and thinks of entering that market, for example; or an urban manufacturer of straw hats comes upon that same village in search of additional, low-cost production capacity; or the two cross paths, recognize a kinship, and join forces. However exactly maker and market are provisionally connected, there ensues a period of exploration and problem solving in which the incipient project is unavoidably disclosed to a broader public. Working straw for hats is different from working straw for baskets, so consultation is required with those who select and prepare straw for weaving,

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[5] On Japan, see Friedman (1988). On Taiwan, see Saxenian (2006) and Feenstra and Hamilton (2006). On Brazil and Latin America, see Giuliani, Pietrobelli, and Rabellotti (2005). On Italy, see Rabellotti, Carabelli, and Hirsch (2009). On Silicon Valley, see Saxenian (1996) and Gilson (1999).

and supply lacquers for finishing. Protective containers have to be configured for shipping. Fashion is particularly fickle until the maker knows whose lead to follow, or finds agents who do. But the problems, once solved, prove to have simple and therefore easily imitable solutions. So, in the spirit of the original Hausmann-Rodrik conjecture, imitators quickly enter the market, first locally, then from similar locales, and prices fall, depriving the innovators of the fruits of their efforts and expense. But only impetuous or arrogantly overconfident entrepreneurs suffer this fate. More cautious or modest souls see the danger coming and abandon the effort at self-discovery before they are out of pocket.

Though the literature on agglomerations is full of tales of initial self-discovery as fanciful as the one just imagined, it tells a consistently different story insofar as problems of appropriability are concerned. The first and perhaps most familiar finding, suggested above, is that agglomeration protects any one cluster from outside external competitors by making possible the provision of specialized inputs at prices below those available to less-clustered producers—and indeed in some cases by making possible the provision of inputs so specialized that they would otherwise not be available at all. The greater the number of, say, avocado producers in a given area, the greater the chances that a firm will find it profitable to produce packaging specially suited to shipping avocados. Also, the proximity of the supplier to numerous and demanding customers will help ensure that the latter will benefit before more distant competitors from improvements in the quality or reductions in the price of the input.

Relatedly, the larger the number of specialized firms in an agglomeration, the more feasible it becomes for them to share the costs of jointly providing some services such as courses for training skilled workers to use particular machines or engineers to use a new software package, that no one firm is large enough to finance alone. Once a cluster is established, firms learn rapidly from one another's successes and failures, reducing—but by no means eliminating—the risk that the cluster will be taken unaware by a change in technology, taste, or some other market condition.

With regard to appropriability problems *within* a single cluster or agglomeration, the same literature suggests that every local production system includes a range of complementary agents—subcontractors specialized in the use of certain machines or processes, product integrators (that prepare samples or prototypes and contract with specialists to produce the goods that the market demands), and capital goods suppliers—such that firms and individuals who lose their footing in one activity or line of business can regain it in another. The machinist becomes an independent subcontractor specializing in

a process, then a maker of specialized components, then the designer of a new product, then a subcontractor once again. The blueberry grower becomes a distributor of seedlings or the operator of cold-storage facilities. Indeed these transitions are regarded as so commonplace and natural that they are incorporated into individual career plans and the strategies of firms. The machinist *expects* to go into business for herself, starting as a subcontractor, and her current employer—well aware of this ambition—*finances* her purchase of (his) used machines, in the expectation that she will be a reliable subcontractor and remain a good collaborator as her business expands. Put another way, the greater the number of potential competitors, the greater the chances that each can work for others if she loses her current market.

A third and more circuitous way in which agglomeration creates barriers to appropriability both for clusters as a whole and for individual firms within them is by encouraging the formation of trade or industry associations—and, at their urging, the provision by local, regional, and sometimes national authorities of industry-specific or local public goods: technical schools with an emphasis on locally relevant engineering disciplines or skilled trades, special cargo flights for highly perishable goods, waste treatment facilities, materials testing laboratories, phytosanitary rules that conform with international standards and technical help in implementing them, and the like. All of these must be suited to the needs of a particular cluster if they are to be of any use at all. All are beyond the means of any single firm or small consortium. All are closely regulated and in some cases can be provided only by government. Because of this combination of features, private firms, from within or from outside the cluster, are unlikely to market these services: These are, after all, public goods, even if the public is local rather than national. But without the direction of a well-informed public—of the firms that actually have need of the services—government will not know what to provide. The forms of everyday cooperation that arise within local production systems—the types of complementary relations by which they grow—facilitate the emergence of associations that identify this type of problem and press its solution. Once provided, of course, the local public goods further protect the cluster and its component firms against appropriation by outsiders—and by new entrants to the cluster itself that do not belong to the relevant associations and public bodies.

Formal Cooperation: Producing Flowers for Export in Colombia

The development of Colombian export floriculture—beginning in the 1960s with carnations and chrysanthemums and later expanding to roses, pompoms,

and other varieties—closely follows this sequence of discovery of market possibility: initial, frantic problem solving and diffusion; and then, as part and parcel of this, a differentiating resolution of coordination problems that, in turn, creates barriers to appropriability and helps stabilize the cluster and industry. The rich detail of the case makes it particularly useful as an illustration both of the inherent complexity and difficulty of self-discovery, and of the general view of cluster evolution just presented. Its findings are amply confirmed by those in analogous settings in Brazil, Chile, and Ecuador, although these cases are not reviewed here.

Self-discovery in Colombian export floriculture originated principally in the search by U.S. flower growers for production locations with more intense sunlight, more moderate temperatures, and lower labor and heating costs than in the northeast of the United States, where the growers had clustered in the 1940s to be close to their chief urban markets. As air transportation developed in the 1950s, production of carnations and chrysanthemums shifted to California, Colorado, and Florida, where costs were generally lower, although limited luminosity and temperature fluctuations remained expensive problems. The industry therefore encouraged research into still more favorable, if more distant, locations. In 1966, David Cheever, then a graduate student at Colorado State University, identified Sabana de Bogotá as the ideal location (all things considered) for growing carnations for export to the United States. In general, he found that the areas around Bogotá and Antioquia had an unmatched combination of fertile, cheap soil; flat topography; adequate temperatures and luminosity in all seasons; cheap (female) labor; and favorable logistics that would permit high-quality production year-round (especially in winter, when holiday demand in the United States was high, but so too were production costs); along with inexpensive wood and plastic greenhouses (not glass, as in the United States) that required no expensive heating, cooling, or artificial light. Cheever was not alone. In the same period, a Colombian floriculturist learned to produce flowers at an industrial scale for the same purpose, and Cheever's findings further stimulated domestic interest in export.

But it was Cheever, with three U.S. partners, who in 1969 founded Floramérica, the firm that demonstrated the highly profitable feasibility of exporting flowers to the United States *and* helped diffuse its practices to what became a large domestic industry. Floramérica's success depended on adapting U.S. floriculture technology to Colombian conditions in many ways. First, the company imported rootstocks to get flower varieties that could be planted at optimal times and yield desirable colors. Second, it built abutting greenhouses, as in the United States, eliminating the separation common in

Colombia (thus conserving productive land and facilitating maintenance of adequate temperatures), and introduced more efficiently sized sheeting for covering the structures. Third, from the beginning, Floramérica established a wholly owned importer-distributor in Miami to ensure control over sales and distribution in the United States. Responding to information gathered from this and other sources, the company altered its products to distinguish them on the U.S. market. As wholesalers wanted very high-quality flowers, Floramérica created a new, "selected" grade, with extra-long stems. Again, in response to wholesalers' suggestions, the company packed assortments of flowers with seasonal colors in small boxes. Fourth, the company introduced the forms of work organization standard in the United States at the time, including hierarchically organized, specialized departments, under the direction of managers with correspondingly specialized training.

Even as Floramérica was adaptively importing the U.S. production model, it was grappling with unforeseen problems arising from the local context. Plant nutrition proved problematic, for instance, because Colombian soil is poor in boron, which is essential for carnations. The solution was to apply magnesium and calcium in great quantity. Plant diseases, some imported with the new rootstocks, were also a threat, brought under control with the help of Israeli consultants hired for months at a time. Poor water quality was yet another problem. On one occasion, the United Kingdom barred flowers from Colombia because worms had been introduced into the flower boxes through impure water. Floramérica responded with dry packing, and so on.

As one might expect from this account of self-discovery and agglomeration, Floramérica's model—although it required substantial investment in greenhouse construction, rootstock methods, packing, training, and distribution—diffused to many domestic firms almost as soon as it was put in place. Floramérica's staff were often hired by Colombian companies. David Cheever himself left the firm in 1971 and became an independent technical consultant to many Colombian companies. At the same time, two members of Sunburst Farms—Floramérica's importer and distributor in Miami—left to create their own flower brokerage. Pesticide vendors in Colombia passed on what they learned from one customer to others. In short, the channels of diffusion were endless. Moreover, "secrets" were easy to steal, for example, by taking pictures of greenhouses. The proprietors of at least one extremely successful competitor were convinced to enter the business in part because of the glimpse they sneaked of a profitable future during an early morning visit to the Floramérica farm.

Nonetheless, the absence of obstacles to appropriation of Floramérica's innovations, far from ruining the firm, in fundamental ways increased its viability,

and that of the whole industry. There were two reasons for this. First, the size of the U.S. flower market—where flowers were rapidly becoming an item of everyday, not luxury, consumption—permitted the entrance of many enterprises without imposing losses on incumbents. Even including shipping, Colombian production costs were still substantially lower than costs in the United States, allowing for very high returns on initial investment. Growth was vertiginous and, by 1980, the industry had become the world's second-largest exporter of flowers. In this period, Floramérica became one of the major flower-exporting companies in the world, with sales in 1986 of $50 million. But whereas in 1970 Floramérica accounted for nearly all of Colombian cut-flower exports, in 1986 domestic firms had increased their share of exports to over 67 percent.

But second, and more fundamentally, diffusion was, according to Arbeláez, Meléndez, and León (2007), "beneficial as the emergence of new participants helped exporters to overcome obstacles through coordination and cooperation between them. Flower growers found that they had to combine efforts in order to achieve their goals in the American market."

This was particularly true with regard to the most urgent of all the common problems facing the nascent industry: organizing reliable transportation of the flowers to their export destinations. Searching for an answer to the transportation question, the producers founded Asocolflores, an industry association. Asocolflores, in turn, organized coordinated solutions to a range of subsequent problems and, in this way, shaped the sector's operation (Arbeláez, Meléndez, and León, 2007).

Take transportation. At the time of the first exports, Colombia had few airlines, and each of these had only a few old planes transporting cargo domestically, with only a few flights to the Caribbean. Avianca, the major Colombian carrier, was initially unresponsive to the exporters' needs. New entrants appeared, some with the backing of Floramérica and Flores de los Andes, but they lacked the necessary financing or equipment and soon failed or faltered. Amidst this confusion, the exporters in 1970 created Colflores, whose 11 members became Asocolflores three years later. They were well aware that even the largest firms could not provide enough cargo to fill entire planes, and that joint shipments had to be carefully coordinated (with regard, for example, to box size.) After some false starts, the association secured more cooperation from Avianca and helped induce other airlines to begin scheduled operations to Colombia, eliminating the transportation bottleneck to the United States.

This initial success led to further collective challenges. Almost as soon as exports started to grow in the 1970s, Asocolflores had to defend the Colombian exporters' access to the U.S. market. U.S. growers, organized in the

Society of American Flower Growers, claimed that their Colombian competitors were receiving illegal benefits and subsidies, and asked the U.S. government to impose a countervailing duty in an amount equivalent to the alleged benefits. Asocolflores responded by entering into an agreement with the U.S. Department of Commerce to promote domestic flower consumption, with the intent of enlarging the market for all producers, and by promoting the creation of the Florida Importers Association, an independent U.S. entity inclined to protect the interests of foreign growers in the United States. The Florida Importers Association later helped the Colombian exporters defend themselves against a dumping suit and respond to the imposition of phytosanitary restrictions. Asocolflores is now permanently present in Washington, and is a recognized interlocutor of the U.S. regulatory authorities and Congress. Finally—and again as the literature on cooperative problem solving in clusters would suggest—Asocolflores has also supported research on plant development and disease control for the industry.

Taking these developments into account, the conclusions of the case study are emphatic:

> It is remarkable how local producers and exporters have managed to overcome obstacles and coordination problems…. Indeed, the need for coordination and combined efforts to overcome obstacles… favored a rapid diffusion process. … It is worth noting that the early stages of exporting diffusion were extremely beneficial for pioneers and for the rapid development of the exporting activity. Moreover, such diffusion was desirable and even necessary, as it [contributed to the solution of] coordination problems (Arbeláez, Meléndez, and León, 2007).

It should be noted that, in some cases, diffusion was more disruptive than in Colombia. The leading example in the project is blueberries in Argentina. A crucial discovery in that case was that soil and climatic conditions allowed Argentine producers to harvest and market their blueberries a month earlier than producers in any other part of the world, and thus sell them at much higher prices. The ensuing gold rush led to very rapid and chaotic diffusion, declining market prices, and a substantial decrease in the profitability of the sector.

But in no case in the research project did diffusion to a cluster of producers destroy the nascent industry as a whole or even foreclose lucrative development paths for pioneers, even if the latter—unlike Floramérica—did not

take them.[6] On the contrary, the Colombian experience of the agglomerating or clustering diffusion of self-discovery as beneficial for the "rapid development of the exporting activity" and "desirable and even necessary" as a means of solving coordination problems is echoed in the other cases in the project.

Informal Cooperation: Furniture Making in Brazil

Whereas cooperation is relatively formalized in industry associations in the floriculture cases, the example of the cluster of furniture makers in São Bento do Sul (in the state of Santa Catarina, Brazil) shows that diffusion of practices within a cluster can address coordination problems by less formal means. São Bento do Sul is the largest exporter of furniture in the country; in 2005, it made up 43 percent of all Brazilian furniture exports.

São Bento do Sul is an area of Austrian and German immigration, and the immigrants lacked, or lost in migration, any tradition of associativism. As a result, the São Bento do Sul cluster is generally viewed as closed and the "level of associativism is also considered low" (see da Rocha et al., 2008) in comparison to other centers of production in Brazil. Interviews made it clear that "firms in the cluster did not value formal mechanisms of coordination, such as syndicates or associations" (da Rocha et al., 2008).

Nonetheless, because of spin-offs, the circulation of employees and with them ideas and practices, and the general ease of communication facilitated by a common culture, da Rocha et al. (2008) found that spillovers were pervasive, and that São Bento do Sul could be described as "one single unit" or "a constellation of similar firms." While joint actions were uncommon, communication flows were high and, with few exceptions, imitators followed the lead of the pioneer, exporting to the same markets and shifting from one market to another as changes in demand dictated.

Neighborhood Effects: Avocado Production in Mexico

In sharp contrast to the informality of coordination among furniture makers in São Bento do Sul, the production of Hass avocados in Michoacán, Mexico illustrates the case where neighborhood effects—the need for each producer to take into account the actions of adjacent ones in addressing his or

[6] In the case of blueberries, the pioneer, Vergel, actually encouraged limited diffusion, and became a provider of nursery and commercialization services.

her own problems—lead not only to the formal organization of cooperation, but to legal requirements for doing so. The decisive problem in relation to Mexican avocado growing is pests, in particular, weevils of various types. These threaten not only the crop in Michoacán, but also agriculture in export markets—notably, the United States. Under these circumstances, protective measures must be locally coordinated if they are to be effective. Treatment in one orchard is plainly useless unless pests are likewise eliminated from adjoining ones. Otherwise, reinfestation is inevitable. As a single, uncooperative producer (hoping, perhaps, for a free ride on the exertions of others) can undo the joint effort, the solution is a law requiring all to act together. As importing countries, for a familiar mixture of motives (protection of domestic crops and protection against foreign growers), will insist on highly credible assurances of pest eradication, the pressure for legal coordination will be almost irresistible.

Mexico, no doubt convinced of the need for action and pressed to act regardless of its convictions, has indeed enacted phytosanitary regulation to address such neighborhood effects. The chief instrument is a system of Local Plant Health Boards (Juntas Locales de Sanidad Vegetal, or JLSV), that operate as auxiliary organizations of the Ministry of Agriculture, Ranching, Rural Development, Fisheries, and Food Supply (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, or SAGARPA). These boards are composed of local growers. Decisions are by consensus or majority vote. The boards have a technical staff that helps growers meet phytosanitary norms, for example, by giving advice on sampling procedures or responses to the presence of pests that might require quarantines. The technical staff also supervises the use of authorized insecticides and monitors the overall cleanliness of orchards. A representative from each local board serves on a State Committee on Plant Health (Comité Estatal de Sanidad Vegetal) under the supervision of relevant public officials from the state level.

In sum, as the literature on clusters suggests, the benefits of agglomeration or positive externalities to firms outweigh—indeed swamp—the costs to them of their neighbors' ability to learn from, and at least partially appropriate, the returns on their innovations. Indeed, by treating agglomeration and platform building as related forms of organization—in that both involve information pooling and close, flexible collaboration among firms with highly complementary specialties—it is only a slight exaggeration to say that the discovery of new exports is fundamentally a story about the building of new clusters, and the agglomeration effects they produce.

But if the positive externalities of clustering are a key part of many new export discoveries, they are certainly not the whole story. If they were, then

once a cluster succeeded, the cumulative advantages of agglomeration would make it successful forever. But it is clear from the historical record and from current experience that clusters in general are vulnerable to competitive challenges and both abrupt and long-term changes in market conditions, and that clusters in developing countries may be especially susceptible to some kinds of disruption.

The Hidden Costs of Incumbency

Perhaps the greatest threat to clusters, as to large firms, lies in the hidden costs of incumbency. Successful clusters, like successful multinationals, can easily become prisoners of their success, assuming that the way forward is to improve on what is already working. This assumption and the inertia it produces afford potential competitors the chance to develop apparently irrelevant or inferior technologies until some combination of technical progress and change in market conditions enables them to challenge established players. The same mimicry that facilitates learning in clusters can open the way to group think and complacency about large, distant problems—a mind-set that is all the more dangerous because it is masked by acute concern about many small, current problems.

In addition, the very informality of clusters, and their reliance on often tacit, craft skills—both of which traditionally contribute to the ease of reconfiguring production arrangements—can pose problems when, as today, increasingly stringent quality standards and rapid changes in technology require firms to master (and often to be certified as having mastered) clearly articulated protocols for joint problem solving. Clusters can master these collaborative disciplines but until they do, they are at the mercy of competitors that have beaten them to the punch, and can meet the needs of demanding partners in world markets. Finally, clusters in developing economies—typically far from the consumers and centers of design in the most advanced countries, and therefore largely dependent for the specifications of their products on the customers they supply—are especially vulnerable to abrupt market changes: above all, the entry of low-cost competitors that can consistently underbid in contests for supply contracts.

There is evidence of all these vulnerabilities in the experiences reported in the case studies. Developments in the furniture cluster of São Bento do Sul are especially dramatic. The cluster was unprepared for the entry of low-cost, Chinese competitors, the appreciation of the *real*, and the global financial crisis. Exports fell sharply beginning in 2006 and, in just a couple of years,

nearly 20 percent of the firms failed, and the area's population declined by almost 6 percent.

The initial reactions to these shocks were a clutch of short-term expedients: layoffs, reductions in hours, temporary shutdowns, cuts in investment, all seconded by state and then federal tax reductions and energy subsidies. As the ineffectiveness of these measures and the deep causes of the crisis—high costs, lack of design, and marketing capacities—have become clear, groups of firms and, in some cases, the cluster as a whole have begun to undertake long-term adjustments: creating low-priced product lines and a joint brand (Biomóvel) to serve the domestic market (which is expanding because of strong growth and state subsidies to low-cost housing); and reducing costs by shifting to lean production and other means, including reorganizing supply chains and renegotiating collective bargaining agreements.

But it will take time for this ensemble of strategies to work, if they do. While the increase in domestic demand has allowed the situation in the cluster to stabilize, and many bankrupt firms to reorganize, there are no clear prospects of a general recovery or (with the currency at its current highs) a renewal of exports.

The situation of the Michoacán avocado producers is more ambiguous. On the one hand, the industry is highly profitable; short-term prospects are excellent and medium-term prospects are good, though meeting the EurepGAP standards required for exporting to the European Union may strain the current capacities of the JLSV and the State Committees on Plant Health. In the long term, however, Michoacán growers may face risks from new, highly efficient entrants such as Australia, Chile, New Zealand, Peru, and South Africa—and as the literature on the limits of incumbency never tires of repeating, those risks may be especially perilous because they are all too easily underestimated.

The long-term threat to Michoacán growers, if there is one, would most likely come from a form of high-yield, high-density cultivation currently best practiced in Peru. Peruvian avocado plantations attain average yields of 26–30 tons per hectare, and the most efficient producers achieve 40 tons per hectare. In Michoacán, yields average 10–15 tons per hectare, and the best results reach 30 tons per hectare. The superior yield results from much denser planting. But more intense cultivation taxes managerial capacity. Packing the trees so densely and pushing their productivity to genetic limits greatly increase the risks of new plant diseases and pests, and so the demand for countermeasures. Peruvian producers have the resources and experience to meet these challenges because they are vertically integrated, quite large, and diversified (they produce, pack, process, and market several products, including avocados).

Despite their small plots (in Peru the average orchard size is 100 hectares; in Michoacán, it is little more than a tenth of that), Mexican growers could conceivably adopt dense cultivation. Cooperatives and other forms of cooperation developed to meet export requirements could be extended to accommodate denser planting. But the current organization and market circumstances of the industry create disincentives, at least in the short to medium term, to taking the risks associated with intensive cultivation. Profits in the industry are currently so high—annual returns on investments range from 75 percent to 500 percent—that there is little appetite for large, risky investments in replanting trees and waiting several years before they begin to produce. "Why complicate life?" is the growers' understandable response to the question of why they do not emulate the Peruvian example, or even, for that matter, increase their very modest expenditures in R&D. Whether this preference for simplicity is an adequate response to a remote threat remains to be seen.

But these vulnerabilities, with the (partial) exception of dependence on distant design capacities, are, to repeat, common to clusters in advanced and developing countries—not a feature of new clusters or clusters only in developing economies. Thus Italian clusters, producing goods as diverse as ceramic tiles, high-end textiles and apparel, and the capital goods for these and many other industries, have been under the kind of pressure from Chinese and other new competitors for the past decade that São Bento do Sul has experienced in the last few years, and they have responded in similar (if more fully elaborated and therefore often more successful) ways: adopting more explicit forms of collaboration with partners to increase efficiency, meet new quality standards and, above all, facilitate co-development of distinct, often innovative products (Chiarvesio, Di Maria, and Micelli, 2010). By doing this, successful clusters in Italy and elsewhere are taking on some of the collaborative features typical of platform production, and heightening barriers to appropriability even as they augment their capacity to solve coordination problems.

Platforms

In platform production, the performance of the product depends on the performance of a series of independently produced and rapidly developing subsystems—microprocessors, Web browsers, media players, and other applications in the case of an operating system; digital signal processors, radios, and antennae for various frequencies in the case of a cell phone; wings, engines, and fuselage in the case of planes (Gawer and Cusumano, 2002; Farrell and Weiser, 2003; Evans and Schmalensee, 2002). The performance of each of

these subsystems depends conversely on the performance of the others, as transmitted through the architecture—the platform—linking them all.

In each case, the platform owner—the operating system developer, the cell phone maker, or the airframe producer—knows that it could not possibly produce all or even most of the components or applications whose interplay creates the platform. In particular, the producer could not develop or sustain the capacity for cutting-edge innovation in all the areas necessary for the various components. Collaboration with groups of key technology suppliers involving continual mutual adjustment and exchange of quintessentially proprietary knowledge becomes the norm (Evans and Schmalensee, 2002; Evans, 2003; Farrell and Weiser, 2003). Thus, the recent emergence of a literature on platform industries and the forms of predation that tempt platform owners attest to the diffusion of enduring (though sometimes fraught) cooperation across firm boundaries (Evans and Schmalensee, 2002; Evans, Hagiu, and Schmalensee, 2004; Rochet and Tirole, 2004).

A strikingly successful example of a platform producer is ARTech Consultores S.R.L., a Uruguayan maker of software tools for configuring relational databases and their applications: On the one hand, it supplies a richly featured application to the suppliers of general purpose, computer operating systems such as Microsoft and IBM. On the other hand, it supplies its end users—firms in financial services, health, and many other sectors—a platform that itself integrates many software tools so as to allow not only intuitive, high-level programming of databases, but also the rapid creation of applications that interact with them. To manage this two-sided problem, the firm has deliberately created a community of practice including international technology suppliers, applications developers, two levels of special-projects "solution partners," and end users. Or, in the language of the discussion here, this community is the instrument by which the firm addresses its coordination problems; and the very existence of the community in turn creates (together with, but perhaps even more than, intellectual property rights) the barriers to appropriability to ensure the firm's prosperity. Only recently has the government begun to explicitly support this strategy on behalf of the software sector as a whole. The authors of the case study present the software maker precisely in these terms; only as much of their discussion is reprised here as is necessary to illustrate the workings of these mechanisms.[7]

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[7] Another successful case of platform production—aircraft in Brazil—will be discussed later when the impact of industrial policies is considered.

ARTech Consultores S.R.L. was founded in 1988 by two Uruguayan computer engineers. Although their original intention was to automate some aspects of database programming, they quickly realized they could create tools for consultants to develop database applications more efficiently. The first version of their GeneXus software was released in 1989, and by 1991 ARTech had sold 350 copies of GeneXus, mostly in Latin America. Today, ARTech has offices in Chicago, Mexico, São Paulo, and Shanghai, as well as distributors in 28 countries, and its software is used by 4,500 firms worldwide.

Since GeneXus is a (software) tool for use by other toolmakers (software developers who build applications for final users), ARTech must build strong relationships with key software developers in order eventually to sell its products to customers using applications designed with those developers. This is done through ARTech's Solution Partners Program, which is at the center of the GeneXus community of practice. Solution Partners are developers of GeneXus-based solutions for their own clients, with whom ARTech establishes an information exchange regime. A developer of GeneXus-based applications who is engaged with substantial clients gets technical support, a chance to participate in beta testing, and special discounts. In exchange, ARTech acquires information on bugs, possibilities for improving features, or improvements in error detection. There are about 150 Solution Partners, two-thirds of them in Uruguay. Within this group, 10 are regarded as "level 1" partners, with whom ARTech exchanges strategic knowledge about next-generation products so that tools and applications (typically for market niches such as Enterprise Resource Planning, or ERP; maintenance; or distribution and logistics) have the necessary complementarities. This collaboration solves immediate problems for ARTech's clients (the software developers and *their* clients), while helping to improve the platform. As one of ARTech's managers explained:

> "If a local firm—for example, a GeneXus user specialized in the development of distribution and logistics applications—has a problem in Malaysia with its beverage distribution system, we send a person, or work in Zonamerica, to solve that precise problem. And this helps us to achieve GeneXus product optimization because it shows us a shortcoming. Despite our internal tests, with thousands of users, unexpected events can occur; this is the market filter" (see Snoeck et al., 2009).

Because ARTech has been so effective at solving its coordination problems by creating such relations, private sector organizations and the public

sector have played only small roles in the development of the industry. That is now changing as all participants have come to understand the strengths and generalizability of the ARTech platform model. For example, several years ago the Centro de Ensayos de Software (Center for Software Testing) was established in Uruguay with EU funding as a public-private consortium between the Engineering School of the public university and the Cámara Uruguaya de Tecnologías de la Información (CUTI—Uruguay's IT industry association) as a test bed for the platform and other capabilities of new software, and as a technological observatory. In another example, in 2006, the software industry applied to participate in a new governmental program, PACC (cofinanced by the Inter-American Development Bank), aimed at developing the competitiveness of local clusters.

Vertical Integration in Transition to Lean Production

This category has an ungainly, composite rubric because a simpler name would be a misnomer. These firms are in transition. They began as traditional, large, and vertically integrated mass producers. Their original success depended on achieving large economies of scale through the use of highly efficient, dedicated or process-specific equipment. The low cost of their products—the result of the efficiencies—and the high investments in fixed capital needed to achieve it created significant barriers to entry. But economies of scale are no longer an invincible barrier to entry. If they were, General Motors would still be riding high (Lazonick, 2009). Over the past few decades, Japanese auto producers have demonstrated the superiority of lean or just-in-time production to mass production. In lean production, work or in-process inventories are removed. Parts are thus in effect produced one at a time, so disruptions at one machine stop the whole production line—until the source of the disruption is eliminated (and the production process thus improved) so that operations can resume. Building an organization that can identify and eliminate the root causes of these disruptions is equivalent to building an organization that can rapidly rebuild itself in response to unforeseen changes in its environment. The upshot is that lean production not only increases efficiency in the production of any single good by eliminating unsuspected sources of disruption and waste, but also dramatically increases the flexibility of the production setup as a whole, making it easy to shift from one product to another. Economies of scope are revealed to be complements to, not substitutes for, economies of scale. The large firms in this category in the research project have proven successful—often surprisingly so—at developing new exports precisely by using

the new techniques of organization to identify and respond to more differentiated and rapidly shifting demands for variants of their traditional products.

An exemplar of this type of firm is Leonisa, a Colombian manufacturer of knit underwear, brassieres, girdles, other undergarments, and swimwear.[8] Leonisa was founded in 1956 by Julio Ernesto and Joaquín Urrea. The brothers owned a successful textile mill in Medellín, and they wanted to integrate forward into the production of (woven) underwear using its output. As is usual in this industry (but not in Colombia at the time), Leonisa outsourced sewing and embellishing of the garments to small household firms, working for piece rates. In part because of the flexibility in responding to changes in the level of demand that these local *maquilas* allowed, the Urreas expanded into international markets early on, setting up a plant in Costa Rica in 1965 to supply Central American countries and opening an office in Chile in 1981 to enter the Southern Cone. By the late 1980s, exports were a significant share of the firm's output, but the export products had very low value added ($2 to $3 per unit), and went mostly to neighboring Venezuela.

The company shifted strategy dramatically in 1989–90, when, apparently inspired by the success of Spanish firms in the industry, and perhaps concerned about increasing competition from low-cost countries like China, it decided to produce higher-value-added products. This meant shifting from wovens to knits (with superior elasticity), and increasing design content and sophistication so that the firm's products could compete with French and Italian goods selling for $50 per unit. This required a technological leap—replacing looms costing $50,000 with looms costing $1 million, but able to produce elastic lace—and, more fundamentally, a greatly increased capacity to detect and respond to subtle changes in the composition of demand.

The crucial steps in the realization of the "demand-oriented" production systems were, first, a decision to focus on Latino consumers, and, second, the creation of a data collection system that linked Leonisa directly with the cash registers of chain stores, so that it had real-time access to the inventory information of products being sold: sizes, colors, styles, and so on. This kind of information, in turn, allowed product segmentation by type of customer: women of various age groups, and occasion of use—pregnancy, sports, work, parties. The company currently handles about 8,500 distinct articles or stock-keeping units (SKUs).

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[8] The case of Leonisa and the underwear sector in Colombia is not included in this volume. For a detailed account, see Arbeláez, Meléndez, and León (2007).

To reduce production costs and increase responsiveness to demand, the firm reduced inventories by cutting through, in subsequent stages of production and in finished goods, what it calls a "constraint theory system": a method, as Arbeláez, Meléndez, and León (2007) put it, that consists of "solving the main bottlenecks in production one at a time until all main bottlenecks are eliminated." This is, of course, lean production, in other terms. Using this method, Leonisa reduced inventories to eight hours in cutting, three weeks in production, and 45 days in distribution, while competitors in other countries had inventories of three to four months. In addition, to increase flexibility in responding to export orders, Leonisa began to apply just-in-time principles to the organization of its outsourcing network, improving its coordination with external partners and investing in training for them to increase their capacity to produce high-quality work rapidly and reliably.

Because of its scale and complexity, Leonisa's full strategy has not been replicated by any competitor: again, the solution to coordination problems creates barriers to appropriability. But there have been many spillovers, including the creation of a cohort of managers and workers with new and valuable skills in design and production, the introduction of improved design standards to the country, and the demonstration of the feasibility of a business model based on high-value-added products and using a decentralized system of local *maquila* production to reduce the fixed investments needed for entry into export markets.

Onda de Mar, the leading Colombian maker of swimwear, has demonstrated the effectiveness of this model. The firm began making trendy swimwear for the domestic market in 1986, but in 1999 it began applying lean production techniques to demand analysis and production management. Its fortune as an exporter was made in 2002, when *Sports Illustrated* placed one of Onda de Mar's bikinis on the front cover of its swimsuit issue.

Examples of this type of transition abound in the cases included in the project. In the Colombian paper products industry, for instance, Colombiana-Kimberly-Colpapel (the result of a merger between Kimberly Clark and Colpapel, a domestic firm) started out producing soft papers and light paper for cigarettes, shifted to sanitary products for the local market, and then, following the trajectory of Leonisa, used sophisticated demand analysis and manufacturing organization to differentiate its products according to the needs of export markets. Familia-Sancela did essentially the same, starting out in soft paper, writing, and printing paper, cardboard, and boxes, then shifting to highly differentiated sanitary articles. In chocolate confections, Arcor, a family-owned Argentine firm founded in 1951, achieved export success only

in the 1990s "after the development of differentiated products that were adapted to local preferences in different markets, together with competitive prices" (Sánchez et al., 2008). Colombina S.A., founded in 1928 in Cali as a division of Riopaila—the largest sugarcane producer in Colombia—underwent an analogous, but more gradual, development. After failing in an effort to export sweets to the United States in 1965, the company began a sustained process of learning about foreign markets and reorganizing production accordingly that made it an export leader from the 1980s on. Or, to take a final, Brazilian, example: Sadia, a producer of poultry and pork, and one of the country's largest exporters, carefully adapts its products to the needs of various export markets. It maintains tight control over the genetic stocks and feed used as inputs to its products, but uses an elaborate platform-like system of collaboration with independent poultry and hog producers to supply its slaughtering facilities.

How Industrial Policy Can Support the Development of New Exports: The Lessons of Programs Created before the Washington Consensus

The focus so far has been on firms, and on the trade and industrial associations they create to solve coordination problems that they cannot resolve individually. Government has entered the picture, if at all, to provide industry-specific public goods at the urging of these associations. Examples are the provision of cargo flights by state-owned airlines for floriculture in Colombia, or the creation of *juntas locales* (local boards) for the avocado industry in Mexico under the auspices of a national phytosanitary law. But there is more to the public sector role in encouraging new exports than that. In fact, sector-specific industrial policies, favoring capacity building by private actors rather than just solving coordination problems beyond their reach, have played an important, if very inconspicuous, part in the "reinvention" of some significant export products, particularly in agriculture and related industries. This section goes some way toward completing the picture by tracing these developments. The suggestion—and it is, for now, no more than that—is that the capacities for state action demonstrated in these successful policies could be extended to other domains, especially those where the emergence of cluster and platform production indicates possibilities for rapid growth and learning.

That the role of industrial policy in the discovery of new exports has been inconspicuous, not to say invisible, is easily explained. Industrial policy was strongly disfavored in the 1990s under the Washington Consensus as a misguided and unworkable effort to bypass markets and "pick winners" by

bureaucratic means. As avid proponents of Consensus reforms, many Latin American governments were especially adverse to industrial policies. The industrial policies at work during the last two decades in Latin America were therefore in the main those created well before the Washington Consensus took hold, sometimes as early as the 1950s; their services, long familiar, had often come to be regarded as integral to the economic life of particular sectors, not an intrusive and suspect government intervention.

The most effective of these long-standing and continuing industrial policies tended to be those that decentralized at least some decision making to local units, which answered to local stakeholders as well as national authorities. Such decentralization helped ensure both that the services provided in some measure addressed actual needs, and that well-regarded units could count on the support of potent, local interests to protect them and their programs against abrupt changes of course or sheer disorganization at the national level.

Agricultural and veterinary research and extension services, established in many Latin American countries after World War II to help cultivators open new territories to agriculture, mechanize farming, and improve seed or livestock selection in ways specific to their particular and various conditions, fit this description. So too do vocational education institutions, of which the most successful, such as INFOTEP in the Dominican Republic, collaborate closely with industry to identify the need for and provide training in sophisticated skills (managing lean production, or, lately, building Web applications using programs such as C++). Often, these institutions are sheltered from the vicissitudes of budgetary politics by inclusion in a special tax regime. They are assured a fraction of the revenues from a payroll tax (in the case of vocational training in the Dominican Republic) or a national tax on agricultural exports (in the case of agricultural extension in Argentina), often with the proviso that national and regional councils of client firms and farms agree to and participate in the monitoring of the services provided.[9]

It is unsurprising, therefore, that the contribution of industrial policy to new exports from Latin America appears most consistently in the provision of vocational training and, in this study, collaboration between research and

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[9] On INFOTEP, and especially its success in helping the apparel industry in the Cibao Valley adopt lean and other sophisticated production techniques, see Shrank (2008, 2009). On INTA, Argentina's National Institute for Agricultural Technology, see Lengyel and Bottino (2010).

extension services and their rural clients in adapting traditional and GMO crops to new soils, genetically modifying traditional crops, improving vintners' grape stocks, and applying biotechnology to the improvement of animal health through the production of vaccines. (The exception that proves the rule in the area of manufacturing is the aircraft industry in Brazil, which will be examined later.) Consider these striking and carefully documented examples from the case studies:

Bringing Soy to the Savannah

Brazil is the world's second-largest soybean producer and the largest exporter, with soy exports of more than $10 billion in 2005—10.4 percent of total Brazilian exports that year. Between 1994 and 2004, soybean exports doubled. To achieve this result, cultivation of the legume was significantly expanded beyond its traditional, limited planting area in the temperate climate and rich soils of Rio Grande do Sul to the more abundant but much less hospitable savannahs or *cerrado* to the north. The area under soy cultivation increased from 6.9 million hectares in 1976 to 12.9 million hectares in 1989, while productivity was dramatically improved, with soy yields rising by 65 percent between 1988 and 2003 (while in the United States, the world's largest soybean producer, yields increased by only about 10 percent in this last period). The solution of many problems of coordination among producers of different inputs (required for both the extension of the planting area and the increase in productivity) has been facilitated by, and perhaps depended on, intensive and continuing collaboration between private growers and EMBRAPA—the Brazilian Agriculture Research Agency. EMBRAPA is today a vast entity made up of 9,248 employees (of whom 2,220 are researchers—74 percent of them with PhDs), with a budget of around $1 billion, which finances 37 research centers. The success of soybean cultivation in Brazil also depended on the legume's early exposure to export markets, and on a constellation of domestic interests that protected growers against the application of a price controls regime that deterred investment in a related crop—wheat.

EMBRAPA and soy production grew up together. The agency was created in 1973 as part of a drive to increase domestic food production in order to meet the needs of a rapidly growing urban population and provide export earnings—a conspicuously attractive possibility after a worldwide crop failure in 1968 caused a large spike in the prices of agricultural commodities. An initial task was creating technical capacity in all the disciplines relevant to the advanced agriculture of the day: between 1974 and 1978, some 1,500 researchers

enrolled in post-graduate programs abroad under EMBRAPA's aegis. A central goal was to discover how to bring commercial agriculture to the savannahs despite their low-fertility soils and irregular rainfall. Soybean was considered a strategic crop in this effort given increasing international demand for soy as a protein substitute for fish meal, as well as the extensive experience of cultivating soy in the temperate south of Brazil. The challenges were clear: creating new soybean varieties adapted to low latitudes, and developing methods of tilling, fertilizing, and conserving the soil to increase its fertility.

To address these challenges, in 1975 EMBRAPA created the EMBRAPA SOJA division to "tropicalize" the soybean and, in the same year, the EMBRAPA CERRADOS division to improve soil-handling techniques in the savannah region. In 1980, EMBRAPA SOJA created the first of a line of soybean varieties successively better adapted to Brazilian savannah soil. This and other results were widely diffused to farmers, large and small, through EMATER, the main public agricultural extension company. EMATER trained its agents to help farmers make effective use of what it termed "technological packages": bundles of complementary technologies found, after careful study, to be suited to particular agriculture-producing areas. By the time EMATER was closed in 1991 in connection with a wave of Washington Consensus deregulation, smaller farmers could rely on producers' cooperatives to access innovative technology, or turn to state rural extension services (whose quality, however, varied considerably from state to state and unit to unit), while larger planters could employ their own personnel to maintain direct contact with EMBRAPA and keep abreast of its developments. The government's role in the development of soybean production and exportation was not limited to technology development and diffusion. An important complement to the services provided by EMBRAPA was the creation of special credit lines that, until the wave of liberalization, subsidized investment in new soy technologies—but only those developed by EMBRAPA and supported by EMATER (as long as it existed). Later, the Moderfronta program was developed to help finance investment in agricultural equipment, and it played a fundamental role in the modernization of the Brazilian agricultural implement fleet, to the great benefit of productivity.

But as the requirement to use subsidized credit only for EMBRAPA/EMATER technology suggests, Brazilian policy, especially before the liberal opening of the 1990s, could become overly prescriptive, and even degenerate into a self-defeating effort to dictate the behavior of those it aimed to assist. This was the outcome of government efforts to extend wheat cultivation at the same time it was encouraging soybean expansion, and by many of the same

means. But because wheat was crucial to domestic food consumption, the military government of the 1960s and 1970s did not hesitate to regulate wheat growing and processing minutely and comprehensively: the total volume of ground wheat was registered and flour imports prohibited; domestic wheat had to be sold to Banco do Brasil at set prices, and an official committee managed international purchases. The result was to depress the domestic price of wheat and discourage improvements in quality because producers were not rewarded with higher sale prices for these.

Soy escaped this fate because it was, at the beginning, relatively insignificant as a source of food or fodder on the domestic market, but highly prized in international trade. The state had little reason to regulate it, and at least some private actors were able to capitalize on the fruits of their engagement with state agencies quickly enough to make themselves less vulnerable to political changes. Industrial policy, in the sense of the provision of complex, industry-specific public goods—EMBRAPA's research and EMATER's extension work—could complement private initiative unencumbered by regulatory disincentives. The result was a striking demonstration of the ability of public-private cooperation to substantially enlarge the capacities of the domestic economy.

Veterinary Vaccines in Uruguay

Uruguay's exports of animal vaccines—mainly bacterial vaccines for anthrax and clostridia, but also viral vaccines for rabies and eye diseases—grew at a cumulative annual rate of 9 percent between 1995 and 2006, about double the current rate of growth of the market worldwide, to reach about $6 million. The emergence of this highly competitive, technologically demanding industry is the outgrowth of decades of intellectual exchange between public and university laboratories and private sector R&D aimed at controlling foot-and-mouth disease—and, with the success of those efforts, the emergence in recent years of an increasingly intense and formalized system of public-private collaboration in new areas of biotechnology. In this case, too, the success of industrial policy depended on exposing the products it helped develop to the validating test of international competition, whether or not these products were exported initially.

With its 10 million head of cattle and location in the Rio de la Plata estuary, Uruguay is, and has been for more than a century, a substantial part of one of the largest stockbreeding areas in the world. With cattle comes—or came, until very recently—foot-and-mouth disease (FMD). The origins of the country's biotech industry date to the establishment in the 1930s of state

laboratories to develop vaccines against the virus. Starting in 1946, private firms were authorized to produce vaccines; new state laboratories specializing in the disease were created in the following decades. The upshot, given convergent developments in Argentina and Brazil, was to create a pool of public and private expertise in animal health in the Plata basin that attracted substantial investment by leading multinational firms.

Subsidiaries of four multinationals came to dominate the Uruguayan market for FMD vaccines. But they did so under a regime that both facilitated quality improvement and innovation and potentially sanctioned the failure to achieve it. In 1968, as part of a national campaign against FMD, a state institution—DILFA—was created to monitor the quality of all vaccine production. The standards it applied were strict enough to eventually force 7 of 11 producers out of the market. Only the multinational subsidiaries survived. But in the same year, and despite the general thrust of the import-substitution strategy in place at the time, the government effectively removed duties on imports used to prevent or treat cattle-related diseases. Domestically produced vaccines could thus succeed in the Uruguayan market only if they were as effective as alternatives available on world markets, ensuring that local producers, regardless of the nationality of their owners, were under continuing pressure to meet international standards. To facilitate the necessary innovation, a public laboratory, Laboratorios Rubino, and the DILFA were charged with transferring their research results to private firms. There was, however, no incentive to export, as the domestic market was huge and stable, and returns on capital high.

The situation changed dramatically in the mid-1990s, when Uruguay sought and secured from the International Organization for Animal Health the certification that its cattle were "free of FMD without vaccination": an extremely valuable label in global meat markets. To obtain this status, the government had to discontinue vaccination and prohibit handling of the live virus. These measures ended production of FMD vaccine in the country, provoking the withdrawal of several multinationals (some of which were already relocating production to take account of opportunities created by MERCOSUR—a free trade agreement between [at that time] Argentina, Brazil, Paraguay, and Uruguay). This withdrawal in turn cleared the way for the reassertion of domestic capital in the industry and the redirection of production to new vaccines for export markets, particularly in developing countries.

Two leading examples of the new exporters that have emerged since then are Laboratorios Santa Elena and Laboratorio Prondil S.A. Santa Elena was created in 1957 by a small group of researchers of the Veterinary School of

the public university to produce animal health products. Its clients were veterinarians, cattle breeders, and traders from the countryside. The firm focused almost exclusively on the domestic market until the mid-1990s, when, in reaction to the ban on FMD vaccine production, it began exporting bacterial and viral vaccines to other Latin American countries and the Caribbean. Prondil was formed in 1992 by a group of former employees of Coopers, a multinational making veterinary and other products for the care of livestock, when the firm exited the Uruguayan veterinary vaccine market. Prondil's capital is entirely national but given the restrictions on the domestic market, it targeted exports from the first, initially building on Coopers' connections to South Africa, but then quickly developing new products in two lines of bacterial vaccines for the Latin American and Caribbean region, with further expansion in sight. Both companies benefit in international competition from the low salaries of skilled professionals in Uruguay as compared to those paid in richer countries, and from the lower costs of animal testing there.

Crucially, both Prondil and Santa Elena rely on partnerships with many local academic groups and institutes, including the Department of Biotechnology at the Instituto de Higiene (the School of Medicine of the public university), to draw on local knowledge to improve their production processes and to develop niche products for export markets. Industrial policy in this sense is crucial to their export success.

The development in Argentina of an export-capable industry applying biotechnology to plant and animal health confirms the generalizability of the Uruguayan experience. In Argentina, as in Uruguay, farmers and ranchers have collaborated for decades with public entities to improve crop conditions and stockbreeding. INTA, the National Institute for Agricultural Technology, with 15 regional centers, some 50 experimental stations, and many institutes specializing in disciplines related to biotechnology, is the producers' principal state interlocutor, although university departments are active collaborators as well. In Argentina, as in Uruguay, collaboration between public entities and private firms has become more intense and formalized in recent years, as suggested by the profusion of new instruments of cooperation such as *convenios de vinculación tecnológica* (technological linkage agreements) and *convenios de asistencia técnica* (technical assistance agreements). The pace of innovation has been, if anything, more rapid in Argentina than in Uruguay, with the development of a commercially important mutagenic variety of rice resistant to red rust as a signal achievement (Lengyel and Bottino, 2010). The story of the successful development of animal vaccines in Uruguay is, in light of this corroboration by a neighbor, a story that can be repeated.

Regional Aircraft in Brazil

Embraer (Empresa Brasileira de Aeronáutica S.A.), a formerly state-owned firm, is today the world's third-largest civil aircraft manufacturer, after Boeing and Airbus. It has been one of the top two Brazilian exporters since 1999, with international sales in excess of $3 billion in 2005, chiefly to the United States. By any standard it is a large firm, currently employing more than 16,500 people, of whom 85 percent are based in Brazil. Embraer is the exception—in industry, rather than agriculture—that proves the "rule" of industrial policy success in Latin America. The firm's ability to enter the tightly defended oligopoly of international airframe producers depended, as did the development of soy in the savannahs and animal vaccines in the Rio de la Plata estuary, both on industrial policies that were well established before the advent of the Washington Consensus and on early, continuing exposure of crucial aspects of the new endeavor to the discipline of world markets.

The drive to create a sophisticated, domestic aircraft industry serving civilian and military needs was a key part of the national ambitions of the Brazilian technical elite from at least the time of the Second World War. This drive found expression in the late 1940s in the creation of the Aerospace Technological Center (Centro Tecnológico Aeroespacial, or CTA), which housed the country's first (and still leading) school of aeronautical engineering (the Instituto Tecnológico de Aeronáutica, or ITA) and, from 1954 on, a high-level research and development unit (Instituto de Pesquisa e Desenvolvimento, or IPD). By 1968, the IPD had developed and successfully flown the prototype of an eight-seat turboprop plane, equipped with Pratt & Whitney engines. Embraer was founded the following year as a state-owned company controlled by the federal government and reporting to the Ministry of Aeronautics, to manufacture variants of this prototype, which came to be called the Bandeirante.

In conformance with the reigning import-substitution strategy, the initial focus was on the domestic market. Because of Brazil's enormous size and the dispersion of its population, Brazilian air traffic was dependent on the import of light planes. This dependency was made salient and worrisome by the increasing attention of leading international airframe manufacturers to larger and larger planes that could operate with great efficiency in dense markets with high load factors, but were unsuited to Brazilian conditions. Fearing that Brazil could not count in the long term on imported equipment to serve its own smaller and more dispersed market, the IPD and Embraer concentrated on designing aircraft that could economically provide reliable, frequent service on relatively short routes with small loads: small, light planes that minimized

the weight of the aircraft per passenger and could use short, ill-kept (often unpaved) runways under harsh weather conditions with little air traffic control and infrequent maintenance. The fact that regional civilian aviation was so tightly regulated in the 1970s by the Brazilian aeronautic authorities as to create a largely captive market for Embraer planes could only have sharpened the domestic focus. Convergent considerations led to collaboration with the Brazilian air force on complementary projects.

The focus on the domestic market was not, however, incompatible with cooperation with foreign component makers and attention to export possibilities. The costs of project development in the airframe industry are dauntingly high, even for advanced-country producers with deep pockets. Embraer quickly realized that a way to reduce these costs at the outset was to agree to share them with the producers of engines and other key components, in return for long-term purchase agreements or a share of eventual profits. In the medium and long term, the remaining investment costs could be more easily amortized by increasing production runs (thus achieving economies of scale and reducing unit costs) through exports. Exports were also attractive as a way of limiting the company's exchange rate risk, and so helping to ensure the affordability of necessary foreign components.

The result was that Embraer, even in the 1970s, pursued a strategy of buying high-technology, high-value-added components rather than making them itself. The firm was thus free to concentrate instead on aircraft design, fuselage production, and final assembly. Think of this as an early, industry-specific variant of what today would be called a platform model of production, in which the maker of an "operating system" (here, the design and the physical fuselage) collaborates over many product generations with the makers of the "applications" (the engines and the wings) that it connects. For example, although the 19-seat non-pressurized, twin-engine turboprop Bandeirante was of thoroughly national design, more than half the plane's total value added was embedded in imported parts.[10]

In entering into these cooperation agreements, Embraer was careful, on the one hand, to avoid licensing arrangements that would have limited its ability to export planes and, on the other, to ensure that its partners transfer

[10] This reliance on foreign component makers in the aircraft industry was instrumental to the success of the industry, and differed from Brazilian industrial policy in some other sectors. For example, a strict requirement to use Brazilian suppliers was an integral part of industrial policy in the computer sector, where intervention failed.

to it not only relevant, product-specific technical knowledge, but also organizational know-how related to series production in the aircraft industry. Aside from cutting development costs and risks, this strategy assured Embraer that key components were available at competitive prices (because its suppliers benefited from worldwide economies of scale) and helped create a potent lobby against trade restrictions on its planes, as large foreign suppliers had much to gain if Embraer products could be sold in their countries of origin.

By 1975, Embraer was exporting, and three years later the firm entered the U.S. market. Its timing was perfect. The Airline Deregulation Act of 1978 left commercial airlines largely free to determine their own routes, frequency of service, and tariffs. Deregulation accelerated the shift to the hub-and-spoke system of civil aviation, in which larger, more efficient passenger planes connect central hubs fed by smaller, regional aircraft. This change, in turn, led to the creation of a large number of regional or commuter airlines, to serve as "spokes". The U.S. airframe manufacturers, having neglected this market to build large, long-haul planes, could not respond rapidly to the sudden increase in demand for regional aircraft. Embraer, whose growth had been spurred by U.S. producers' neglect of just this market, could. The Bandeirante was quickly adopted by a number of commuter airlines in the United States and, by 1982, accounted for one-third of the U.S. fleet of commercial, 10–20 seat planes. Success followed success: Embraer sold 356 Brasília planes (EMB 120), a fast, pressurized 30-passenger model derived from the Bandeirante, in 14 countries from 1985 on.

However, also beginning in the mid-1980s, the Brazilian state owner began to intrude more directly and disruptively into the company's decision making. Perhaps the firm's undeniable successes emboldened officials and politicians, allowing them to imagine, imprudently, that Embraer was indestructible if not invincible. Or perhaps the constraints of prudence were relaxed by the impending retirement of Dr. Ozires Silva, the much-admired and famously independent chief executive of Embraer, who had led the firm since its founding. In any case, public control of management became much more cumbersome, and important decisions often required executive and legislative approval from the federal government in Brasília. Worse still, the government forced the company to enter into collaborative projects that proved unprofitable. As the world recession hit in the early 1990s, and the government—now embracing the market-reform program—cut various export finance and incentive schemes, sales fell sharply, losses exploded, and morale plummeted. By 1994, Embraer had been sold to a consortium of banks and pension funds in a complex transaction that allowed the private acquirers to

pay with government debt securities and the Ministry of Aeronautics to keep a golden share in the company after its privatization.

Given the prior decades of successful innovation and production, and the relative brevity of the state's truly meddlesome interference, it is perhaps unsurprising that privatization and the accompanying large capital infusion quickly revitalized Embraer. The emblem of its success (and the continuity between the old state and the new private firm) is the EMB 145, the company's first commercial jet for the regional market. Launched in 1989, but certified and first exported only in 1996, this plane has become the mainstay of the firm's exports, with a thousand sold so far.

Today, Embraer has a leading position in its market segment, and the benefits of incumbency are augmented by comparatively lower labor costs. The market for regional aircraft, moreover, is likely to expand, as emerging economies such as China (where Embraer now has production facilities) develop, and as airlines in the advanced countries shift from the hub-and-spoke model to dedicated, point-to-point traffic patterns—essentially shuttle service between two cities—that require just the sort of aircraft in which the company specializes. Beyond all this, the firm's need for direct public support of export financing is decreasing as its own costs of capital decline, in part because of improvements in the Brazilian financial markets, and in part because of its access to international credit.

In sum, Embraer, having built a platform that connected it both to leading producers of key components and to sophisticated, international markets for its final products almost from the beginning, is likely to continue as a major producer of commercial aircraft. More generally, industrial policies, whether in domains related to agriculture or industry, can make indispensable contributions to such platform building.

Capacity Building, Diversification, and Development

The original cluster of claims regarding the importance of self-discovery bears a family resemblance to earlier ideas about the need for, and barriers to, diversification of Latin American exports, crystallized in the work of Raúl Prebisch and colleagues at CEPAL (or ECLAC—the Economic Commission for Latin America and the Caribbean). By way of conclusion, this section briefly examines this connection in light of the study's findings, and suggests that the possibilities for export diversification may be even greater than the initial formulation of the problem of self-discovery, and the background research motivating and supporting it, might suggest.

The key family similarity between structuralism and self-discovery is the idea that some feature of the currently efficient division of labor between advanced and developing countries limits the long-term diversification, and thus growth potential, of developing countries. For Prebisch and the structuralists, the key obstacle to diversification was found in the observation of the deteriorating terms of trade for primary products. From the vantage point of the late 1940s when they took up the theme, and in the following decades, it seemed that prices of primary products, especially foodstuffs—as measured by the value of the industrial products for which they could be exchanged—were in constant decline. This might have been because demand for industrial goods increases more with increments of national income than does demand for food and other primary products, or because trade unions in advanced countries could claim a greater share of the gains from trade than their counterparts in developing economies. But either way, or for yet another reason, the upshot was clear: the returns to efficiency increases through trade, and by the steady improvement of production techniques, went disproportionately to the advanced countries; further, this impoverishment was self-perpetuating because, by depriving developing countries of the capital to diversify, it locked them into the very activities that made continuing expropriation possible. The way out was thought to be a program of import-substituting industrialization—in effect using a sheltered domestic market to build the (diversified) capacities with which to engage world markets fully and fairly (Prebisch, 1981, 1986).

For Hausmann, Rodrik, and their collaborators, capacity building through diversification is also the key to development. They have demonstrated, as noted at the outset, that countries become what they export. Thus, the key to development is learning to make and export the sophisticated goods the advanced economies already make for one another. A key task of development economics is identifying obstacles, in general and in particular economies, to this diversification. But in contrast to the structuralists, declining terms of trade for primary products do not figure in their analysis (for the simple and conspicuous reason that terms of trade for primary products are, if anything, improving today, and seem in general to have played a small role in shaping the economic prospects of developing countries) (Hadass and Williamson, 2003). Nor is there any other equivalent mechanism in their view that directly blocks development through unequal exchange, making the prosperity of the advanced countries dependent upon the misery of the developing ones.

Of the general obstacles to diversification on which they do focus, the first and most directly relevant here is the problem of self-discovery itself. In

the original formulation of the idea, problems of appropriability led to underinvestment in the search for new exports as alternatives or, better, supplements to current ones. In the context, moreover, of the Washington Consensus program of reducing barriers to entry and other market distortions generally, without attending to this specific problem, the perverse result of the failure to explore new opportunities, especially in Latin America, might have been to encourage dedication of still more resources to existing activities.

A second general obstacle to diversification identified in the self-discovery research program has to do with intrinsic features of products themselves or, more exactly, with the generalizability of the capacities required to produce them. Hausmann and co-authors have devised ingenious methods for "mapping" the space of export products, where the proximity of two goods on the map (derived from measures of their co-occurrence in particular economies) indicates dependence on common, or closely related capacities, and thus the ease of diversifying from one to the other (Barabási et al., 2007). As might be expected, industries like telecommunications, computers, and capital goods tend to be "close" to one another on this product map, and countries that are good at one can enter the others if it is opportune to do so. Conversely, products that are isolated from these rich clusters on the map are those dependent on specialized capacities. An economy dedicated to producing these kinds of products entrenches itself in its routines, rather than acquiring the capacity to master new, more demanding and rewarding skills. Isolated, specialized industries in this developmental sense include mining, forestry, agriculture, and animal husbandry—the very primary products that Latin American economies have traditionally exported. Thus, self-discovery turns out to be especially important for Latin America because its traditional vocation for primary products has led into remote and isolated zones of the product space, far from the interrelated capacities that constitute the common core of modern production.

In light of the results of the study on new exports from Latin America, these concerns seem not misplaced, but mischaracterized. Self-discovery is arduous and costly; it is not simply an incidental and automatic result of well-functioning markets. But neither is it a straightforward market failure that can be remediated by a patent-like tightening of property rights that allows pioneers to capture the positive externalities of their efforts. On the contrary, based on the evidence presented in this research project, self-discovery turns out to be largely a problem of complex coordination, solved by cooperation among diverse actors in the private and public sectors. Industrial policies, especially the provision of club or industry-specific public goods in the form of

specialized services—technical assistance, help in meeting phytosanitary requirements, and so on—can help, but only if the beneficiaries are exposed to the continuing discipline of competition. Under favorable political circumstances, Latin American countries were able to develop such policies in the period before the Washington Consensus, and there is every reason to think that they are even more capable of doing so now.

Similarly, dedication to traditional primary products surely continues to be a burden to development, but the obstacle lies in the adherence to tradition in production methods, not in some essential feature of the products themselves. On the contrary, again, the renovation or reinvention of these products—as captured most dramatically in the shift to GMO soy—is manifestly an opportunity to acquire many of the kinds of skills that form part of the core competencies of the modern economy. Primary production can be—and is on the way to becoming—a springboard as well as a trap. This is not a surprise, given what is known of the contribution of agriculture to the development of Australia, Canada, Denmark, and the United States, or of forestry to Finland. But evidently it is a lesson that bears repeating given the history of Latin America and the lingering legacy of the structuralists.

Taken together, these two recharacterizations of the problem of self-discovery and export diversification suggest that while the struggle for development and the acquisition of new capacities continue with undiminished urgency, the paths to these goals may be different, and perhaps more accessible, than economists might have feared.

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CHAPTER 2

The Emergence of Blueberry Exports in Argentina

Gabriel Sánchez, Inés Butler, Ricardo Rozemberg, and Hernán Ruffo

The production of blueberries for export in Argentina is a clear example of self-discovery of comparative advantage in a differentiated agricultural product, which also entailed the solution of coordination failures, mostly by private firms, to provide the required industry-specific public goods. Argentina's main exports have traditionally been agricultural commodities (mostly grains and oilseeds), reflecting a large comparative advantage in this sector. Despite the availability of required natural resources and general agronomic capabilities, the development of differentiated agricultural goods for niche export markets failed to occur before the 1990s. Growth took off once comparative advantage was discovered and relevant industry-specific public goods were provided.

Before 1992, the production of blueberries in Argentina was limited and dispersed, and had no commercial value. Starting that year, some varieties of the plant were imported and planted, the first harvest took place, and the first exports were undertaken by a pioneering entrepreneur. Exports started growing quickly after 1998, when diffusion became more widespread. In 2005, total exports reached $28 million, becoming Argentina's seventh-largest fruit export; in 2008, exports jumped to $58 million. In 2009, exports dropped considerably because of bad weather conditions and a drop in international demand due to the world financial crisis. In the past few years, the sector has been undergoing a rationalization in response to a combination of falling

prices and rising costs that resulted from overinvestment in this sector. This overinvestment resulted partly from overplanting, but mostly from many entrants that did not survive.

Three stages of the value chain had to be developed to support the emergence of this sector: nursery, production, and commercialization. Some of the most important exporters are vertically integrated, but most of the growth in this sector can be traced to newcomers that specialize in a specific stage.

The main consumption markets are in the Northern Hemisphere (United States, the European Union, and Japan). Argentina competes with Chile, New Zealand, and South Africa in the off-season market, which commands more attractive prices than the in-season market.

The Discovery of Blueberries in Argentina

The pioneer was the Vergel firm, which was created in the early 1990s by Francisco Caffarena, an individual entrepreneur who had been working as an executive for an important multinational corporation in the automobile industry and wanted to apply his savings to develop his own business. To this end, he used a project evaluation methodology to search for innovative investment alternatives with highly profitable niche export markets in the agricultural sector.[1]

The opportunity to export blueberries came by chance, during a business trip to Italy, where Caffarena learned of the attractiveness of the European off-season market for this fruit from local business contacts. A preliminary project evaluation yielded very high expected payoffs—given high world prices in the Northern Hemisphere off-season—estimated at between two and ten times the seasonal prices. He thus decided to learn more about the product and to evaluate the feasibility of its production in Argentina. To this end, Caffarena contacted a U.S. nursery, from which he gathered information about production techniques and plant varieties. He also contacted UK importers, who confirmed his initial promising estimates of free-on-board (FOB) prices and export volumes.[2] In addition, he discovered that commercialization could be easily handled. Costs of inputs and land in Argentina were also known. The expectation of a temporary monopoly period (two to four years), due to the time lag

[1] He considered a wide variety of products that faced a low degree of competition in world markets, including artichokes, asparagus, capers, chestnuts, goat cheese, kiwi, iguanas, and raspberries.

[2] Free-on-board price is defined as a price that includes the cost of goods plus the cost of loading those goods onto some vehicle or vessel for shipment to market.

for the plantations of potential imitators to mature, also facilitated Caffarena's decision. Another factor contributing to his choice was that the required initial investment (about $200,000) was within his reach.

There were several uncertainties undermining the production stage. First, agronomic engineers lacked previous knowledge of some important aspects of growing blueberries in Argentina, such as climate requirements, soil characteristics, harvest season, and diseases. Caffarena was able to overcome these problems in part by contracting a U.S. consultant to assist him in dealing with different problems regarding production and sanitation, but uncertainty remained high, demanding experimentation. A significant proportion of plants in the first field died despite the technical assistance.

Second, no previous knowledge existed about which varieties of plants were the most suitable for Argentine soil. Vergel had to import diverse varieties from the United States in order to test them. Caffarena also had to experiment with plants in his nursery, as the imports lacked the required phytosanitary quality. The pioneer chose to use macro-propagation techniques for the multiplication of plants, which was cheaper, faster, and less risky to implement than micro-propagation techniques (which are much more productive, but require costly and lengthy R&D).[3] Macro-propagation allowed him to start producing earlier, albeit probably with less-reliable plants and lower productivity.

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[3] Blueberry plants can be propagated using two different techniques. The simpler one is the macro-propagation technique, or propagation by stakes. The micro-propagation technique is the multiplication of a plant in vitro. Interviews revealed some controversy about both methods. Macro-propagation allows a simple, costless way of multiplying the plant because it can be done by the farmer or in a traditional nursery. This is the most common system for renewing plants in a plantation and the method with greater diffusion worldwide. Opponents of this technique have three main objections: (1) as new plants come from a diversity of existing plants, some diseases can be propagated if the original plants are infected; (2) the method harms original plants, which limits the multiplication of plants and obliges the nursery to use both "good" plants and "bad" plants; and (3) the plant has axial growth, which is inconvenient for the renewal phase. On the other hand, the micro-propagation technique demands specific knowledge and important investments in development, laboratories, and inputs. The most important characteristic of this method is that it enables one plant to be multiplied into millions of plants in less than two years without harming the original. This leads propagators to select one plant (the "best" plant) and multiply it in a controlled environment, free of diseases. One of the critical issues is the extent to which micropropagation leads to mutation and does not allow an accurate certification of varieties. Advocates argue that, on the contrary, the plants are clones, genetically identical to the original plant.

In an interview, Caffarena admitted that initially Vergel made "all the imaginable mistakes." Once production proved to be feasible, uncertainties were significantly reduced, providing useful information for new plantings. However, significant technological uncertainties remained, resulting in low productivity of the first plantations.

Returns on investment were also uncertain. Input prices and labor costs for harvest were relatively well known, and the choice of macro-propagation techniques helped control costs. The export prices to be received in Northern markets were more uncertain, as they varied depending on the date of harvest and the transportation method used. The initial contacts with UK importers provided Vergel with some information about these aspects, but final returns were not revealed until Vergel experimented with production. Caffarena calculated that the business would be profitable at all estimated prices, provided that the right production techniques and plant varieties were used. What was key was the fact that costs were half those of Chile, the main potential competitor in the off-season market ($40,000 per hectare, compared to $80,000).

In the first stage, Caffarena planted two hectares that he owned in northern Buenos Aires, without knowing if this was the best location for production. This experiment failed (many plants died), but it revealed crucial information about the best production location and the actual prices that he could obtain. This location allowed Vergel to harvest in October, one month ahead of the harvest in Chile. The Northern Hemisphere price for this month was between $20 and $40 per kilo (depending on the particular week) and Vergel faced no competition, allowing him to become a (temporary) monopolist.[4] In contrast, the prices obtained by Chile and New Zealand were fractions of this (see Table 2.1). This price advantage made the business profitable even if the worst possible production techniques were used.

Caffarena then decided to expand production and incorporate the nursery, which gave him the opportunity to generate a separate line of business. The first harvest was exported in 1994 to the United Kingdom. It was experimental, and the first shipment was so limited that he transported it in his own car to the international airport.

The subsequent plantation in Entre Ríos, north of Buenos Aires, allowed him to experiment with techniques and varieties in different locations and

[4] The information on this price range was provided by Caffarena and verified by comparing COMTRADE data on the volume and value of blueberry exports from Argentina during those years.

TABLE 2.1 | Initial Off-Season FOB Prices for Blueberries

	Argentina	Chile	New Zealand
1994	20.11	1.29	4.22
1995	22.11	1.91	5.11

Source: Authors' estimates based on COMTRADE data.

climates. This kind of information was so important that imitators followed him closely in these new locations—sometimes so closely that they planted in the nearest fields.

Investment in blueberry plantations should be evaluated over a 15- to 20-year period (a plant yield reaches 100 percent only after eight years). Newcomers could erode Vergel's prices during this period, as they faced downward-sloping demand in the prime months of the off-season. The pioneer's expectation, however, was that diffusion would be bigger at the production stage and that he would be able to keep a relevant market share in nursery and commercialization activities, offsetting this price effect. In any case, Vergel was at least two years ahead of any other competitor, which guaranteed breaking even and several years of monopoly.[5] Growing international demand and the opening of new markets were other factors for persistent gains.

Potential coordination failures in this initial stage were averted through vertical integration by the pioneer in nursery, production, and commercialization. This was made possible by the relatively small investment required in each stage, which was within his financial reach. Managerial requirements were also within his scope. Access to a niche market where he was the only supplier greatly reduced the challenges.

The Diffusion of Blueberries in Argentina

The diffusion process proceeded in three stages. The first occurred at the production level between 1994 and 1998, was promoted by the pioneer, was limited in scope, and concentrated mainly in northern Buenos Aires. During the second stage, from 1999 to 2001, diffusion occurred at the production, nursery, and commercialization levels, and different clusters of producers emerged in different locations. In the third and final stage, between 2002 and 2006, there

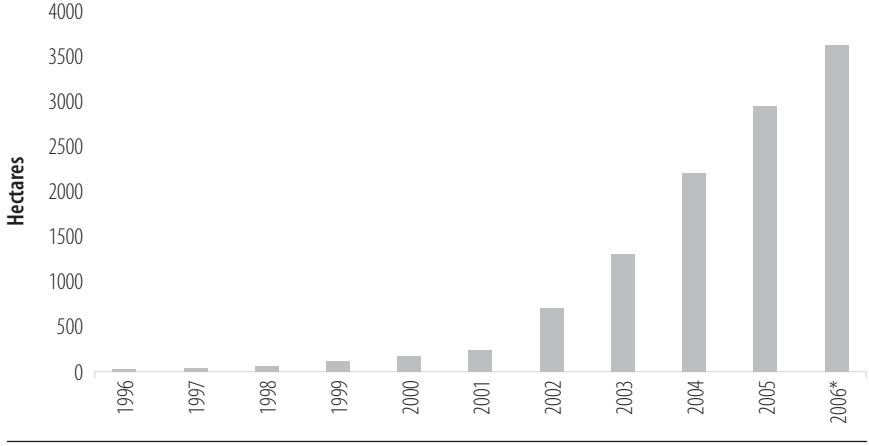
[5] An ex post calculation using actual prices from 1994 to 2005 showed an internal rate of return (IRR) of more than 60 percent at the onset of this activity.

was a boom in blueberry plantations that was promoted both by the 2002 devaluation of the Argentine peso and by the opening of the U.S. market in the late 1990s (see Figure 2.1). This dissemination slowed down and has been partially reversed since 2007 because of falling prices and rising costs.

Following his initial success under limited vertical integration, Caffarena's next natural step should have been to expand the three activities to the monopoly optimum. However, he faced financial and managerial constraints. The investment required to prevent newcomers from entering was beyond his capacity and highly risky, given that continuous experimentation (varieties, locations, growing techniques, and the like) was still essential. He thus concentrated on the nursery and commercialization aspects of the business and promoted a limited diffusion of production. His choice of activities was based on the larger economies of scale in these two activities and on the fact that production was still the most uncertain activity.

From Caffarena's point of view, an additional hectare planted by other producers reduced his profits through a cut in FOB prices, but increased his gains through sales in the nursery business and commercialization fees. Marginal gains of an additional hectare can initially be higher than marginal costs, but the price effect would eventually be stronger. Hence, a limited diffusion would have maximized Vergel's profits. At the same time, this limited dissemination reduced the visibility of blueberries as a potentially highly profitable crop, slowing down the entry of competitors at the nursery and commercialization stages.

FIGURE 2.1 | Hectares of Blueberries Planted, Argentina, 1996–2006



Source: Authors' estimates based on Secretary of Agriculture, Argentina.

Given the lack of knowledge about blueberry production techniques, the relatively long time for reaching top production capacity, and the (a priori) difficulty of selling the product (only for export markets), any farmer would have been reluctant to initiate this activity on his or her own. For that reason, the pioneer not only sold plants but provided technical assistance in production and secured sales from new firms by signing contracts to buy future production. Vergel also offered potential investors a calculation of blueberry internal rate of return (IRR) (based on their own costs and operations) and opened its plantation to extension activities.

Since the pioneer still had not fully mastered the technological aspects of production, this initial diffusion coexisted with an experimental phase in which some techniques, soils, and varieties continued to be tested. The learning process was rather slow, and many of the first farms and plantations failed. These initial mistakes and unsuccessful experiences significantly slowed down diffusion in this first stage. The production obtained in 1996 (almost 3 tons) was only one-fifth of the potential output that could have been obtained using the right technology.

The second stage of diffusion was characterized by the entry of new, relatively large players at the nursery and commercialization levels, and by a continued diffusion of production driven by the initiatives of the new upstream players, the signaling effects of Vergel's first investments and its limited diffusion of production, and the pioneer's opening of the U.S. market.

Two Argentine nursery firms had been attracted by the potential of blueberries in Argentina at the beginning of the 1990s—the same period in which Vergel's initial investments were made—although neither nursery was aware of the other. These new nurseries had different core businesses, but both can be considered pioneers of the development of micro-propagation techniques.

One of these firms was Cuinex, based in Mercedes, in the province of Buenos Aires. The firm was set up by two Argentine agronomic engineers who had been working with asparagus producers and wanted to promote the expansion of other related agricultural activities to use their installed packing capacity in the off-season. They evaluated blueberry production, and its promising payoff (given high FOB prices) convinced them to invest in this activity. In 1990, they imported the first plants for testing purposes from the United States. They learned through laboratories at the National Institute for Agricultural Technology (INTA) that these plants had several diseases, and that some of them were specific to the blueberry plant. They thus realized that to promote the diffusion of this sector, they had to develop healthy and high-quality plants. They made a big investment in a two-year experimentation

process, during which time they finally learned all the relevant issues about micro-propagation techniques. They overcame the large, initial technological uncertainties and began their plant sales around 1995.

Cuinex expected that production would emerge in response to high prices and that blueberry plantations would boom during 1995–96. Their estimates proved to be wrong, as blueberry production diffused significantly only after 1998. They attributed this slow diffusion to the insufficient initial investment by Vergel in learning about the most adequate production technologies and plant varieties.

Meanwhile, the pharmaceutical firm, Sidus, based in Buenos Aires, had developed a new firm devoted to plant biotechnology. In 1992, it became Tecnoplant, and its core activity was the micro-propagation of plants. Like Cuinex, the firm started investing in the nursery business ahead of the expected emergence of production in response to high prices. It focused on developing new, early varieties, to differentiate them from the Chilean supply. During a two-year experimentation period, biotechnology techniques were adjusted and varieties tested in different climates and soils. The firm also imported varieties developed by U.S. universities and bought the required licenses for planting them, without real knowledge about what their yields would be in Argentina.

The limited diffusion pursued by Vergel forced Cuinex and Tecnoplant to commit actively to this diffusion phase. For example, Tecnoplant provided farmers with project appraisals, technical assistance, financing for packaging plants, and commercialization contracts.[6]

The emergence of producers during the first and second diffusion stages also attracted the entry of new players at the commercialization level that had core activities in trading and logistics, as the product requires careful packaging, immediate and continued cooling in a cold chain, and export by plane in order to take advantage of higher, early-season market prices. All this makes commercialization and logistics key aspects for this activity. Chilean exporters were natural entrants to the sector at this stage, given that production from Argentina is complementary to production from Chile (due to the different

[6] It is worth noting that the initial investments in R&D and laboratories operate as barriers to entry to other micro-propagators. Hence, it is probable that Cuinex and Tecnoplant emerged simultaneously because of the fortuitous fact that the two firms initiated their activities the same year without knowing about the other. The capacity for scaling their production became evident in the third stage of diffusion, as each firm boosted its yearly sales from 100,000 to 1.5 million plants.

harvest month), which allows Chilean firms to maintain commercial contacts during the entire off-season.

Some newcomers implemented strategic alliances with Chilean or U.S. firms whose core activity was commercialization of fine fruits. Other local newcomers were motivated by their knowledge of exports of other food products to the U.S. or EU markets. They added blueberries to the commercialization of other products, typically by initially buying the product from farmers, and only then starting to produce them.

The boost to diffusion by Cuinex and Tecnoplant and increased competition in commercialization allowed farmers to operate in a more competitive fringe in upstream and downstream activities, which gave them better prices, significantly reduced technological uncertainty, and improved plant quality and productivity. It also reduced the uncertainty that could have arisen had the feasibility of the project depended on only one client and supplier.[7]

During this phase, there were interesting examples of cooperation among farmers in solving coordination failures. A cooperative of small farmers was created with the goal of improving commercialization and production techniques, and cutting costs. Most of its members were geographically concentrated and had administrative or professional backgrounds. When a packing plant was required, the members invested jointly to provide it. The cooperative also connected with other producers in distant locations, and eventually led to the formation of a farmers' association (CAPAB) that provides some common services (contacting the government; increasing the commitment of the food safety agency, SENASA, to the sector; promoting research; and the like), and which has grown to 600 members.

During this stage, Vergel provided a key public good by opening up the U.S. market. In the early 1990s, there was no protocol for blueberry exports from Argentina to the United States, and Caffarena pushed for establishing one. After working its way through the U.S. and Argentine bureaucracies for two years, a blueberry export protocol was approved, which required exported fruits to be subject to postharvest fumigation with methyl bromide (to prevent the spread of the Mediterranean fruit fly) before entering the United

[7] For instance, in 1999, Jorge Pazos, a former executive from an important metal mechanics exporting firm, decided to convert his seven-hectare production of peaches and plums in Mercedes, 100 kilometers west of Buenos Aires. He chose blueberries as a possible alternative and contacted Vergel, acquiring information from it, visiting its plantation, and receiving advice about Vergel's production techniques. But he finally decided to buy the plants from Cuinex, which also offered specialized advice on production.

States. This protocol at first allowed exports to enter the United States only through the New York airport, where the fruit was fumigated. This increased costs and complicated logistics considerably. For this reason, another alternative was explored, which required building up and approving a new fumigation infrastructure in Argentina. The U.S. Department of Agriculture (USDA) requirements were strict and demanded the construction of a fumigation chamber with the newest technology, not yet developed in Argentina. Vergel invested $200,000 in the development of this chamber without knowing if it was going to be approved by the USDA. It finally was approved after one year in operation.

Vergel undertook this risky investment because at that time competition was not that widespread, and the U.S. market was very large and lucrative (this market represented 60 percent of total exports in 2006). Hence, Vergel expected to enjoy above-normal rents for a time span that was long enough to recoup the investment. While the approval of the fumigation technology was a public good, the physical infrastructure developed by Vergel was a private good, which helped it sell a new service to its clients. Most exporters now use this technology, and many other similar chambers have been constructed. Interviews did not reveal whether Vergel actually earned money from the construction of these new chambers.

While Vergel was the only significant exporter in 1998, by 2001 there were seven new exporters, and new producers had diffused the activity from Buenos Aires to other locations.

The last and largest diffusion wave started in 2002. During this phase, many nurseries supplied different varieties of blueberry plants and propagation systems, and the number of farmers and exporters grew, which signaled the feasibility and the profitability of production and exports, and also generated public goods in the form of refined technological knowledge, attracting newcomers. In addition, the 2001–02 financial crisis and devaluation lured many investors that had managed to maintain large liquidity positions in foreign currency but lacked financial alternatives for investing. The devaluation also reduced labor costs. The fact that Cuinex and Tecnoplant/Tecnovital Nurseries offered business packages that included plant supply, technical assistance, commercialization, and an updated project appraisal of blueberry plantations was especially useful and attractive in this context.

Blueberry plantations have boomed since 2002–03, when clusters of newcomers proliferated in small plantations and big firms or groups of investors started large plantations of 200 hectares or more. New locations were discovered, including Tucumán in the north, Entre Ríos in the east, and San Luis in the

west, which helped widen the harvest season. Tecnovital and Cuinex decided to integrate vertically in this stage, investing in big plantations. These firms and Vergel were some of the biggest investors in terms of hectares planted and locations covered.

The U.S. market opening by Vergel played a very important role during this stage. One of the biggest players stated in an interview that without access to U.S. markets, the investment would have been only one-tenth of the actual amount.

Newcomers account for 98 percent of the total growth in exports of blueberries between the early 1990s and 2005, which increased from $1 million to $28 million (see Table 2.2). While Vergel increased its exports by 50 percent between 1998 and 2005, its importance in the sector was reduced, to represent only 4 percent in 2005. By volume, exports increased from 300 kilograms to almost 2,700 tons in 2005, and then jumped to more than 10,000 tons in 2008. This exponential growth resulted from the maturation of plantations started during the 2002–04 booms.

The diffusion process is also reflected in the planted surface, which grew from around 50 hectares in a few locations initially to 4,000 hectares

TABLE 2.2 | Blueberry Production by Firm, Argentina, 1998–2005

Share (percent)

Firms	1998	1999	2000	2001	2002	2003	2004	2005
Tecnovital S.A.	—	14.21	31.89	8.73	25.82	16.67	32.78	23.36
North Bay Argentina S.A.	—	—	—	24.97	28.13	32.41	21.08	19.85
Berries del Plata S.A.	—	27.51	27.59	25.64	20.21	23.99	19.87	12.42
Blueberries S.A.	—	—	—	—	—	1.07	3.82	9.77
Vergel S.A.	79.32	57.45	6.85	23.33	14.93	11.05	6.98	4.13
Sri Argentina S.A.	—	—	—	10.54	8.32	9.74	6.70	3.67
Frutazul S.A.	—	—	1.34	1.98	1.16	1.15	1.32	1.72
Argesa Argentina Exportadora S.A.	—	—	—	0.70	0.08	0.59	0.57	1.37
Hortifrut Argentina S.A.	—	—	0.20	0.12	n.a.	n.a.	n.a.	0.92
Expofrut S.A.	—	—	6.02	3.92	1.33	1.03	0.49	0.16
Total share (percent)	**79.32**	**99.16**	**73.89**	**99.92**	**99.98**	**97.70**	**93.61**	**77.37**
Total exported (US$)	**1,007,109**	**1,506,358**	**2,287,740**	**3,824,716**	**6,015,668**	**7,085,889**	**16,366,342**	**28,371,183**

Source: Authors' estimates based on Customs Agency data.
n.a. not applicable
— Not available

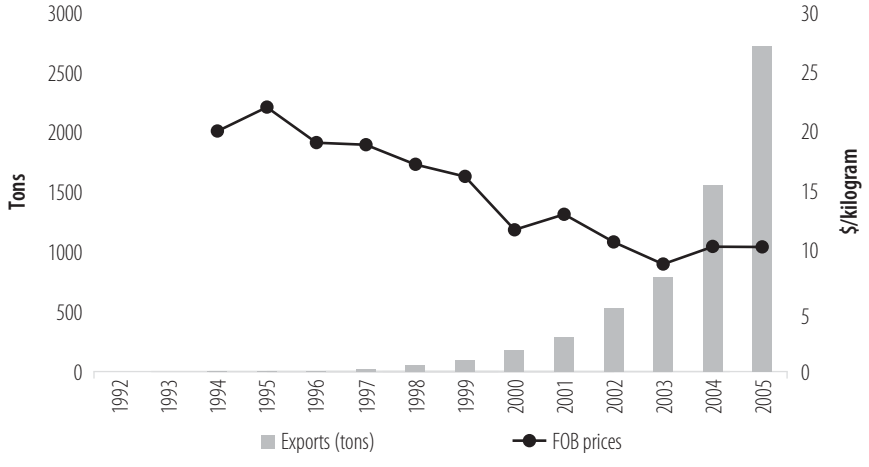
distributed in several locations currently. The number of players rose from around 15 farmers at the onset to 600 producers in 2006, and from 1 exporter to 22 exporters, 9 of which exported more than $1 million in 2005.

This diffusion had a clear impact on prices and costs. While in 1994–95 the FOB price of exports was $22 per kilo (and the price for exports from Chile was less than $2), the increase in production lowered the price to around $10 in 2002–05 and then to $6 in 2008 (see Figure 2.2). This average price includes production in new locations that command higher prices because of their early harvest season.

Investment in production was overshot (driven both by excessive entry and excessive inframarginal planting), probably because prices remained too high for too long because of the low productivity of the initial plantations. Up to the point where only 1,000 hectares had been planted and plants were in their fourth year of production, the business was very profitable. Profitability now is not guaranteed and depends on the scale and efficiency of each individual producer, and the year in which the business was started.

Industry rationalization has been taking place as prices declined, markets became more demanding, and not all producers could meet these demands at reasonable costs. This decline has led to the shutdown and/or abandonment of many fields. In regions like Tucumán and Concordia, the planted area declined by about 50 percent.

FIGURE 2.2 | Blueberry Exports and FOB Prices, Argentina, 1993–2008



Source: Authors' estimates based on COMTRADE data.

This decline is largely associated with the rise in costs caused by a lack of adequate planning and organization in production and commercialization. World demand and supply followed an upward trend until 2008. The price decline up till then was due mostly to growth in Argentine supply in the prime months of the off-season, and to growth in the supply of competing countries in the off-season market. Additionally, the large monopsony power of trading firms has allowed them to lower producer prices to remain competitive without losing profits, but has forced the exit of many other smaller producers.

Additionally, the boom in production and exports has also been constrained by bottlenecks in the access to industry-specific public goods: insufficient availability of air transportation, inefficient customs, regulatory and bureaucratic constraints, roadblocks by picketers (involved in political and/or social protests of different kinds), high transportation costs, and bureaucratic delays. The quality of roads and railroads is quite poor, and has gotten worse in the past six years. Port and airport tariffs are also rising and hurting costs. There are also bottlenecks in fumigation capacity.

Industry Response to the 2009 Crisis

This industry was hit in 2009 by the international financial crisis (which lowered export prices) and by bad weather that forced fruit to be harvested all at once, which led to higher costs and to the perishing of production that could not be adequately harvested, stored, and/or transported due to bottlenecks in logistics and labor supply.[8] In addition, the bad weather prevented exporters from supplying the Northern Hemisphere in the prime off-season months, which further hurt export prices. Production costs exceeded all expectations because during extreme weather episodes, the use and cost of inputs go up

[8] Uruguay's harvest is also shipped via Buenos Aires' Ezeiza airport, which exacerbated congestion. A lot of fruit awaiting shipment in the airport area could not be properly stored at the right temperature, which accelerated its ripening. This logistics bottleneck further reduced the amount of fruit that could be shipped. This fruit was attacked by fungus, requiring a very costly repacking that was borne by producers. There was also a bottleneck in the supply of labor as a result of the congestion in harvesting. Without congestion, 10,000 to 12,000 workers are required for the whole season. With congestion, 30,000 workers were needed at once. There were further logistics problems in the fields, as SENASA (the food safety agency) did not supply the required number of personnel to undertake the fumigation with methyl bromide when the congestion in the harvest was occurring.

(treatments, cures, drip irrigation, anti-frost, fungicides, calcium chloride applications, and the like).

Exports fell dramatically in 2009, to about 50 percent less than in 2007 and 33 percent less than in 2008. In 2008 and 2009, the largest firms abandoned part of the planted area without harvesting to stop losing money, and several of them filed for bankruptcy in early 2010. Some firms exited the sector. Others are aiming to plant other varieties that are more weather-resistant, or are starting to diversify their production, replacing part of the blueberry production with pecans and citrus fruits.[9]

Many trading firms also posted big losses. These firms met only half the shipments demanded by U.S. customers. These firms had made and paid arrangements for double the fruit they ended up exporting. While exporters all around the world in many types of products faced the negative effects of the international financial crisis in 2009, Argentine blueberry exporters also faced the negative impact of the bad weather shock and the associated logistics bottlenecks.

The prospects for 2010 were that a large area will not be harvested again, and that some fields would have to undergo a change in the varieties being planted, which entails investments that many producers resist in the face of declining profits. The challenge now is to differentiate products via better quality and to improve the commercialization channel.

The Role of Accumulated Capabilities, Industry-Specific Public Goods, and Public Policies

Argentina's comparative advantage in agricultural activities generated a set of general capabilities that could be quickly adapted to the needs of the new product, such as the nurseries devoted to traditional crops, and agronomic engineers with research and entrepreneurial skills who assisted producers in alternative crops. The emergence of blueberries also benefited from the existence of an entrepreneurial class that consisted of former executives of large firms, plus biotechnological firms with far-reaching interests and capabilities.

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[9] In Concordia (Entre Ríos), there was a 15 percent decline in planted area in 2009 compared to 2008, and many establishments shut down. In Tucumán and Concordia, at some point more than 70 percent of producers decided to stop harvesting. Many producers harvested less than 30 percent of what was expected, and those that harvested reached 50–60 percent of what was expected. In Buenos Aires, most producers also harvested below expectations and had quality problems that prevented shipping.

In a later stage, the entry of other fruit exporters (with accumulated capabilities in apples, pears, and lemons) gave an extra boost to this sector. Some capabilities needed initially were imported, like the consulting and technical assistance of foreign experts.

These accumulated capabilities and Argentina's comparative advantage made it possible to overcome some industry-specific "public bads" that unduly raised the costs of experimentation and hurt the competitiveness of local production. The interviewees stressed the deficiencies of relevant local institutions when compared to those of other countries. For example, they emphasized that the food safety agency, SENASA, has been a constant barrier to importing the required plants and agrochemicals, and that it has been of little help in controlling the Mediterranean fruit fly or in helping producers negotiate new protocols with the U.S. Department of Agriculture (USDA).[10] In the case of INTA (the National Institute for Agricultural Technology), interviewees criticized its lengthy processes, its lack of knowledge of this particular fruit, and the scarce extension activities.[11] Even when the public sector tried to "do good," it almost ended up "doing bad," as attested by the attempt to promote further diffusion when there already was an overinvestment in the sector.

It appears that the provision of industry-specific public goods (ISPG) in Argentina was sufficient up to a certain volume of output and exports, and when prices and costs were highly favorable to producers. Discovery and initial diffusion were served with ISPGs that were relatively easy to provide. However, when this industry reached a certain threshold, coordination failures emerged, which have capped further growth of this sector.

For instance, the development of logistics infrastructure to export fruit resulted from private and public investments in response to the growth in demand for these services, and in the diversification of fruits and varieties exported. The big boom in blueberry exports and the resulting large demand

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[10] In 2009, when the crop has to be harvested all at once because of bad weather, SENASA failed to provide the required bromide fumigating capacity (by making available extra shifts of its personnel). One of CAPAB's most recent collective actions was to complain formally to the government because SENASA has not yet authorized the use of certain fertilizers that are extremely important for increasing productivity and that are being used elsewhere.

[11] They also complained about the role of Argentina's embassies, which appear not to have contributed to the opening of new markets. In addition, they criticized specific support programs for different reasons. For example, the research team obtained evidence that the PREX program, a subsidy to help firms obtain export consulting, never reimbursed the funds to a producer who had participated in the program.

for logistics services took place in 2005–06. In response to this growth, a new cargo terminal for perishable products was set up in Ezeiza airport. The terminal was expanded as demand grew, but it is currently insufficient. The logistics infrastructure in Argentina is not that different from the infrastructure available in other countries that serve off-season markets. The difference lies in the number of airports available for overseas shipments and the associated infrastructure. There is a big coordination problem caused by the seasonality of exports. It is difficult to set up the required infrastructure to operate during only one month. This problem has been partially solved with government intervention to make it possible to ship directly from another airport (Tucumán).

Further coordination problems arise from the industrial organization of the sector, such as the lack of coordination among producers and traders in bargaining with foreign buyers, planning production, improving logistics at the trading level, and bargaining for the development and approval of a "cool treatment" protocol that allows for fumigation with bromide at lower temperatures (so as to slow down ripening). It is generally perceived that actors within the production and commercialization chain have difficulty communicating, and a low propensity to adapt (such as changing varieties).

Counterfactual Analysis

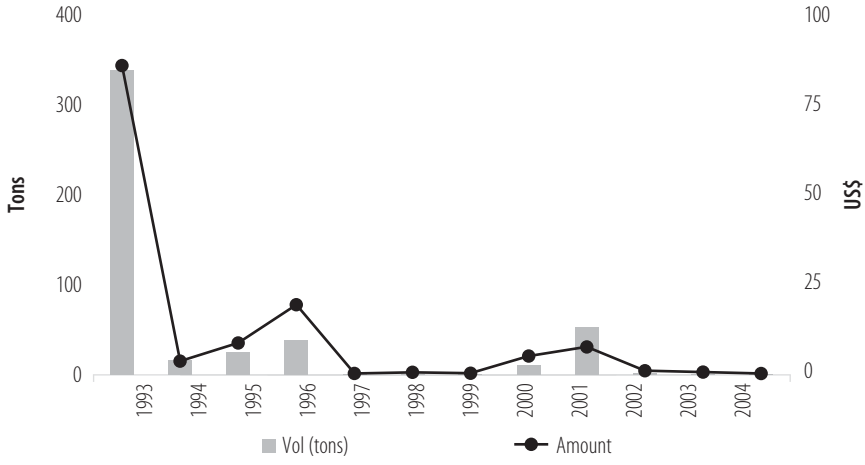
The most important factors that shaped the discovery and diffusion of blueberries in Argentina can be isolated by analyzing the lackluster experience with fresh raspberries in Argentina and the rapid diffusion of blueberries in Chile.

Fresh Raspberries in Argentina

Raspberries have been produced since the 1970s in the Patagonian region. This production was traditionally commercialized in the local market either fresh or processed as jam. However, in 1993, exports of fresh raspberries jumped from negligible amounts to almost $350,000. Nevertheless, these exports dropped to insignificant levels in the years that followed (see Figure 2.3).

The production of berries expanded northward to Buenos Aires and Santa Fe around 1989. Plantations in those areas boomed in 1993, but were limited in size from 0.5 to 5.0 hectares. This boom was driven by the growing trend in world demand and the perception that it was feasible for Argentina to become a competitive supplier of the Northern Hemisphere in the off-season. There was not an identifiable first mover. Raspberry farmers' attempt to export fresh

FIGURE 2.3 | Raspberry Exports, Argentina, 1993–2008



Source: Authors' estimates based on COMTRADE data.

production was based on the Chilean success and on information gathered from specialized publications.

Initial experimentation quickly revealed the following insurmountable hurdles for developing these new exports in Argentina: lack of comparative advantage and poor timing, low profits caused by low prices and high logistics costs, very large coordination externalities, and lack of public support.

Unlike the case of blueberries, in the case of raspberries, Argentina, whose harvest season stretches from December to March, must compete with Chile, which has extended its production season from October to May.[12]

The raspberry sector in Chile expanded in the 1980s. Big plantations of about 50 hectares were established. This validated the investment in infrastructure for cooling logistics, which was coordinated by the government. Exporters commercialize jointly, and also jointly exploit a packing plant next to the plantations, which generates important scale economies. But the key advantage is that Chile entered the market first, when prices were higher, which allowed producers to finance logistics costs and experimentation phases. Argentina's late attempt to export at an initial low scale, with high unit costs of logistics and commercialization, was not profitable.

[12] Additionally, recent competition from Mexico and southern Spain in the crucial months of October and May has lowered prices.

Additionally, exports had to compete with a very attractive domestic demand for frozen raspberries. In 2007, local prices of fresh raspberries were around Arg$12/kg. (US$4), while Argentine exports fetched a similar price of around US$4, and export prices (in Chile) varied from US$1.75/kg. to US$4.5/kg. During the early 1990s, the local market demanded more raspberries than could be met by the local production capacity, leading to yearly imports of 260 tons of frozen raspberries. In fact, Argentina had been importing an important proportion of its consumption from Chile.[13]

Profits were significantly higher for blueberries, which have a yield of 8–10 tons per hectare and, until 2007, fetched an average FOB price above US$8/kg. FOB (US$20 in the early years of exporting). Raspberries have a (riskier) yield of 5–10 tons per hectare and a FOB price of US$4/kg. Additionally, raspberry harvest costs are almost triple those of blueberries. The low yields of initial plantations were inconvenient for blueberries but did not jeopardize their profitability. But for raspberries, initial shortcomings meant failure for several farmers.

Rapid perishability added significantly to logistics costs. The postharvest period for commercialization is very short. While blueberries have a 30-day margin for consumption after harvest, raspberries have only three to six days to be consumed (which requires them to be shipped to the export destination in only one day). This demands an excellent logistic and commercialization procedure.[14] Because of this rapid period of perishability, transportation by truck and then by plane demanded a level of coordination in logistics that was never reached. Perishability also strongly conditioned the choice of optimal soils and climates for planting exportable raspberries, such as those of Patagonia, which are far from international airports. Finally, perishability excluded exports to the United States, as the fumigation required to rid the plant of Mediterranean fruit flies would ripen it before it could reach its foreign consumption market.

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[13] The devaluation in 2002 promoted a production of raspberries that was oriented toward import substitution rather than toward exports. The competition with the domestic market is also reflected in the fact that the most popular and most widely disseminated variety in Argentina (Autumn Bliss) does not have the required consistency for export.

[14] The process includes a manual, delicate harvest (with 15 to 25 workers per hectare), the immediate cooling and packing of the product (including fumigation), its transportation by truck to the international airport, and then by plane to the Northern Hemisphere for immediate distribution.

In addition, there were large coordination externalities. A plantation must target several markets given that the fruit quality is not homogeneous (only around 35 percent goes to the fresh market, while the rest must be frozen or processed). One hectare during harvest season produces approximately 100 kilograms per day. Hence, in order to export a relevant quantity—say, 1,000 kilograms—that allows absorption of the fixed costs of logistics and commercialization, at least 30 hectares must be planted. Thus, all the new farmers, who were exploiting small farms of one or two hectares, should be in strict coordination. This coordination in production appears to have occurred fleetingly in 1993, but was discontinued as exports proved to be unprofitable and the commercialization channel did not emerge instantaneously. The difference between blueberries and raspberries in terms of production coordination requirements is quite remarkable. Blueberries require planting 0.5 hectares to obtain one ton of exportable fresh fruit, while raspberries require 30 hectares.[15]

Our analysis reveals that even had the required coordination been achieved, the combination of low export prices from late entry into export markets, competition with the domestic market, high harvest costs, and rapid perishability, together with the requirements to control for the Mediterranean fruit fly, and the poor transportation logistics for the best planting areas (Patagonia), doomed this experiment from the onset.

This counterfactual analysis reveals that the key reason why blueberries succeeded was that the fruit enjoyed a unique comparative advantage in the off-season market, obtaining very large profits. This advantage, together with the fact that it was much less perishable, allowed producers, commercializers, and exporters to overcome knowledge and coordination externalities and lack of public support.

Blueberries in Chile

The discovery and diffusion of blueberries in Chile (Agosin and Bravo-Ortega, 2007) were promoted by Fundación Chile, which participated in Berries La Unión, a public-private joint venture that performed the socially optimal experimentation. This endeavor built upon the government program to develop the berries sector in Chile. This program had generated an important cluster of producers and exporters of other berries, local agronomic experts, and

[15] This difference arises because raspberries must be shipped every day, while the production of blueberries can be stored for several days.

nurseries with berry-specific knowledge (attuned to Chilean conditions) that were ready to take advantage of the technological and price information (harvest period) revealed by Berries La Unión. This was very important because Chilean blueberry exporters faced significantly lower world prices (and higher production costs) from the outset than did the Argentine pioneer. Hence, their investment in this new activity could not have survived the same experimentation period marked by high failure rates that the Argentine pioneer and the first newcomers in production endured.

Additionally, unlike Argentina, Chile was free of the Mediterranean fruit fly pest; absent this risk, the investments of Chilean blueberry exporters were always relatively greater, consistent with their access to the U.S. market. This access was also facilitated by the Chilean trade negotiations with the United States, which resulted in a free trade agreement between the two countries. In Argentina, by contrast, this access had to be negotiated by the pioneer at a later stage, which greatly slowed diffusion.

Conclusion

The emergence of successful blueberry exports in Argentina reflected self-discovery of comparative advantage. These new exports emerged because Vergel was able to profit from a temporary monopoly resulting from technology, and could provide by itself the industry-specific public goods that were required at the initial production levels. The large comparative advantage and small, required investments in industry-specific public goods at the initial stages facilitated discovery under laissez-faire.

The emergence of these new exports involved solving uncertainties about local costs and production technologies. Vergel generated a relevant information externality, in the manner proposed by Hausmann and Rodrik (2003). Caffarena himself internalized some of the externalities by selling plants and commercialization services to producers. However, the lack of public policies to support the development of this sector, together with information and coordination externalities, resulted initially in sluggish growth in production and exports (growth of the planted area was more robust). Due to these externalities and to financial constraints, Vergel's experimentation in production was suboptimal compared to what would have been undertaken by an ideal social planner.

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Interviews

The Blueberry Industry

Arriola, Marta, and Manuel Parra, Owners, Cuinex (nursery and production)

Bayá, Federico, Manager, Tecnoplant-Tecnovital (nursery, production, and commercialization)

Bonsini, Federico, Operational Chief, SRI (commercialization)

Caffarena, Francisco, President and Owner, Vergel (nursery, production, and commercialization)

Formichelli, Javier, Owner, RIGEL Berries (farm)

Pazos, Jorge, President, CAPAB (Cámara Argentina de Productores de Arándanos y otros Berries)

Prado, Francisco, President and Owner, Jugos del Sur (juice production)

The Raspberry Industry

Arriola, Marta, and Manuel Parra, Owners, Cuinex (nursery and production)

Bayá, Federico, Manager, Tecnoplant-Tecnovital (nursery, production, and commercialization)

González, Luis, Owner, Vivero Humus (nursery, production, and exports)

Grifoi, Edmundo, President, Berries S.A. (production and commercialization)

Guitart, Esteban, Operational Chief, INTA-Esquel

López, José A., Owner, Mapuhue (production)

Martínez, Eduardo, Coordinator, INTA-El Bolsón

Meglioli, Enrique, Owner, Finca El Martillo (production)

Vial, Carlos, Manager, Hortifrut (Chilean commercialization firm)

CHAPTER 3

The Emergence of Fresh Cut-Flower Exports in Colombia

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Flower growing is one of the most successful cases of Colombian export activity. Colombia is the world's second-largest exporter of fresh cut flowers, and the exports have become an important source of employment and foreign currency for the nation. In the last three decades, no other unsubsidized product in Colombia has managed to gain an equivalent position in external markets.

Extensive flower growing in Colombia began in 1965, and exports rapidly started conquering international markets. Today, Colombia is the leading supplier of fresh cut flowers in the U.S. market, supplying around 60 percent of U.S. total imports,[1] and the fourth-largest provider to the European Union (EU). Flower growing is Colombia's leading nontraditional agricultural export, and has generated important economic and social benefits for the country. The cut-flower industry is labor intensive: in 2005, it generated around 95,000 direct jobs—of which 60 percent were held by women—and 80,000 indirect jobs, representing 4.5 percent of agricultural employment.

[1] Ecuador is the second-largest supplier (20 percent of U.S. flower imports), and the Netherlands is third (10 percent), according to U.S. Customs data for 2004.

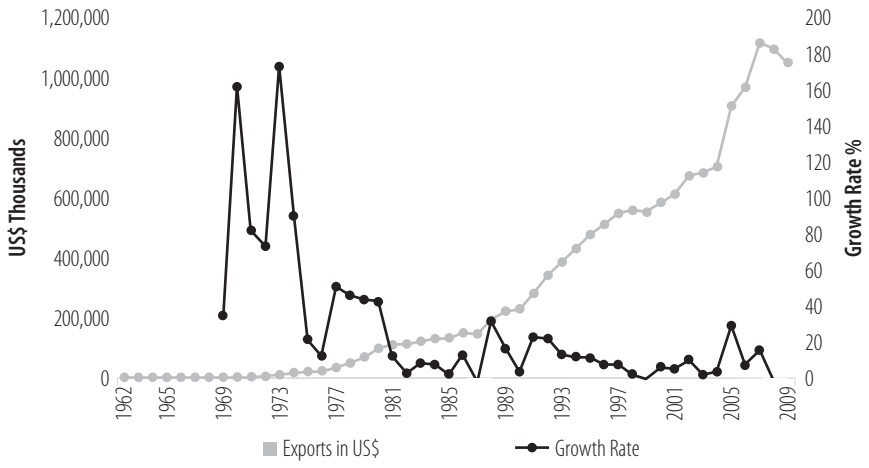
Overview of the Sector

Production and Exports

Colombian flowers are grown in different regions. The Sabana de Bogotá, accounting for 76 percent of total production, mainly grows roses, carnations, and *astromelias*. Rionegro (Antioquia), accounting for 19 percent of production, mostly grows chrysanthemums. Valle del Cauca and Eje Cafetero produce 5 percent, mainly ferns and tropical flowers (Asocolflores, 2010). Product evolution started from the simplest crops demanding the least technology, like carnations and chrysanthemums. Then, when flower growers gained greater market knowledge and expertise, they began growing roses, which required higher investments in technology. In 1996, exports of roses surpassed those of carnations. Today, more than 50 varieties of flowers are produced and exported, including exotic, agrotropical flowers like heliconias and orchids.

Since its inception, flower production has been export-oriented and the export share of production over the years has ranged from 70 percent to 95 percent. The value of flower exports grew from $20,000 in 1965 to $1 million by 1970, the year of the first exports of one of the key pioneers (an average year-over-year increase of 119 percent). Since then, exports have consistently increased, soaring to $1,052 million by 2009 (Figure 3.1).

FIGURE 3.1 | Flower Exports, Colombia, 1962–2009



Sources: Departamento Administrativo Nacional de Estadística (DANE), UN COMTRADE, and authors' calculations.

Different periods of expansion can be distinguished. Growth rates were highest in the 1970s, averaging 75 percent, while in the 1980s, 1990s, and 2000s, exports grew an average of 20 percent, 10 percent, and 6 percent, respectively.

These differences in performance can be partially explained by changes in government policies. The dynamic growth of exports at the end of the 1970s was aided by the adoption of reforms aimed at promoting nontraditional exports. These included the reduction of import restrictions; the introduction in 1961 of direct subsidies to nontraditional exports through export tax credits (known by its Spanish acronym CAT);[2] a bond that was given to exporters, who could use it to pay taxes or sell it in the financial market; the adoption of Plan Vallejo, a sort of drawback system that gave duty exemptions for imports of raw materials and other inputs used in producing export goods;[3] the emergence in 1967 of Proexpo, an export promotion fund administered by the central bank and designed to support export activities through credit subsidies; and the establishment of a policy of mini-devaluations (crawling peg), by which the peso would devalue continuously against the dollar, ensuring a competitive exchange rate.

In the mid-1970s, however, due to high fiscal imbalances, the government began to retreat from its policy of supporting exports. The devaluation rate was reduced in order to control inflation, producing a real revaluation of the currency, and the CAT rate was cut to levels that were insufficient to offset the impact of the revaluation. Moreover, in 1974, flower exporters had to renounce these benefits because of dumping claims made by the United States. As a result, from 1975 until 1983, exports grew at lower rates. Then, beginning in 1984, the government again adopted favorable policies for exports, such as cuts in restrictions on imports and a devaluation of the currency. During the 1990s and 2000s, flower exports continued to increase, although growth rates decreased in partial response to real exchange rate movements.

At first, Colombian flowers were exported mainly to Panama and the Netherlands Antilles, with fewer exports to the United States and Europe. Since 1970 and, to a great extent, after the establishment of the U.S. company Floramérica in Colombia, exports have been concentrated in the United States, averaging 80 percent of total flower exports. Europe became important in the mid-1970s, but since the 1990s its share has fallen to about 10 percent. In recent

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[2] The Certificados de Abono Tributario (CAT) later became the Certificados de Reembolso Tributario (CERT).

[3] Plan Vallejo was introduced in 1959, but began to be used in 1962.

TABLE 3.1 | Flower Exports by Destination

(Percent of total exports)

	1965	1970	1975	1980	1985	1990	1995	2000	2005	2009
United States	18.9	78.4	67.0	69.1	84.8	81.8	78.0	82.0	81.7	80.0
Europe[1]	11.9	0.2	30.3	24.6	12.1	15.2	16.6	10.9	10.0	13.6
Asia				0.1	0.2	0.7	1.4	2.2	5.2	3.0
Others	0.4	0.1	0.9	1.7	2.0	1.9	2.3	2.1	2.3	2.3
MERCOSUR		8.4	0.6	3.2	0.1	0.0	0.8	0.7	0.1	0.3
Caribbean	30.9	11.2	1.0	1.0	0.7	0.3	0.6	0.3	0.4	0.2
Central America	37.9	1.7	0.2	0.1	0.1			0.1	0.2	0.2
CAN[2]				0.2			0.2	1.7		
No. of countries	6	11	24	39	37	43	65	60	78	75

Sources: UN COMTRADE and authors' calculations.

[1] Includes both members of the European Union (EU) and other European nations.

[2] Community of Andean Nations includes Colombia, Peru, Ecuador, Venezuela, and Bolivia.

years, Asia has been a small but growing market for Colombian flowers. This pattern is consistent with the industry's goals and profile, since producers have always focused their efforts on the North American market.[4] This has to do with Colombia's proximity to the United States, which results in lower transportation costs in relation to those of the European market, for instance (see Table 3.1).[5]

Despite the dominance of the North American market, Colombian exporters have tried to diversify the markets for their exports. In 1970, Colombia exported flowers to 11 countries; this number increased to 39 in 1990 and to 78 in 2005. Diversification took place especially in Europe and Asia. In Europe, two countries initially imported Colombian flowers (Germany and Spain). In 1985 the number of European countries grew to 13, and in 2005 to 30. In the case of Asia, until the mid-1980s exports went mainly to Japan, while currently Colombian flowers are exported to 13 Asian countries.

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[4] In the European market, flower prices are set through auctions in the Dutch market, while in the United States, market sale prices are determined in a highly competitive market, with reduced negotiation power for producers.

[5] Besides, it would be extremely difficult to compete directly with the Netherlands for the European market because of the clear geographical advantage that this country has in comparison to Colombian exporters.

The imported component of production inputs is low, and consists mainly of agrochemical products and rootstocks.[6] Changes in rootstocks reflect new market trends (tastes, colors, and sizes) and new production trends (resistance to illness and yields). Specialized irrigation technology is imported from the Netherlands.

Industry Structure

A significant number of firms participate in the sector. Diffusion has been extremely rapid. Production and exports started in the early 1960s with very few producers. By 1969, there were 50 flower growers, and the number increased to 64 in 1974, to 130 in 1981, and to 450 in 1991. In the 1990s, the growth rate slowed, mainly because of the high level of the investments required,[7] which were proportionately greater than those of the 1970s. Currently, there are approximately 600 firms: as of 2005, 55 percent of them were small, 30 percent were medium size, and 15 percent were large.[8]

Most of the firms are exporters: from 2000 to 2005, there were 460 exporters on average,[9] and 495 in 2005. Growth has been steady in recent years (25 percent from 2000 to 2005).[10] Within the export market, a few big firms export between $10 million and $35 million (14 in 2005). A large number (185 in 2005) export between $1 million and $10 million, and the great majority (300) export less than $1 million. Export activity is increasingly demanding technologically and commercially, since domestic and foreign competition has grown dramatically. As discussed later, low labor costs and land prices have ceased to be a competitive advantage. As a consequence, numerous smaller firms struggle to compete with large technologically advanced firms.

Despite the large number of firms of different sizes participating in the industry, the market has remained concentrated. Concentration was especially

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[6] A rootstock is a piece of stem that is grown in order to propagate the plant.

[7] In the 1990s, competition in the sector increased greatly, along with the prices of land.

[8] Small firms are defined as those covering less than three cultivated hectares and having fewer than 100 employees; medium firms, as covering three to 10 cultivated hectares and having 100 to 300 employees; and large firms, as covering more than 10 cultivated hectares, and employing between 300 and 1,000 workers.

[9] According to the Export Customs Register of the Departamento de Impuestos y Aduanas Nacionales (DIAN) (National Department of Taxes and Customs).

[10] There were 395 exporting firms in 2000, 426 in 2001, 453 in 2002, 491 in 2003, 510 in 2004, and 495 in 2005.

high during the initial stages of production and export activities. However, over time, the increase in diffusion and in the number of followers has been accompanied by a small reduction in the levels of concentration. In 1974,[11] 9 percent of total firms (the largest firms) accounted for 60 percent of total exports,[12] while in 2000, the same 9 percent of firms accounted for 45 percent of total exports.[13]

Industry Costs and Vulnerabilities

Unskilled labor accounts for about 50 percent of average production costs; transportation and cold warehousing make up another 25 percent; and the remainder goes toward agrochemical inputs, cuttings, packing material, plastic, land rental, and administrative expenses. Firms' income is highly affected by sales volume, weather-related and phytosanitary issues, agrochemical prices, and air transportation cargo freights—which in turn are affected by the international price of oil and the exchange rate (Tenjo, Montes, and Martínez, 2006).[14] Indeed, the flower business's profitability is correlated with the evolution of the exchange rate.

As a result, major vulnerabilities are associated with the revaluation of the real exchange rate, as well as the currency mismatch; incomes are in foreign currency, while costs, which have a high national component, are more closely linked to the inflation rate and to fluctuations in international prices, particularly the price of oil.

The Discovery Process

The History of Discovery

Cut flowers and flower buds present a clear case of self-discovery: not in the strict sense of discovering the costs of producing a new product, but rather in

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[11] These figures are from the Colombian Ministry of Agriculture, as illustrated in Austin (1990). The 2000–05 data come from the Export Customs Register of DIAN.

[12] The largest 15 firms (23 percent of total firms) accounted for 80 percent of total production.

[13] However, in 2005 this percentage returned to 52 percent.

[14] See Encinales and Austin (1990), and Tenjo, Montes, and Martínez (2006). Calculations correspond to a sample of 146 firms for 2000–04, reporting financial information and balance sheets (from Danies Lacouture, 2005), and exports by firm (from Administrative Export Registers, reported by DANE to Banco de la República).

the sense of discovering the costs of growing flowers in a technically advanced manner, with the clear objective of exporting flowers to the United States. As noted, flower growers started large-scale production during the late 1960s; until then, only small farmers grew flowers.

Colombian floriculture and export discovery have their origins in—and are the result of—the evolution of U.S. flower production. Flower growing is both labor intensive and land intensive. In addition, the production of quality flowers requires long, sunny days and moderate temperatures. In the 1940s, flower production was concentrated in the northeastern United States, mainly in Massachusetts, Pennsylvania, and New York. The only advantage of producing flowers in this region was proximity to the bigger consumption centers. Otherwise, the Northeast was a disadvantageous place to grow flowers: days are short, light intensity is low, and winters are harsh. As a consequence, favorable growing conditions had to be created artificially, at high cost. Expensive greenhouses were required; the materials for making them airtight had to be of consistent quality. Heating and fuel costs were extremely high. In addition, labor in this region was costly due to the scarcity of immigrants, and land prices were high because of the proximity to big urban centers.

The extremely high production costs in the Northeast, together with the development of air transportation in the 1950s, led to a shift in production to the southern and western regions of the country, particularly to California, Colorado, and Florida, where land and labor were cheaper and more abundant, and the climate was more favorable. The first flowers produced in these new growing areas were carnations and chrysanthemums. However, costs of maintaining crops and greenhouses in adequate conditions were still high, mainly due to poor luminosity and temperature fluctuations.

The shift of flower production from the United States to Colombia was an extension of the regional movements that occurred in North America during the 1950s. In the mid-1960s, it was known that Colombia had excellent conditions (superior to those in the western and southern United States) for growing and exporting flowers to the United States, and its attractiveness was improved by the development of commercial air transportation in the country.

For these reasons, the discovery of flower exports in Colombia was driven largely by the search by U.S. businesses and flower growers for lower production costs. However, discovery also took place in the early 1960s in Colombia when an old-time Colombian floriculturist learned how to produce flowers at industrial scale for export to the United States.

Supporting these efforts and the discovery process were the results of a study by a U.S. student of floriculture about the meteorological conditions

necessary for cultivation of carnations. This study was disseminated to U.S. flower growers and businesses and Colombian floriculturists. The author, David Cheever,[15] was aware of the high costs of producing flowers in the United States, and wrote a thesis in 1966 at Colorado State University identifying Colombia as the best place in the world for growing carnations and selling them to the United States, taking into account climate conditions, soil quality, availability and costs of labor and land, and proximity to the U.S. market. Colombia had fertile soil, flat topography, adequate temperatures, and year-round luminosity in the regions surrounding Bogotá and Antioquia, as well as abundant, relatively cheap land and low road transportation and warehousing costs due to the proximity of the El Dorado and Rionegro airports. In particular, Cheever found that the Sabana de Bogotá was the place of the future. Altogether, this research made clear that Colombia was the solution for U.S. businesses, and these findings became a crucial element in their decision to start businesses in Colombia. At the same time, these results encouraged Colombian floriculturists to start extensive, technical flower production with the aim of exporting to the United States.[16]

Cheever turned out to be right. As a result of its natural advantages, high-quality flowers can be grown year-round in Colombia without expensive greenhouses—using wood and plastic[17] structures instead of glass—and without incurring costs for heating, cooling, and artificial lighting. The ability to produce commercial-quality flowers year-round also means that Colombian growers can continue producing during the U.S. winter and spring, when demand is highest (because of the large number of holidays such as Christmas, Valentine's Day, Easter, and Mother's Day), while environmental conditions make it difficult or highly costly for local growers to keep producing in these seasons.

In addition, Colombia is abundantly endowed with naturally fertile land, which during the 1960s and early 1970s was being used in low-value activities. In the early days of flower production for export, companies owned the land, which was important for obtaining other resources, since the land could serve

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[15] David W. Cheever received a B.A. in floriculture at the University of Massachusetts, and in 1965 went to Colorado State University for a post-graduate research degree in floriculture.

[16] In 1966, David Cheever went to the Colombian Embassy in New York to present the paper. It was sent to Miguel de Germán Ribón and Edgar Wells, Colombian pioneers.

[17] High-quality flowers are grown year-round in the Bogotá area, and in Medellín, in simple structures made of wood and plastic.

as collateral. Some landowners went into floriculture and some producers bought land to enter the business. However, land prices started increasing wherever flowers were produced, and beginning in the 1990s, growers started renting the land.

Colombia, like many developing countries, also had an abundance of low-skilled—largely female—labor. This meant that wage rates in Colombia were significantly lower than comparable rates in the United States. In 1966, the average daily wage for production workers in agriculture in Colombia was $0.82, while in the United States the equivalent wage ranged between $16 and $20.[18] As a consequence, Colombian production costs were almost 50 percent lower than U.S. costs. Moreover, the labor and fuel cost advantages were not offset by the high cost of shipping flowers to the United States; even after deducting shipping costs, Colombian production costs were still 31 percent lower than U.S. costs. These great cost advantages meant that export of Colombian flowers to the United States was enormously profitable. In the early 1970s, flower growers could earn profits of around 57 percent of sales value, realizing a 600 percent return per year on their initial investment (Méndez, 1991).

Finally, another Colombian advantage was the quality of its businesspeople. A core group of the business class had been educated abroad, which favored the introduction of new ideas, as well as the initial development and diffusion of the industry.[19]

In sum, the discovery process in Colombian flower exports began in the mid-1960s when floriculturists and businesses (American and Colombian) identified the potential for this activity, thinking exclusively of external markets, with the United States as the core target. They visualized the likely gains of this business on the basis of two facts. First, they identified the competitive advantages of Colombia in this sort of production—meaning its natural, geographical, and economic conditions. Second, they recognized the size of the potential external demand—in particular, the U.S. demand. However, beyond these facts, the challenge for new investors was learning how to exploit those natural and competitive advantages to meet U.S. demand, and how to expand the consumption of flowers, which until the mid-1960s were considered a luxury good.

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[18] Urrutia (1985), cited in Méndez (1991).

[19] According to Cheever (one of the pioneers), violence in Colombia encouraged people to seek education abroad. In addition, business leaders had excellent relationships with workers, which was very important for flower cultivation as long as the industry remained labor intensive.

Pioneers

In the early 1960s, Edgar Wells, an old-time Colombian floriculturist, visualized the great opportunity for Colombia to grow flowers in a more sophisticated way and to export them to the United States. In 1962, he went to the United States to learn about new, industrial-scale floriculture techniques. He also made contacts with flower commercialization experts in the United States who could provide vegetal material (cuttings) for carnation growing. Upon returning to Colombia, Wells joined a company that had been recently founded to serve the local market. At the same time, he persuaded Colombian farmers dedicated to extensive agriculture and livestock to start growing flowers, and they began to diversify their activities.

Edgar Wells joined with two other pioneers from existing Colombian flower-growing companies who were aware of Cheever's study—Miguel de Germán Ribón, from Flores La Conchita, and Gabriel Restrepo, from Flores Colombianas—to lead the first growing and exporting project. After overcoming a great number of technical difficulties (regarding plant disease control and greenhouses, for example) through improvisation and experimentation, Wells managed to persuade one of the U.S. wholesalers to buy a trial shipment. The first shipment to the United States was sent in 1965 and had a value of $20,000. In the following years, exports remained small. Dynamic exporting activity started later with the creation of Floramérica.

The creation of the firm also traces back to Cheever's study. In 1968, William Penn Mott, a conservationist and horticulturist with ties to the Rockefeller family, was searching for development projects. His interest in growing flowers in California led to a feasibility study that showed that flowers had no future there. Mott knew about Cheever's study and contacted him. After reviewing the results, both agreed to seek investments for opening a business in Bogotá, and began looking for the team. They met a U.S. entrepreneur, Thomas Kehler, who was already working in Bogotá, and Harmond Brown, a flower grower from California. The group evaluated the viability of establishing a flower-exporting business in Colombia. After obtaining positive results, each of them invested $25,000 to create a new flower-growing firm in Colombia—Floramérica—in 1969.[20] Kehler was the General Manager; Cheever,

[20] The same year, a local company, Flores de los Andes, started growing flowers and exported for the first time in 1970.

the Technical Manager; and Brown, the Marketing Manager.[21] Floramérica exported for the first time in 1970 for Mother's Day, with Sunburst Farms.

The creation of Floramérica was also made possible thanks to a policy exception made by the Colombian government. At the time, foreign capital in companies was highly restricted, and Floramérica was the only project that the National Planning Department accepted as being funded 100 percent with foreign capital. This was consistent with an export-promotion program put in place by the government.

Given the founders' previous knowledge and expertise in growing flowers, the company started using sophisticated techniques originating in the United States in the entire production and distribution process. In particular, Floramérica introduced innovations in four areas: production technology, which involved rootstocks and greenhouses; distribution channels; changes and adaptation to the product to satisfy the U.S. demand; and training workers and improving work organization.

First, the company started importing rootstocks to get different flower varieties and qualities, and those varieties were planted at different times to get different colors. In addition, it started building greenhouses without separations between them, which was much more efficient, as it conserved productive land and facilitated the maintenance of adequate temperatures. The company also began using wider plastics (3.5 meters) in greenhouses, which allowed it to lower costs.

Second, from the beginning, Kehler and his team realized the need to establish efficient systems for the sale and distribution of flowers in the United States. A wholly owned importer-distributor company was the solution, as it allowed them to eliminate third-party brokerage houses and to control the marketing of their product. Consequently, the group set up in Miami the first wholly owned brokerage unit (Sunburst Farms) in the United States for Colombian flower exports.

Third, Floramérica put in place different mechanisms to adapt to U.S. demand requirements. For instance, wholesalers wanted flowers of very high quality, so the firm invented a new grade, "the selected grade" of longer flowers, which was superior to the U.S. competition. In addition, wholesalers wanted assorted flowers of seasonal color packed in smaller boxes.

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[21] Much of this history is drawn from an interview with David Cheever.

Fourth, the company started training people and introduced new methods for organizing work. One example was a hierarchical structure utilizing specialized areas managed by people with specific skills.

Finally, as explained in detail in the next section, Floramérica provided the right combination of skills to overcome the many obstacles to exporting.

Floramérica played a crucial role in the history of the Colombian floriculture industry. Its success was dramatic. In 1970, the company accounted for nearly all of Colombia's flower exports.[22] More important was its demonstration effect on Colombian industry: many local companies copied its production and marketing techniques (including the use and type of greenhouses, methods for planting rootstocks, packing, training of people, and distribution channels).

The company was also responsible for the rapid diffusion of the export activity, which took place through different channels. Colombian companies often hired Floramérica's staff. David Cheever left Floramérica in 1971 and became an independent advisor on technical issues to a great number of Colombian companies. At the same time, two members of Sunburst Farms —Floramérica's brokerage office in Miami—left the company to create their own brokerage firm.

In 1998, Floramérica and its related company, Sunburst Farms, were bought by Dole, which also acquired other smaller, Colombian flower-growing firms. Dole became the largest flower producer in the country.

Main Uncertainties and Obstacles

Most of the uncertainties and obstacles mentioned in this section were common to the first exporters. However, some uncertainties specific to Floramérica are also described.[23]

Phytosanitary Problems

These were especially important in the case of Floramérica. Exporters faced three different kinds of problems: inadequate nutrition, plant disease, and poor quality of water. Nutrition problems were related to the availability of microelements in the soil. It was known that soil in Colombia had insufficient

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[22] It became one of the major flower-exporting companies in the world. By 1986, the company had $50 million in annual sales.

[23] David Cheever (one of Floramérica's founders) highlighted those uncertainties in the interview.

boron, which was essential for carnations. This scarcity of boron was resolved by applying a great quantity of magnesium and calcium.

Flower growers also experienced severe problems regarding plant diseases, some of them present in the imported rootstocks.[24] At the beginning, plant disease control was partially managed through consultation with some technicians from Israel who came to Colombia and spent months working with local producers. The Colombian Association of Flower Exporters (Asocolflores), supported by the Colombian Agricultural Institute (Instituto Colombiano Agropecuario, or ICA), played a crucial role in helping producers overcome some of these obstacles by continuously finding ways to control plant diseases.

Finally, poor water quality was a serious problem. On one occasion, the United Kingdom stopped admitting flowers from Floramérica because worms were found in the shipment boxes, a direct consequence of the contaminated water in which the flowers were packed. To solve this problem, Cheever and other exporters learned about dry packing. Flores de la Sabana started employing this method, and knowledge of its use spread rapidly.

Transportation

This is one of the most important issues in Colombian flower exporting, as cargo companies play a crucial role in its success.[25] At the time of the first exports, Colombia had few airlines,[26] flying a few piston engine lanes, which made transportation of flowers to the United States difficult. Some companies started transporting Colombian flowers themselves, but faced serious difficulties.[27] To

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[24] However, according to David Cheever, the control of diseases in imported rootstocks by the ICA was inefficient during the initial stages of the activity.

[25] Most of this history is taken directly from Pedro Narváez's speech at the celebration of the thirtieth anniversary of Asocolflores (Asocolflores, 2003: 38–40). See also Méndez (1991).

[26] Aerolíneas del Cesar and Aerocosta transported cargo domestically, and only a few shipments were transported to the Caribbean.

[27] Aerocondor faced serious financial difficulties, and an airplane crashed in Bogotá, causing tremendous chaos in the Colombian aviation industry and disrupting its ability to transport flowers. At that time, Captain Gutiérrez appeared with an airline company called ARC. But its airplanes had narrow doors, so that flower boxes had to be put in the planes manually, and ARC lacked adequate infrastructure. Initially, Avianca, the major Colombian carrier, was unresponsive to flower exporters. The company accepted flower shipments, but refused to make special provisions for them. Flowers were shipped on regularly scheduled passenger flights and stored with the passengers' luggage.

overcome this obstacle, some leading companies (Floramérica and Jardines de los Andes) encouraged the largest Colombian airline companies (Avianca and Sam) to enter the business of shipping flowers, to handle flowers at night, and to get new freighters to transport them. However, new obstacles appeared, including another plane crash. After some time, a flight captain bought two airplanes from Alitalia and brought them to Colombia, which allowed exporters to transport flowers to the United States again. Asocolflores also took an important step since it decided to hire a charter from Ecuador. The association brought together exporters, and convinced each of them to agree to send a certain number of flower boxes. This event marked the beginning of the search for a method of transporting flowers in mass quantities. Then, other companies (U.S.-based carriers) such as Frontier, Challenger, and Florida West came to Colombia and started transporting flowers to the United States.

Transportation to Europe was even more difficult, given that Colombia had commercial flights only via Caracas or Miami.[28] To overcome this bottleneck, some exporters managed to convince the German-based carrier, Lufthansa, to bring an airplane with a wider cabin (a DC-10) to Colombia. The government helped the exporters by allowing the airplane to come and pick up the load, but the plane was too wide and could not get to either the international gate or the loading gate.[29] After this experience, Avianca got a 747 airplane, half of which was used for passengers and the other half for cargo, which helped solve some of the problems of transporting flowers to Europe. In addition, the director of Aerocivil invited Asocolflores and some companies to Madrid to contact the Spanish carrier Iberia, and this company started sending a freighter to ship Colombian flowers to Spain.

To sum up, in the early stages of export, growers had to make special arrangements with Colombian airlines to transport flowers directly from Colombia to the United States. As this scheme was extremely costly, insecure, and inefficient, exporters—supported by Asocolflores—hired the services of foreign airlines, which allowed them to have access to the European markets. The government was very supportive in this process. Thus, overcoming transportation obstacles was the result of a joint effort by exporters, Asocolflores, and the government. Nonetheless, flower exporters pay today the most

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[28] Pedro Narváez, the second president of Asocolflores' board, and Ricardo Valenzuela went to Curaçao to see if they could nationalize Colombian flowers as Dutch products, and then ship them via the Dutch airline—KLM—to the Netherlands.

[29] As a consequence, the airplane had to park in the middle of the runway to load flowers.

expensive freight per mile of any transported load in the world, a problem that is shared by all sectors in Colombia.

Flower Reception and Storage

Another major obstacle faced by pioneers was flower reception and storage in the foreign country. For instance, when flowers arrived in Miami, the airport did not have facilities for unloading flower boxes from the airplane.[30] In addition, there were no cold rooms to store the flowers, and flowers were left outside at high temperatures, awaiting inspection by customs officials of the Department of Agriculture. Customs officers also pricked the boxes to check their contents, thus damaging many flowers.

Once again, coordination among exporters was crucial to overcoming this bottleneck. Through Asocolflores (and financed by Proexpo, the government-backed export-promotion fund), Colombian flower exporters established a joint company in Miami (Transcold) that was in charge of unloading the flowers and keeping them in refrigerated storage rooms until inspection by customs.

Distribution and Commercialization Channels

From the beginning, Colombian entrepreneurs were aware of the need to have business executives located in the United States to facilitate market penetration, distribution, and commercialization of flowers. As a result, in 1969 the first flower-importing enterprise initiated operations in New York. These were transferred to Miami in 1970 to avoid several obstacles and barriers faced in New York. On the other hand, Floramérica found the solution by creating its own importer-distributor company in Miami (Sunburst Farms), which allowed it to eliminate third-party brokerage houses, as well as to control the marketing of their product.

Other exporters rapidly adopted this strategy. At the beginning of the 1970s, a new distribution and commercialization model began taking shape.[31] Exporters started establishing Colombian flower-import companies[32] in the

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[30] Companies had to wait until they were provided with an escalator—which could take hours—and they had to hire someone from the airport to unload the flowers.

[31] Exporters considered it fundamental to have business executives located in the U.S. market who were educated in the United States and who had social skills and knowledge of the U.S. social and cultural environment.

[32] Some firms that still operate are Jardines de América, Gelco, Sabana a través de Master Flowers, Continental Flowers, and Inversiones Targa.

United States, with the support associations of sellers in the United States. The role played by these companies and the strategic alliances they formed with U.S. firms were crucial for early export success. This model was followed by most of the growers, and in the mid-1980s there were more than 100 importers-distributors of flowers located in Miami. Nowadays, these facilities handle over 90 percent of Colombian flower imports entering the United States.

Distribution of Flowers throughout the United States

Another initial uncertainty was how to manage the logistics of flower distribution inside the country. This obstacle was easily solved, since flower growers tapped into an already well-established system in the United States. They started working with a trucking company, Armellini, that had originally handled the shipping of chrysanthemums produced in Florida to major consumer markets in the Northeast.[33] The existence of this distribution system resulted in lower transportation costs for Colombian flowers sold in eastern markets than those for flowers shipped from the West Coast.

Meeting U.S. Demand

Knowledge of U.S. demand, methods for satisfying U.S. consumers' needs, and methods to compete with local production were important challenges for initial exporters. First, the importer-distributor companies in the United States played a key role in providing information about U.S. demand. Second, production (and even packing) evolved and changed to satisfy buyers' requests and consumers' needs.

One way to satisfy consumers' needs was to develop new varieties. For instance, product evolution started from the simplest and least technologically demanding crops, like carnations and chrysanthemums. When flower growers gained greater market knowledge and expertise, they began growing roses, which required higher technology investments. In addition, in 1978, other kinds of flowers, such as *estatice*, *gypsophilia*, *astromelia*, gerbera, miniature carnations, daisies, and lilies, were introduced as part of a diversification policy of the sector. In the 1980s, exports of carnations, pompoms, and chrysanthemums dropped, while exports of roses increased. In 1983, 50 percent of exports were carnations, 20 percent pompoms, 5 percent chrysanthemums, 16

[33] Armellini guaranteed delivery to eastern markets within two days.

percent roses, and 9 percent "other kinds." In 1991, the share of the first three types was reduced to 20 percent, 13.5 percent, and 1.6 percent, respectively, while the share of roses increased to 23 percent and that of "other kinds" to 24 percent. Current production trends involve exotic, agrotropical flowers like heliconias and orchids.[34]

Introducing changes in packing was another way to satisfy U.S. demand. For instance, at the request of wholesalers, Colombian exporters produced assorted flowers of seasonal color packed in smaller boxes. Floramérica introduced the first changes to the product and packing. However, as these smaller boxes had to be transported together with other exporters' products, and boxes had to be of the same size, Floramérica persuaded other Colombian exporters to reduce the size of their boxes, requiring them to change the product as well. This is another case in which there was a coordinated solution.

The Role of Asocolflores

Even though some companies adopted their own solutions to deal with specific uncertainties and/or obstacles, in general, the best way that the first Colombian flower exporters found to overcome severe common obstacles was cooperation and coordination with one another. In the early days of the industry, the main uncertainty was related to the infrastructure and logistics required to produce and export a perishable product, especially when volumes were still small and did not justify large investments. Therefore, there was only one possible strategy that all understood: joining efforts, coordination, and solidarity.

In 1970, exporters decided that it was urgent to have a united association that would represent exporters' interests both at the national level and before foreign government entities, as well as help them coordinate to overcome obstacles in transportation and communication. In addition, exporters were concerned about the industry's impact on the social welfare of workers and environmental protection. As a result, some exporters got together and created Colflores, which in 1973 was transformed into Asocolflores (the

[34] Another strategy that allowed Colombian exporters to compete with U.S. flower growers was the improvement of Colombian flower quality and, at the same time, differentiation of the product from that sold in the U.S. market. One example was the new grade ("the selected grade") developed by Floramérica, which was of superior quality to the U.S. competition.

Colombian Association of Flower Exporters), consisting initially of 11 companies.[35] This trade association played a major role in Colombian flower exports, as it shaped the sector's operation.

Some of the main areas of support provided by Asocolflores have been improving access to international markets; helping exporters overcome obstacles (such as transportation and legal problems); promoting research to control plant diseases and improve quality; improving the welfare of the industry's workers; and dealing with environmental protection.

Improving access to international markets has been one of the main targets of the association. One area of focus has been the promotional activity and recognition of Colombian flowers in international markets. As a consequence, the association has facilitated the efforts of exporters to participate in fairs and exhibitions, with Proexport playing a supportive role.[36]

Another major task of Asocolflores has been defending the access of exporters to international markets. For instance, beginning in the 1970s, the high growth in Colombian flower exports to the United States became a concern for U.S. flower growers, who sought legal means to block Colombian flower activity in their country. Through the Society of American Flower Growers, local growers filed a claim with the U.S. Department of Commerce against Colombian flower imports. They claimed that flowers coming from Colombia should pay a countervailing duty equivalent to the amount of benefits and subsidies received for flower production and exports in the home country.

In response, Colombian exporters (through Asocolflores) adopted a comprehensive strategy that became fundamental to overcoming future problems in the U.S. market. In 1973, missions began going to the United States to defend Colombian flower exporters. Asocolflores convinced the U.S. Department of Commerce to agree to encourage an alliance between both countries to promote U.S. flower consumption. Asocolflores' strategy was aimed at finding a way

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[35] The 11 companies were: Floramérica, Flores Colombianas, Flores la Conchita, Flores de la Sabana, Flores de los Andes, Flores del Río, Inversiones Targa, Jardines Bacatá, Jardines del Muña, Jardines de los Andes, and Superflores.

[36] Illustrative events organized by Asocolflores include the festival feature flowers from the area north of Suesca (1987); the festival feature flowers from the area west of Madrid, Colombia (1988); the Fourth International Symposium of Carnations in Bogotá; the creation of Proflora, the largest, fresh cut-flower trade show in the Americas, hosted in Colombia (biannual); the International Symposium on cut flowers in the tropics, Bogotá, National University-Asocolflores-ISHS (1997); and the "Salón de la floricultura anual, Acopaflor" (2000).

to have an entity in the United States that was not vulnerable to North American protectionism for domestic products. Therefore, the association promoted the creation of the Florida Importers' Association, which was legitimately constituted as an independent U.S. entity whose main objective was to protect the interests of commercial flower growers outside the United States. It became an extremely useful mechanism for exporters to organize their defenses in different areas, such as the dumping case and the imposition of phytosanitary barriers.

In addition, Asocolflores hired a group of U.S. lawyers and technical advisors, and began to develop a strategy of lobbying U.S. authorities. Since then, Asocolflores has had a permanent presence in Washington, and has even succeeded in earning respect and recognition from U.S. authorities and the Congress. This strategy was also very useful in improving access for Colombian flowers, for example, by getting favorable conditions for flowers in the Andean Tariff Preference Agreement (ATPA) negotiated between the United States and the Andean nations in 1991, and in its expansion in 2002.

Asocolflores has also served as a powerful means of helping exporters coordinate to overcome difficulties that have arisen since the beginning of their export activities. Some of the most critical difficulties have been the lack of transportation, poor telecommunications, and inadequate road networks. As noted previously, in the 1970s Asocolflores brought together exporters and chartered a plane from Ecuador, which marked the beginning of flower shipments in mass quantities. Also, as noted earlier, through Asocolflores, Colombian flower exporters established a joint company in Miami (Transcold) to take charge of unloading flowers and placing them in refrigerated storage rooms until inspection by customs.

The association was also responsible for research and plant disease control within the industry. Given that these concerns were common to all exporters from the initial stages, they decided to empower the association to handle these issues instead of dealing with them on their own. Accordingly, the results of the research became common knowledge and contributed to the diffusion process. Asocolflores engaged in research projects with ICA and universities (national and international), too. From the beginning, it has financed research studies, promoted the creation of courses in Colombian universities, opened its own technical research department, and continuously trained its workers outside the country.[37]

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[37] Some events in the 1970s, 1980s, and 1990s are illustrative. Asocolflores financed different research studies, including the 1979 United Nations study, "Reconocimiento e identificación de *Phialophora cinerescens* y *Fusarium oxysporum* f. sp. *dianthi* en el

Finally, Asocolflores has also dealt with the welfare of the industry's workers and environmental protection. In this regard, it has developed programs to improve the quality of life of workers and their families and communities.[38] Asocolflores has led training programs[39] for workers and developed methods to improve the social responsibility of the whole sector.[40] Asocolflores has also been active in support of environmental issues, especially in the 1990s.[41]

The Diffusion Process

The flower-export industry experienced a clear diffusion process with important spillovers. After the first exporters revealed that the activity was highly profitable, an increasing number of investors entered the industry. In the early 1960s, there were very few producers. In 1968–69, new enterprises emerged in

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cultivo del clavel en la sabana de Bogotá", and a study in 1982 about biological control of *Fusarium oxysporum* at the University of Colorado. In 1983, it promoted the project, "Investigación y Diversificación de la Floricultura Colombiana," which proposed establishing the Colombian Center for Innovation and Diversification (CINDIF). In 1984, Asocolflores helped create a course on floriculture in the Universidad Nacional de Bogotá. In 1985, it started its own technical department. In 1987, it established its laboratory for diagnostics of plant diseases and pests.

[38] In 1989, Asocolflores established the first center to assist workers with social security issues. In 1998, it created a mechanism to resolve conflicts through nonviolent means, "Cultivemos la Paz en Familia", and also created child care centers to look after children under seven years of age while their parents are at work. Recently, it created the Floriculture School for Displaced People (supported by the Fundación Panamericana para el Desarrollo, [FUPAD], and the U.S. Agency for International Development [USAID]). In 2002, it developed Asocolflor-es-Hogar, a program that has provided housing solutions for 20,000 people.

[39] In 1992, Asocolflores created Acopaflor (Asociación Cooperativa de Profesionales de la Floricultura Colombiana), an association for fresh cut-flower workers. In 1996, it created a technical education program with the Colombian government (SENA), named Trabajador Calificado en Flores de Corte, to train workers in the skills required for growing fresh cut flowers. In 1997, it established a special program on floriculture and horticulture with Jorge Tadeo Lozano University.

[40] In 2001, Asocolflores created the Gerencia de Desarrollo Social, a division within Asocolflores to manage social development and, in particular, to improve the quality of life of workers, their families, and their communities.

[41] In 1995, Asocolflores created Ecoflor, a program designed to improve the ecological impact of flower cropping. In 1996, it created Florverde, a code of conduct based on international standards, to set best environmental and social practices. In 1996, it created the Department of Environmental Issues.

the flower-exporting business such as Floramérica, Flores de la Sabana, Flores de los Andes, Jardines Bacatá, Jardines de los Andes, Jardines del Muña, and Superflores. The number of firms grew to 64 by 1974, to 130 by 1981, and to 450 by 1991. During the 1990s, the growth rate slowed down mainly due to high costs of the investments required (higher land prices and labor costs). Currently, approximately 600 firms of different sizes participate in the industry, of which about 500 are exporters.

This rapid expansion of the sector was triggered by the considerable profitability of the business. In 1971, FEDESARROLLO estimated that the profitability enjoyed by a Colombian flower exporter was 57 percent over the value of its sales, and that the annual return over initial investment was around 700 percent.

As noted, the entrance of Floramérica and its success were also decisive in the diffusion process. In 1970, the company accounted for nearly all Colombian cut-flower exports, but by 1986, the share held by Colombian firms had risen to over 67 percent. At the early stages of export activity, Floramérica diffused knowledge to other firms, mainly production techniques (copied from the United States) and efficient systems of marketing, distribution, and commercialization. Many Colombian companies starting out copied their model. Copying in this industry is considered relatively easy and can be done, for example, by taking pictures of greenhouses—especially those used by Floramérica.[42]

In the first few years, the diffusion process inside the flower-export industry was not characterized by rivalry among competitors. The size of the U.S. flower market permitted the entrance of more enterprises without market losses for incumbents. Moreover, diffusion was beneficial, as the emergence of new participants helped exporters overcome obstacles through coordination and cooperation. Flower growers found that they had to combine efforts to achieve their goals in the U.S. market. Transportation issues, for instance,

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[42] According to a speech by John Vaughan—Asocolflores' first board director, and one of the owners of Flores de los Andes—at the celebration of Asocolflores' thirtieth anniversary, at the end of the 1960s, most of the local growers wanted to closely examine Floramérica's greenhouses. In 1969, when the Vaughan family was thinking of entering the flower business, they considered it essential to take a look at the Floramérica farm, *La Guanica*. The Vaughan brothers got there at 6:05 p.m., when the guard could not see them. Once inside Floramérica's facility, they were hounded by two enormous Doberman dogs. Eventually, the Vaughan brothers were invited by Floramérica's managers to visit their installations. The advanced technology, especially their structures, impressed them, and helped convince them to decide to invest.

required combined negotiations.[43] Achievement of suitable trade tariffs and import taxes also required joint efforts. Even some investments followed this pattern, such as those related to the establishment of adequate facilities in Miami to receive flowers for distribution to the U.S. market. In the distribution and commercialization channels, combined efforts were also desirable. In addition, diffusion and joint efforts helped position flowers in the U.S. market, as well as gain recognition of Colombian flowers, with positive effects for the industry as a whole.

Accordingly, the diffusion process was favorable during the 1970s and 1980s, while the exporting process consolidated. Appropriability problems were largely offset by extremely high profits. However, expansion continued and the absence of entry barriers encouraged new entrants—even including some small or micro producers that began growing flowers on recreational plots of land. According to one interviewee, this influx of inexperienced producers threatened the export market by introducing low-quality flowers into commerce, potentially undermining the reputation of Colombian flowers. But there is no indication of lasting damage, perhaps because the very inexperience of the new entrants—many without knowledge of flowers or the cultivation of any perishable good—led to their bankruptcy, before their incompetence could harm more capable competitors.

The Role of the Government

The shift in Colombian government policy in 1967, aimed at improving macroeconomic stability and expanding its trade sector, has supported and encouraged fresh flower exporters in Colombia, although not in a decisive manner.

Four main policy actions favored floriculture: the formation of Proexpo; the creation of Export Tax Credits (CAT), a bond that was given to exporters, which they could use to pay taxes or sell in the financial market;[44] the adoption

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[43] An airline would not offer a complete cargo airplane just for one producer, so it was necessary for several of them to transport their flowers in one plane.

[44] Initially, the face value of these CATs was established at 15 percent of the exported value. Over the years, several classifications have been defined. In 1977, most agricultural products received 7 percent CATs, most manufacturing products received 5 percent CATs, and some other products not needing this support received 0.1 percent CATs. Cut flowers were included in this latter category in 1974, after the U.S. Treasury determined that due to the CATs, flowers from Colombia would be subject to an additional countervailing duty of 10.2 percent.

of Plan Vallejo, which extended duty exemptions for imports of raw materials and other inputs used in producing export goods; and the establishment of a policy of mini-devaluations (crawling peg), by which the peso would devalue continuously against the dollar. These policies provided a favorable environment in which flower exporters' efforts would be rewarded.

Proexpo started financing the working capital needs of exporting companies and, to a lesser degree, investments in fixed capital. Credits to the flower industry grew quickly in the early 1970s, increasing from $1.88 million in 1973 to $5 million per year in 1975–77. Interest rates charged by Proexpo were well below the market rates. For example, Proexpo's rate in 1977 was 13 percent, while commercial bank rates were around 32 percent. Proexpo financed two important projects for flower growers. The first involved financing a large refrigerated facility in Miami so that imported flowers could be kept at adequate temperatures while clearing customs and sanitary inspections before being shipped to their final destination. The second involved financing Avianca Airlines for the installation of refrigerated compartments in some of its planes for the transportation of flowers (Encinales and Austin, 1990).

In addition, Proexpo's role in external promotion was also helpful. Initially, commercial offices were opened in several cities in Europe, North and South America, and Japan. They were useful in exploring possibilities for Colombian products, for giving information to potential importers and Colombian exporters, and in establishing contacts between Colombian exporters and local buyers.

Finally, Proexpo, in association with Asocolflores, helped in the international promotion of flowers. This included the provision of technical assistance, participation in international fairs, the distribution of information about foreign markets and the organization of commercial missions to different countries.

At the time of the first exports, the value of the CAT was established at 15 percent of the exported value. However, in 1974, the U.S. Treasury determined that, due to this public support, flowers from Colombia would be subject to an additional countervailing duty of 10.2 percent, thus reducing the value of the bond for flower exporters significantly. From 1975 to 1980, flower exports did not benefit from the CAT. However, it was reissued for flowers in 1981–84, although at very low values (4 percent).

Colombian flower growers have continuously faced protectionist pressures from their counterparts in North America. During the 1980s, several threats of compensatory tariffs in the U.S. markets strongly persuaded

Colombian flower exporters to reject any kind of fiscal assistance from the Colombian government. In 1984 and 1985, Colombia signed a series of Benefit Suspension Agreements as a result of antidumping demands made by the United States, in response to the threat represented by the growth in imports from Colombia. When the agreements were signed, Colombia renounced the use of government aid that could be seen as a subsidy under U.S. commercial legislation. As a consequence, Colombian flower growers stopped receiving CAT/CERT for exports made to the United States or subsidies from Proexpo, Bancóldex's loan interest rates were tied to minimum rates in accordance with international rates,[45] and exporters were allowed to use Plan Vallejo for capital goods.

Other sorts of commercial incentives supported fresh flower exporters in Colombia, encouraging more investors to enter this industry. The ATPA (Andean Tariff Preference Agreement), established in 1991, reduced to zero the tariff applied to Colombian flowers for a period of ten years (renewed in 2002). In addition, in 1990, exports to the European Union were aided by the introduction of a preferential program that reduced import tariffs to zero (lasting eight years). The GAPS (General Andean Preference System) agreement with the EU also contributed to the industry.[46] Nowadays, Colombian floriculture greatly depends on the results of negotiations of the Free Trade Agreement with the United States on this issue.

According to different sources (including interviews), Colombian flower growers could have competed in foreign markets without government benefits and incentives, but the development of Colombian flower growers as mass suppliers could not have occurred as fast as it did without them. That is why flower growers focused on growing their businesses as fast as possible, before protectionist pressures from counterparts became stronger.

In addition, although the government helped exporters overcome some bottlenecks in specific areas (transportation, for instance), the key solutions for success were the result of strategies adopted by exporters through coordination and cooperation. However, during the 1980s and 1990s, the role of the ICA related to phytosanitary issues and research of plant diseases, in coordination with Asocolflores, was of great importance.

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[45] Bancóldex is a state-owned, second-tier bank that fosters business activity and foreign trade.

[46] The agreement was valid until December 2005.

Later Developments in the Flower Industry

The Colombian flower sector has rapidly generated an important production cluster, which has favored gains in market position by Colombian producers. The sector's advantages have changed through time.

During the first decades of production, Colombia had several competitive advantages because of its favorable natural and economic conditions. The sector has also been dynamic in continuously finding efficient ways of adapting advanced technologies used in developed countries to Colombia's specific conditions, and in making large investments in technology aimed at improving flower quality and productivity. Some of these facts are still the cornerstone of the industry, such as the existence of efficient distribution and commercialization channels. Additionally, the industry's core success relies on the availability and implementation of advanced technology in the entire production and distribution process, the presence of differentiated products, the empowerment of producers, and, especially, the competitive scheme present inside the market (as opposed to paternalistic schemes typical in agricultural exports). For example, with regard to the implementation of advanced technology, besides developing the efficient cold chain, the sector has been active in developing packaging to fit product characteristics, the distribution system, and the type of client. Colombia has currently started exporting flowers in Proconas, a system that allows flowers to be transported in water-filled containers. This system guarantees greater product freshness, simplifies its handling in supermarkets, extends the life of the product, and satisfies clients' needs.[47]

In relation to the distribution and commercialization model, the role played by companies located in the United States has been crucial for positive export dynamics. In the 1960s and 1970s, 80 percent of flowers were sold in florist shops, while in the 1990s, Colombian flower exporters extended their client base by means of new distribution channels, along with stable supply, competitive prices, and product variety.[48] Currently, 50 percent of Colombian

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[47] Export flowers grown in Colombia are also subject to quality, ecological, and labor standards. The required standards are dictated by organizations such as FIAN (Food-First Information and Action Network) from Germany, EurepGAP (Euro Retailers Produce Working Group Good Agricultural Practices), Stichting Milieukeur from the Netherlands, and the International Standardization Organization. Through these and other means, the ultimate quality of Colombian flowers is guaranteed.

[48] Colombia expanded to more than 50 kinds of carnation and rose varieties.

flowers are distributed through supermarkets and chain stores.[49] In addition, the introduction of Colombian bouquets to the U.S. market through supermarkets by two innovative firms, Lafloret and Atlantis Bouquets, was made possible by their associated firms, CFX and Continental Farms, located in the United States.

However, labor costs, a decisive advantage in the initial stage, are now a handicap for Colombian competitors. Today, Dutch production relies on significantly lower labor costs, especially in Kenya. Moreover, flowers of all kinds must compete with a series of products designed for holiday celebrations and it remains important to develop product differentiation to remind the market of the value of flowers and their traditional significance. This needs to be done in a joint effort with local associates in foreign markets (such as flower sellers in the United States). Strategic alliances not only favor market development but also support Colombian floriculturists by helping them design adequate distribution and commercialization channels.

Stimulation of market demand is also essential for the fresh flower export industry. The U.S. market is characterized by seasonal consumption behavior, with high consumption during special holidays. Potential demand can be created by modifying consumption patterns. With this objective in mind, Colombian producers created promotion mechanisms to increase flower consumption in the United States. Through strategic alliances between Colombian exporters and their competitors in the United States, the Flower Promotion Organization (FPO) was created in 1999. The FPO seeks, by means of marketing and communication efforts, to expand the number of flowers sold in the United States by increasing the frequency of buyers' purchases. The campaign has been developed on a regional level, focusing on regions with greater growth potential, and taking into account different consumption patterns. The results show that consumers increased their purchase frequency between 20 percent and 25 percent, resulting in an increase in sales of about $7 million in two years.[50]

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[49] In 1977, only 13 percent of supermarkets sold flowers; currently, this number ranges from 85 percent to 90 percent. Total consumption in supermarkets went from $227.5 million to $984 million between 1976 and 1995. Currently, supermarkets supply about 40 percent of total demand (American Floral Endowment and Ipsos-National Panel Diary Group, 1999–2000).

[50] The first stage of the FPO expired in October 2003, and the second became effective in 2004.

Concerning transportation, today various companies transport flowers from Colombia to different markets. Bogotá's airport, El Dorado, has the most significant load movement in Latin America. More than 200,000 tons per year are moved, 85 percent in flowers, and there are approximately 20 to 30 cargo flights per day. However, exporters continue to pay the most expensive freight costs per mile of transported load in the world. This is due to the fact that no load compensation exists on the flights sent from Bogotá to the United States that justifies lowering the tariffs for companies, as the load movement from the United States back to Colombia is much smaller. Jet fuel prices are extremely high. Despite Colombia's position as a net oil exporter, refineries are not producing enough to satisfy domestic demand and fuel prices in the country are among the highest in the world.

Finally, periods of currency revaluation, such as the first five years of the 1990s and the current decade, negatively affect flower exporters. Exporters have partially managed to hedge against exchange rate fluctuations through the foreign exchange market, but revaluation continues to be a major problem for this sector.

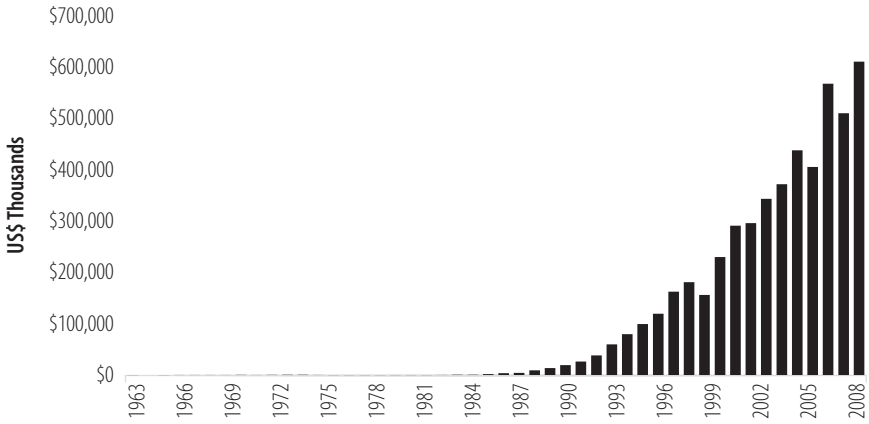
The Counterfactual Case: Flowers in Ecuador

Flower production and export in Ecuador involve two stories: an early failure and a later success. The contrast of the two stories highlights the pivotal strategies in the Colombian flower export discovery.

Ecuador started to export flowers in 1963, and peaked in 1973 with exports of $600,000. During this period, Colombia's flower industry also started to blossom. Nonetheless, while Colombian flower exports continued to grow, exports from Ecuador started to decline, almost disappearing in 1977. During this period, there were two failed pioneer attempts to develop an export flower sector in Ecuador: one in the early 1960s by Jardines del Ecuador, and another in 1976 by Florexport. Other entrepreneurs followed both pioneers; none lasted until 1984. In contrast, in 1983, a new pioneer effort by Agroflora gave birth to a dynamic exporting industry that has resulted in many players, and has made Ecuador the third-largest flower exporter in the world, after Colombia and the Netherlands (Figure 3.2).

Ecuador's current success in this industry shows that natural conditions can be ruled out as a reason for initial export failures. Therefore, other reasons must be considered, such as changes in Ecuadorian conditions between 1963–77 and 1983, and the adoption of strategies by Jardines del Ecuador and Florexport that were different from those of Agroflora.

FIGURE 3.2 | Ecuadorian Flower Exports, 1963–2008



Sources: UN COMTRADE data and authors' calculations.

The main barriers to exports before 1984 were restricted air transportation to the U.S. market—the same problem faced by Colombian flower producers—and phytosanitary problems caused by production without greenhouses. In contrast, Colombian flower growers managed to control phytosanitary problems and plant diseases. They did this in part through the construction of greenhouses using wood and plastic, the same materials they had used previously when building greenhouses for strawberry crops. Also, in the beginning, the problem of plant disease control was partially solved through the advice of some technicians from Israel who came to Colombia and spent months working with local producers. Over time, the role of Asocolflores (in some cases supported by ICA) in continuously finding ways to control plant diseases became crucial.

These barriers were still present when Mauricio Dávalos, Agroflora's main owner, entered the floriculture industry in Ecuador. Agroflora overcame some coordination problems in part because of the existence and experience of a well-developed flower sector in Colombia. It used Colombian producers' previous experience to obtain technical assistance through a partnership, and imported basic supplies from Colombia that were not available in Ecuador, like fertilizers and plastic films for greenhouses. The international buyers of the first shipments of Agroflora's flowers from Ecuador were a Miami importer and Floramérica; the latter, and arguably the former, owed their existence to flower production in Colombia. Agroflora was able to develop in Ecuador without the

need to coordinate with other local producers, which had been a prerequisite for the Colombian discovery. Once the industry grew, the availability of flower inputs considerably facilitated diffusion without the need for coordination with, or even acknowledgment by, the pioneer. This had not been possible for pioneers (during the first stage of the Ecuadorian sector [1963–77]) when the Colombian sector was developing, and it had not been possible in Colombia in the early years of its sector, as no other country in the region had been exporting flowers in a significant manner. The conditions in Ecuador confirm the importance of coordination for the Colombian story.

Resolving transportation issues in Ecuador followed a similar pattern. Although the pioneer did not fully resolve these problems, it did at least reduce them without the need for cooperation with other players, by coordinating with Avianca's counterpart in Ecuador, Ecuatoriana de Aviación, to set up a flight on a specific day for flower exports, instead of having to wait every day for unoccupied space on passenger planes. By 1990, when the sector had grown considerably, Ecuatoriana de Aviación dedicated a plane exclusively for cargo, and the growth of cargo agencies surged.

An important difference between the case of Ecuador and the case of Colombia is the existence of state financing through Ecuador's Corporación Financiera Nacional (CFN). This corporation financed both pioneers and followers, and may have been crucial for the development of both, as stated by some existing flower companies.

Conclusion and Recommendations

In the cut-flower sector in Colombia, discovery took place when a group of business leaders (both Colombian and American) learned that Colombia had great natural, geographic, and economic advantages to produce flowers at low cost, substantially below those in the United States. This allowed Colombian flowers to be competitive in the large and expanding U.S. market. The export discovery was of a product that had not been produced extensively before, and the unique objective of the new activity was to produce flowers for export.

In the export discovery process, the presence of foreign investment played a key role and helped trigger the discovery (one of the pioneers and leading companies, Floramérica, was wholly owned by foreign investors). In addition, the association with foreign companies for distribution and commercialization, as well as for acquiring knowledge about foreign demand and consumers' needs and preferences, was crucial for success.

The export discovery emerged from the private initiative of entrepreneurs who concluded that they could be competitive in exporting flowers to the United States. They bore most of the costs and assumed all the risks of the investments. The information regarding the export of flowers that could be produced in Colombia at low cost came from the private sector, and there was not a specific public policy intended to support the sector. Nevertheless, the Colombian government played an important role in the discovery's development in that it provided favorable conditions for exporting, such as macroeconomic stability (including devaluation of the exchange rate), the removal of import restrictions, and the creation of trade preferences, especially in the 1990s. In particular, the discovery benefited from policies specifically designed to promote nontraditional exports, which included export subsidies (CAT/CERT), subsidized credit (Proexpo/Proexport and Bancóldex), and Plan Vallejo. These programs encouraged initial investments and were useful in generating rents for entrepreneurs investing in new areas; however, the scope of their impact was limited.

Government support in helping investors solve coordination problems or deal with market failures was neither well organized nor systematic. The main obstacles confronting pioneers were related to transportation, phytosanitary issues, and entry barriers or protectionist measures faced in foreign markets (such as dumping cases and phytosanitary barriers). Other common uncertainties were those related to the level of knowledge of foreign markets, competitors, the size and characteristics of the demand, and consumers' needs. The government was helpful only in specific cases, and only sporadically. Obstacles were overcome through coordination among pioneers.

The diffusion in the sector was rapid, deep, and complete. The entrance of a growing number of investors was encouraged by several factors: the common knowledge that Colombia was an excellent place in which to produce flowers and export them to the United States; the vast size of the U.S. market; the existence of many farmers who potentially could diversify their activities; the large profits reaped by the pioneers; and the ease of copying the production technology. The pioneer (Floramérica) diffused knowledge in different areas: in using production technology; in creating distribution channels; in changing and adapting products and packaging to satisfy U.S. demand; and in training workers and changing work organization. Knowledge diffusion took place through different channels: human capital transfer (e.g., technical advice given by Floramérica's former employees and the hiring by some firms of members of Floramérica's staff); input suppliers (pesticide sellers); and imitation and copying.

Diffusion was beneficial, as the emergence of new participants helped exporters overcome obstacles through coordination and cooperation. The main areas of coordination were transportation; the establishment of adequate receipt and storage of flowers in a central location close to the main markets (Miami); distribution and commercialization channels; and gaining recognition for Colombian flowers in the U.S. market, with positive effects for the industry as a whole. Problems of rent appropriability were largely offset by extremely high profitability.

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CHAPTER 4

The Rise and Fall of Furniture Exports in São Bento do Sul, Brazil

Angela da Rocha, Beatriz Kury, and Joana Monteiro

The history of the São Bento do Sul furniture cluster in Brazil is a very interesting case of a set of "discoveries" followed by a diffusion process that led to the development of a successful furniture-exporting cluster—at least for a time. The case portrays a classic cluster. Firms in the cluster are very similar to one another in almost every regard, including firm competences and strategies. Homogeneity and relational ties facilitate communication flows, which in turn accelerate the diffusion of innovations within the cluster. As firms in the cluster mimicked one another, their individual strategic trajectories became indistinguishable, forming one single strategic group. This study explores the reasons that led to the so-called isomorphic strategic behavior within the cluster (DiMaggio and Powell, 1991), including the presence of endogenous spin-offs. As the case illustrates, while homogeneity offers advantages for the diffusion of innovations, it also increases the risks for the cluster because of path dependency: the tendency to pursue a pattern that was previously successful but that is no longer appropriate for the cluster's prosperity (Meyer-Stamer, 1998; Maskell and Malmberg, 1999).

The Brazilian furniture industry consists of around 16,000 firms. The vast majority are domestically and family-owned; less than 5 percent are large. The main competitive advantages of the Brazilian furniture industry are country-specific, such as local availability of raw materials, skilled labor, and cost advantages (a forest matures in 12 to 15 years in Brazil, but between 30 and 50 years in Europe).

TABLE 4.1 | The Performance of the Brazilian Furniture Industry, 2000–08

Indicators	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total sales (US$ millions)	4,802	4,129	3,461	3,849	4,277	5,415	8,697	10,703	11,105
Exports (US$ millions)	485	479	533	662	941	991	948	974	955
Imports (US$ millions)	113	99	78	70	92	108	144	207	301
Exports/Sales (%)	10.1	11.6	15.4	17.2	22.0	18.3	10.9	9.1	8.6

Sources: Abimóvel (exports and imports, 2000–05; sales, 2000–08; exports/sales, 2000–05); Sebrae/Secex (exports and imports, 2006–08; exports/sales, 2006–08).

Table 4.1 presents the evolution of total sales, exports, and imports of the industry from 2000 to 2008. Between 2000 and 2005, Brazil became the twelfth-largest furniture exporter in the world. The main destinations of Brazilian furniture exports in 2005 were: the United States (39 percent), France (10 percent), the United Kingdom (8 percent), Argentina (5 percent), and the Netherlands (4 percent).

From 2006 to 2008, export growth stagnated, due to increased competition from Asia, the overvalued Brazilian currency, and the impact of the world recession. Nonetheless, production continued to grow, thanks to an increase in domestic demand as a result of a construction boom and government stimuli.

Two Brazilian states have led the exports of furniture: Santa Catarina (home to the São Bento do Sul cluster), and Rio Grande do Sul. Until 2007, Santa Catarina produced about 50 percent of Brazilian furniture exports, and Rio Grande do Sul produced an additional 30 percent. In 2008, however, Santa Catarina's share fell to 46 percent, while Rio Grande do Sul's share increased to 33 percent.

Furniture manufacturers are concentrated in production clusters. A typical furniture cluster in Brazil is composed of between 100 to 300 firms. The three most important clusters are located in Bento Gonçalves (state of Rio Grande do Sul), in the São Paulo metropolitan area, and in São Bento do Sul (state of Santa Catarina). The Bento Gonçalves cluster is located in an area of Italian immigration, and produces predominantly home furniture made of medium-density fiberboard (MDF) panels or pine.

The São Paulo cluster, the second largest, is composed of around 3,000 firms, mostly of small and medium size, dispersed throughout the São Paulo metropolitan area. Most of these firms produce office furniture. Despite its size, this cluster is chiefly oriented toward the domestic market.

The São Bento do Sul cluster, the third in size, is located in an area of Austrian and German immigration. Although it occupies third place in the Brazilian ranking of furniture clusters by number of employees, it is the largest

furniture exporter in the country. It consists mostly of small- and medium-sized, family-owned and operated Brazilian firms. In 2005, the cluster included an estimated 403 firms, with about 10,000 employees. Home furniture represented around 80 percent of total furniture production. This cluster is vital to the local economy, generating about 40 percent of the total local value added while accounting for almost 50 percent of area employment.

The Discovery and the Diffusion Process: A Historical Overview

Two companies played a critical role in the "discovery" of furniture exports and the diffusion of exports in the cluster. Indústrias Zipperer was the first mover. It had a major impact on four major steps of the development of the São Bento do Sul furniture cluster: the types of pine scrap that were used, up till then, to produce handicrafts; export of these products; the decision to produce Brazilian colonial-style furniture; the adoption of solid pine wood—rather than engineered wood, such as plywood or fiberboard—and its export. Indústrias Zipperer led other entrepreneurs and local firms in these four stages. The role played by this company has been broadly recognized in interviews with other firm members, industry representatives, and government officials. Artefama was the immediate follower, becoming the leading firm in the industry, and also had a major influence on the development of the cluster.

Zipperer, the First Mover

Indústrias Zipperer was founded in 1923 in São Bento do Sul by Carlos Zipperer Sobrinho, a descendant of Austrian immigrants who became a legendary figure in the region. In 1923, Zipperer Sobrinho acquired from his former employer a small plant that produced small pieces of furniture and windows. Soon afterward, he began to produce handicrafts made of small pieces of pine that had been discarded by the timber industry. Recovery of the small pine pieces was an innovation in itself.

Zipperer Sobrinho was limited by the technological and human resources available in the region, which at that time was quite insulated from the rest of the country. To overcome his firm's limitations, he imported books from Germany, developed his own equipment, and trained his new employees. He was also a proactive businessman; he traveled frequently. The company was also said to be a pioneer in selling wood products outside the state (Denk, 2002; Kormann, 2005). Zipperer Sobrinho was later elected mayor of the city of São Bento do Sul, and served the local community in important ways.

Indústrias Zipperer's products became popular among tourists, generating more orders, and motivating other firms from São Bento do Sul to pursue the same path. In the 1950s, the company initiated its export activities by exporting its products to the United States, Germany, and England; in the early 1960s, it also exported to Japan. According to Denk (2002), it was the first firm in the cluster to export. The initial orders were unsolicited, yet Indústrias Zipperer did not remain a passive exporter.

As competition increased in the 1960s, Indústrias Zipperer decided to expand the production of colonial-style furniture.[1] The plant was modernized and new equipment was acquired. It was at this point that the second generation got involved in management functions at Indústrias Zipperer. The first attempts to export furniture in the mid-1970s were unsuccessful because of the excessive moisture content in the wood, due to inadequate drying techniques. Indústrias Zipperer decided to switch from a local wood, imbuia, to mahogany, a wood that was easier to treat and dry. The company developed its own designs by launching an English-style product line that was soon copied by local competitors. It adapted its products to customer requirements, investing in quality improvements, and acquiring production know-how. Efforts were made to export these products to Florida, with moderate success. Indústrias Zipperer also continued to produce colonial-style furniture, which was sold in the domestic market.

In the late 1970s, a Canadian businessman visiting São Bento do Sul suggested to Indústrias Zipperer's management the use of solid pine timber. The company had invested in pine tree reforesting to take advantage of government tax incentives, but the owners had not considered using solid pine timber for furniture. As a result, in 1979 Carlos Arlindo Zipperer went to Canada to learn the most advanced techniques of using pine, from reforestation to furniture production. At this point, rising ecological concerns about the devastation of forests were turning the use of wood from reforested areas into a critical requirement of European and U.S. customers. There were also initial indications of a shortage of native woods in the region, and the use of pine was already being considered. As Indústrias Zipperer produced and successfully exported this new product line, it started a new cycle in the São Bento do Sul cluster, and other firms followed its example in time.

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[1] According to Denk (2002), two firms, Indústrias Zipperer and Weihermann, were responsible for the introduction of colonial-style furniture in the cluster. Yet oral reports collected during the research process refer solely to Zipperer as being responsible for this move.

The first import markets for the new pine wood furniture produced by Zipperer were West Germany, France, and the United States. With the reunification of Germany, West German buyers shifted their orders to firms in East Germany. Zipperer then led other firms into exporting to the U.S. market, which became the most important market. Typically, importers would bring their own designs and specifications, and Zipperer, as well as its followers in the cluster, would manufacture the products. It was widely considered that Indústrias Zipperer's main competitive advantages were its modern plant—which used the latest equipment and had a high level of operational flexibility—and its vertical integration with pine forests as a source of raw materials. During the 1980s, the company was quite successful in selling to the European market and developed a reputation as a reliable supplier of quality products at a competitive price. Growing exports, combined with high-quality products, led to solid relationships with its foreign buyers.

At some point in the 1990s, however, Indústrias Zipperer lost its leadership in the cluster and Artefama became the flagship firm.[2] The problems faced by the pioneering firm seemed to have more to do with succession problems, which halted its development, than with a loss of its share of Brazilian exports due to the competitive actions of imitators. Reports in the media also suggested the existence of administrative problems. By 2006, Zipperer exported close to 100 percent of its output, mainly to developed countries. The company faced serious challenges that threatened its survival. Externally, like other firms in the cluster, it had to respond to Chinese competition in its main markets at the same time that it had to cope with an overvalued Brazilian currency; internally, it had to deal with succession problems.

Artefama, the Immediate Follower

Founded in 1945 by four entrepreneurs, Artefama was also initially dedicated to the production of handicrafts using pieces of pine traditionally discarded as scrap. The original founders sold the business to three owners, who together currently control 97 percent of the company. Álvaro Weiss, Artefama's chief executive officer, is a descendant of Austrian immigrants and one of the owners.

As the company grew, a new plant was built. Product lines became more diversified, and new handicraft items were launched and sold to stores in Rio

[2] The term "flagship firm" (i.e., the company that leads the cluster) is used here following the work of Ferreira, Tavares, and Hesterly (2006).

de Janeiro, as Zipperer had done. The first export order came in 1965. In the early 1970s, the company entered the furniture business. At the end of the 1970s, Artefama exported around 10 percent of its output. By 1990, the firm was exporting around 50 percent of its total output.

Although the first exports resulted from unsolicited orders, Artefama's management made a strategic decision to develop the business. Managers were aware that exporting was more risky than selling to the domestic market, but they believed that the long-term possibilities were greater. The company imported machinery to improve its production process and started using electronic control mechanisms to monitor the drying process. A major change was implemented during the early 1990s, when it began manufacturing and exporting pine wood products. The company prided itself on combining high technology and artisanal work in its manufacturing processes.

By 1999, with the devaluation of the Brazilian currency, the *real*, Artefama was ready to conquer new foreign markets. The company had invested in new facilities and equipment, improved productivity, and defined its growth strategy. Very quickly, it exported almost 100 percent of its total output, becoming the leading exporter of wood furniture from Brazil. In the early 2000s, the company was selling around 50 percent of its exports to the United States and 50 percent to Europe, using distributors.

The appreciation of the *real* halfway through the first decade of the 2000s reduced the cluster's price competitiveness in foreign markets, at the same time that it had to face lower-cost Chinese competition. To face these new challenges, Artefama adopted a number of palliative actions, none of which was seen as a definitive solution: outsourcing, importing of parts, and exchange rate targets.[3] Cost reductions were obtained by improving production processes.

By 2006, Artefama was the largest exporter of wood furniture from Brazil. The company had 1,250 employees, of which around 60 were white-collar professionals. Good quality products and reliability in delivery schedules at a competitive price permitted the growth of Artefama's export business.

The Diffusion Process

The first evidence of the first mover's influence appeared in the practice of using previously discarded pine wood parts to manufacture handicrafts.

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[3] Artefama predefined an exchange rate that was believed to be the most probable exchange rate in the future, and used it to determine the cost reductions to be achieved.

Artefama seems to have been the immediate follower in manufacturing similar products and exporting these products as early as 1965, only five or six years after Zipperer. Many other firms followed the example of the pioneer. As many handicraft products were starting to be replaced with plastic products in the domestic and international markets, Zipperer increased its production of furniture and, at the same time, launched a "Brazilian colonial" design. The large demand for this furniture style in Brazil motivated a number of other firms in the São Bento do Sul region to emerge.

In the mid-1970s, the growing shortage of imbuia—a tree native to the region—started to be perceived as a threat to the future of the cluster. At this point, the idea of substituting pine for imbuia started to circulate in the cluster. Yet local producers lacked the know-how to correctly manage pine forests, and did not master the technology to produce furniture from this type of wood. In addition, there were no trained workers to deal with pine wood. The creation of the Foundation for Technical Teaching and Research (FETEP) in 1975, with the objective of developing technical know-how and training workers for the furniture industry, was intended to serve this purpose.

Yet it was only in 1979 that the first firm in the cluster—Zipperer—was successful in producing quality pine wood furniture, and started to export this product in 1981. Interestingly enough, although Zipperer started to adopt pine wood to manufacture a different style of furniture as early as 1979, other companies continued producing colonial-style furniture until the impact of the economic recession of the 1980s, combined with changes in consumer tastes for furniture, forced them to change or succumb. Even Artefama, an early adopter of major innovations introduced by Zipperer, was a late adopter of pine wood furniture.

Despite these efforts, furniture made of pine wood was not well received by consumers in the domestic market during the late 1980s. Apparently, the first pine wood furniture sold in the domestic market was poorly finished and the wood itself was of poor quality, such that consumers associated pine wood with low-quality furniture. As efforts to sell pine wood furniture in the domestic market failed, companies started looking at alternative export markets. The cluster had already accumulated some export experience from the early handicrafts and the imbuia furniture years. Some of the early adopters of exporting in the cluster are presented in Table 4.2.

Meanwhile, in Europe, the supply of pine wood furniture from the Balkans collapsed, sending buyers from France, Germany, and the Netherlands to South America. German buyers felt very much at ease negotiating with firms in São Bento do Sul because of their common ancestry and language.

TABLE 4.2 | Adopters of Pine Wood Furniture Exporting in the 1980s, in the São Bento do Sul Cluster

Firm	Year founded	Year exports were initiated	Export intensity as of 2006 (percent)
Móveis Neumann	1971	1983	70
Móveis Walfrido	1972	1983	100
Famossul	1973	1984	100
Móveis Consular	1973	1986	80
Móveis Serraltense	1947	1987	Not available

Sources: Telephone interviews and Brazilian Exporters Catalog.

Export agents started to visit the cluster in the early 1990s. According to an industry expert, these export agents were responsible for the "identification of distributors and retailers in foreign markets." They traveled to foreign markets and became the most important intermediaries in the export process. Most were foreigners, but some local companies also developed. These intermediaries helped improve the quality of the furniture made in the cluster by transferring technical know-how to local firms. As a result of these efforts, the first export boom occurred in 1990–91. Certain firms sold an entire year's worth of production in advance. By 1994, the cluster had attained international product quality standards. Table 4.3 presents a list of firms in the cluster that started to export in the early 1990s.

TABLE 4.3 | Adopters of Pine Wood Furniture Exporting in the Early 1990s, in the São Bento do Sul Cluster

Firm	Year founded	Year exports were initiated	Export intensity as of 2006 (percent)
Intercontinental Indústria de Móveis	1948	1990	50
Tremóvel Indústria de Móveis	1981	1990	90
Indústria de Móveis Três Irmãos	1972	1991	100
Móveis Katzer	1985	1991	100
IMOCOL – Ind. de Móveis Coloniais	1976	1992	100
Móveis Clement	1984	1992	100
Móveis América	1977	1993	100

Sources: Telephone interviews and Brazilian Exporters Catalog.

TABLE 4.4 | Revamping of Manufacturing Facilities, 1996–97

Percentage of revamping	Percentage of firms
Less than 3	7
From 3 to 10	36
From 10 to 30	36
More than 30	14
Made investments	93
Did not invest	7
Total	100

Sources: Ferreira (1998); Garcia and Motta (2005).

Under the Plano Real,[4] it became easier to import foreign equipment and technology. According to industry experts, most firms, even smaller ones, imported equipment from Germany and Italy. Plant automation of larger firms was completed during this period. Table 4.4 presents the percentage of equipment and plant renewal.

Such investments were not unique to firms from the São Bento do Sul cluster; the wave of innovation swept over firms in the furniture industry all over the country. For example, according to Garcia and Motta's (2005) study, 100 percent of the firms from the Bento Gonçalves cluster, 92 percent from the Paraná cluster, and 80 percent from the Metropolitan São Paulo cluster also made investments in plant and equipment during the same period.

As the exchange rate became extremely favorable for exporting after the 1999 devaluation, other firms in the São Bento do Sul cluster entered international markets. Profits from the export business were reinvested, completing the modernization of the local industry. Table 4.5 presents some firms that were late entrants into the export market.

By 2001, the industry started to search for new markets. The United States, the largest market for furniture in the world, was a good prospect. New adaptations were required, since U.S. customers preferred larger furniture of different styles and materials. From 2001 to 2005, exports to the U.S. market grew steadily, with a favorable exchange rate.

[4] The Plano Real consisted of several measures taken in 1994 to stop inflation and stabilize the Brazilian economy. The appreciation of the Brazilian *real* made imports cheaper until the 1999 devaluation.

TABLE 4.5 | Late Adopters of Pine Wood Furniture Exporting, in the São Bento do Sul Cluster

Firm	Year founded	Year exports were initiated	Export intensity as of 2006 (percent)
Milamóveis	1972	2000	100
Móveis Irimar	1967	2002	25
Brasmóveis	1983	2002	100
Móveis 3J	1986	2004	0

Sources: Telephone interviews and Brazilian Exporters Catalog.

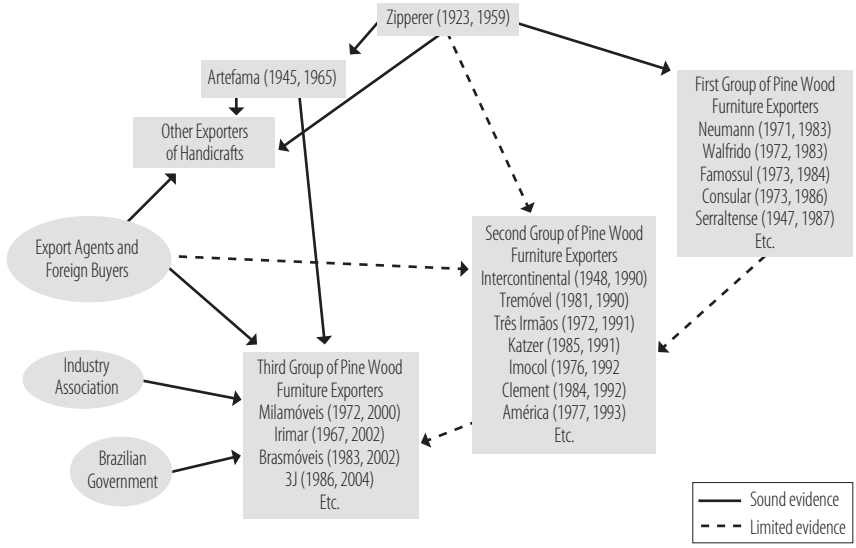
An interesting and complementary aspect of these developments has to do with the diffusion process among clusters. The available data suggest that the clusters of São Bento do Sul (representing 43 percent of total Brazilian furniture exports in 2005) and Bento Gonçalves (representing 27 percent) were earlier movers in the discovery of furniture exports, although this process was more intense first in São Bento do Sul, and second in Bento Gonçalves. Other clusters, located in areas of low-cost labor, also experienced substantial growth: in 2005, the Bahia cluster had the largest increase in exports (50.6 percent), followed by Minas Gerais (44 percent), and Ceará (43 percent), suggesting that the diffusion process among clusters was still under way.

Figure 4.1 presents a tentative schematic representation of the diffusion process in the São Bento do Sul cluster. It is to some extent speculative because only indirect evidence was available regarding certain aspects. The arrows link the various players in the diffusion process. The legend indicates the type of link: those that are derived from concrete evidence are portrayed as a solid line, and those for which only limited evidence exists are represented by a dotted line. The first number in the parentheses next to the firm's name is the year the firm was founded; the second number is the year the firm started exporting.

Cluster Strengths and Vulnerabilities

The main competitive advantages of the cluster were: local availability of raw materials and parts; local availability of experienced and skilled labor; proximity to suppliers; local availability of specialized services; the presence of support institutions, including those providing educational training and technical assistance; recent plant modernization; and quality products, recognized as such in international markets (Lanzer, Cunha, and Orsatto, 1997; Denk, 2006).

FIGURE 4.1 | The Diffusion Process of Exporting in the São Bento do Sul Furniture Cluster



Source: Authors.

But the cluster also had some important weaknesses, including firms' preference for vertical integration and low level of specialization; lack of skills in design, with a strong dependence on foreign design; limited market knowledge and marketing know-how, with a passive presence in international markets; and the adoption of a low-cost strategic positioning, as compared to a product differentiation approach.

An industry expert interviewed suggested that the export-oriented strategy of the São Bento do Sul cluster was actually mistaken, since these firms were highly dependent on exchange rate policies. In his view, opting to enter international markets increased the firms' risk. He claimed that while the average export intensity (percentage of exports on total sales) for the furniture industry in Brazil was around 20 percent, firms in the São Bento do Sul cluster exported as much as 80 percent to 100 percent of their output. Moreover, their products were specifically geared to European (especially German) tastes, but turned out also to be acceptable to American tastes.

A major weakness perceived by most interviewees was the lack of a marketing-oriented approach to exporting. Local traditions are strongly production-oriented. The São Bento do Sul cluster has demonstrated its capacity to

become a leading production cluster, but has delegated the marketing function to intermediaries, maintaining little control over the commercialization of its products. One consultant to the industry noted that many managers "never visited their customers abroad, never visited their export markets, never visited a store, never talked with a customer. These firms lack management control systems, management indicators, and professional evaluations. There are still many paradigms that need to be broken."

The Role of Support Institutions

The evidence collected in this case suggests that a number of institutional actors played an important role in the diffusion process. Support institutions did not play a role in starting the export development process—which was begun at the initiative of local firms—but they did support its continuation.

The most important institutional actor in the industry was the Brazilian Association of Furniture Manufacturers (Associação Brasileira das Indústrias do Mobiliário, or Abimóvel). Founded in 1975, its membership spans furniture producers and suppliers to the industry. Abimóvel has been active in promoting cooperation among several private support institutions; it also promoted cooperative efforts within the production chain, and among firms in production clusters. The association has also been extremely successful in representing the various subsectors of the industry with the Brazilian government. Nevertheless, it appears that Abimóvel had a stronger influence in other clusters.

Another organization that played a significant role in the cluster's export development was the Syndicate of the Construction and Furniture Industries of São Bento do Sul (Sindicato das Indústrias da Construção e do Mobiliário de São Bento do Sul, or Sindusmobil), which supported the development of industry studies and offered legal advice to member firms.

Two other institutions were instrumental in providing education, training, and technical know-how to the cluster. One was FETEP, a foundation created in 1975 by a group of businessmen and the city government, which played an important role in the education and training of local workers, as well as in the solution of technical problems associated with the use of pine wood. The other was the State University of Santa Catarina (UDESC), which started its activities in São Bento do Sul in 1994.

Among public institutions, certain government actions at various levels had a positive impact on the sector. At the city level, coordinated actions between the local government and the local business community provided

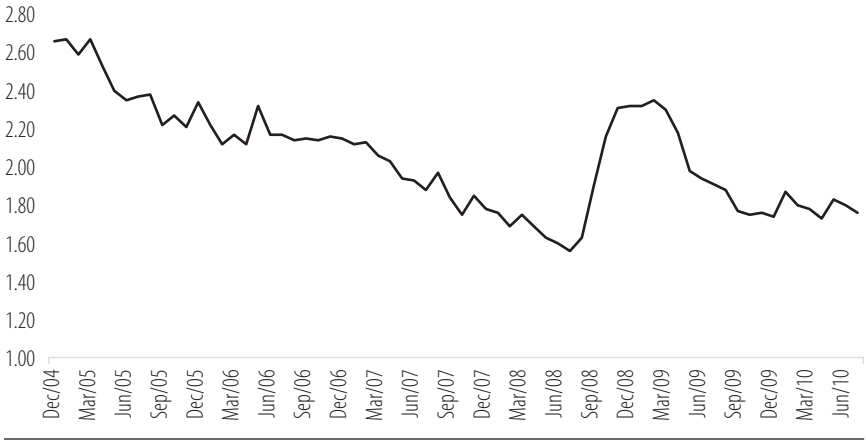
several examples of successful cooperation (as with the creation of FETEP, or when attracting UDESC to São Bento do Sul). At the federal level, the most effective government action was through Apex, the export-promotion agency, and its association with Abimóvel. Negative aspects that merit consideration when analyzing the relationship between government actions and furniture exports include the high level of taxation, and severe bureaucratic impediments that affect the whole exporting process.

The Crisis (2006–10)

Starting in 2006, the cluster had to face long-term external trends that threatened its successful trajectory. The most relevant were the appreciation of Brazil's currency (see Figure 4.2; the exchange rate during this period varied from 2.66 to 1.76 *reais* per dollar), competition from low-cost Chinese products, and the world economic recession (which mainly affected the United States and Europe—the markets for most of the cluster's exports). The changes were abrupt: exports from São Bento do Sul fell 22.6 percent in 2006, compared to 2005, and an additional 9.6 percent in 2007.

While these events were taking place, the Brazilian government developed programs to stimulate the construction of lower-middle-class housing, which increased the demand for home furniture. Many exporters tried to increase their sales to the domestic market, especially after 2007, and competition in

FIGURE 4.2 | Evolution of the Exchange Rate, December 2004–June 2010 (*reais* per dollar)



Source: Central Bank of Brazil.

the domestic market increased substantially. Total domestic demand, even including the government stimulus, was insufficient to absorb Brazilian production aimed at the home market, including goods that were redirected from exports. These trends affected companies' financial and export performance, prompting short-term actions by the state and federal governments.

Firms in the São Bento do Sul cluster adopted several strategies and corresponding actions to respond to these challenges (Table 4.6). When these external events started to impact companies' performance, most responses were again short term. Moreover, these actions did not address the real problem underlying the symptoms.

As time passed and conditions worsened, firms in the cluster adopted strategies and actions aimed at increasing their chances of long-term survival. Organized political action, such as lobbying, was only partially successful in attracting the attention of the public and of the federal and state governments to the threat faced by the industry. Some firms were forced to file for preventive judicial reorganization, while others went into bankruptcy, and others simply closed. By 2007, the São Bento do Sul cluster was composed of only 315 firms—down from 403 in 2005—and almost 6 percent of the local population had left the cluster. Several firms in the supply chain also disappeared. In May 2008, Indústrias Zipperer, the first flagship firm in the cluster, closed its operations and laid off its remaining 74 employees. At the end of 2008, export sales had dropped to an estimated 69 percent of the cluster's total output.

Most firms adopted a strategy of cost reduction. This included imports of raw materials, parts, and components;[5] negotiation with suppliers to reduce prices; use of supplier financing; adoption of lean manufacturing techniques; waste reduction; and more layoffs. A few firms chose to pursue differentiation strategies, including product differentiation, licensing, and investments in design. Firms also adopted cooperative strategies, aiming both at cost reduction (e.g., joint purchasing and informal agreements with the local labor force) and product differentiation (creation of a joint brand).[6] Interestingly, with the

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[5] In several firms, imports of raw materials, parts, and components rose from less than 5 percent of their total purchasing to between 10 percent and 20 percent. Imports came from Argentina (wood), China (metal components), Taiwan (screws), and Belgium (varnishes and paints), among others.

[6] The Biomóvel brand belongs to Sindusmobil and is used by 62 firms, which are responsible for 80 percent of furniture sales from the region, including larger firms such as Artefama, Rudnick, and Weihermann. The brand was launched in the domestic market and is positioned as a "green" product line.

TABLE 4.6 | Strategies and Actions Adopted by São Bento do Sul Furniture Manufacturers to Face the 2006–10 Crisis

Strategy	Specific actions
Early reactions	Price increases Reduction in working hours Layoffs Temporary shutdown Plant shutdown Investment reduction
Legal action	Bankruptcy or judicial reorganization
Political action	Lobbying the federal and state governments Workers' demonstrations
Market diversification	Targeting the Brazilian domestic market Entry into new foreign markets Entry into new market niches
Product diversification	Creation of low-priced product lines to serve the domestic market New products launch to avoid price comparisons (in dollars)
Promotional strategies	Organization of foreign missions Participation in trade fairs and exhibitions
Cost reduction	Imports of raw materials (wood, parts, and components) Negotiation with suppliers Supplier financing Adoption of lean manufacturing Waste reduction Layoffs Agreement with workers to reduce labor benefits Joint purchasing of raw materials
Differentiation	Product differentiation Licensing of foreign brands Investments in design Creation of a joint brand (Biomóvel) to serve the domestic market Adoption of new varieties of wood

Source: Authors' compilations, based on several newspaper and business magazine articles.

exception of investments in design, which was reported by only one firm in the cluster, all other differentiation efforts were aimed at conquering a share of the domestic market. Cost reduction strategies were not enough, however, to overcome the combined effect of cost advantages of Chinese furniture manufacturers and the appreciation of the Brazilian *real*, which continued throughout the first half of 2010, when the exchange rate went as low as 1.73 *reais* per dollar. As a benchmark, Artefama's management believed the firm

could compete effectively against the Chinese at an exchange rate of 2.20 *reais* per dollar.

With the São Bento do Sul furniture cluster facing competition from low-cost Chinese products, the appreciation of the *real*, and the world economic recession, the low-cost, high-quality, production-oriented export model is no longer viable. Nevertheless, firms seem to be locked into this model, and unable to find a different path. As market conditions worsened, other large firms that had relied on exports got into trouble in late 2009 and early 2010, with the continued appreciation of the *real*. Despite its virtues, Artefama filed for reorganization under Brazilian bankruptcy laws in December 2009.

The current crisis at the São Bento do Sul furniture cluster will certainly have a major impact on its future. Once the old path became obviously impossible, firms in the cluster needed to find a new model. At the time of this writing, the leading firms in the cluster have still not found one. But crises are often triggers for change. The destiny of the São Bento do Sul cluster has yet to be written.

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Interviewees

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Duschenes, Ronaldo, Founder and Chief Executive Officer, Flexiv; Vice President, Federation of Industries in the State of Paraná (Federação das Indústrias do Estado do Paraná, or FIEP)

Kemper, Célia Regina, Executive Secretary, Sindusmobil

Myszka, Andreia, Trader, Commercial Department, Indústrias Zipperer S.A.

Sanchez Junior, Miguel, Executive Superintendent, Abimóvel

da Silva, Joelma Lucia, Trader, Export Department, Móveis Rudnick S.A.

Weiss, Álvaro, Chief Executive Officer, Indústrias Artefama S.A.; Regional Vice President, Abimóvel

Zipperer, Ana Carolina, Manager and Owner, Indústrias Zipperer S.A.

Zipperer, Osvaldo, Founder and Financial Executive Officer, Zipperer Comercial Exportadora Ltda

Zschoerper, Nícia Terezinha, Former Chief Executive Officer and Owner, Indústrias Zipperer S.A.

CHAPTER 5

The Emergence and Consolidation of the Chilean Wine Industry

Manuel Agosin and Claudio Bravo-Ortega

The discovery of new export opportunities has been important to economic growth and development in Chile since the mid-1970s (Meller, 1994; Meller and Sáez, 1995; Agosin, 1999). These export opportunities have arisen almost entirely in segments of the food and forestry sectors,[1] in clear contrast to Asian countries, whose export growth has been driven by the creation of new, comparative advantages in the manufacturing sector. In fact, manufacturing has been almost absent from the Chilean process.

Chile is also of interest because of the diversity of cases of export growth and the variety of the likely causes for their success. This study will concentrate on the emergence and evolution of wine exports. Wine is an interesting case study because it is the product within the most dynamic category of exports in Chile (non-mineral products) that has grown the fastest. Wine exports rose from practically nothing in 1980 to about $50 million in 1990, and to $1.4 billion in 2009. While the export discovery was due entirely to the arrival of a Spanish producer (Miguel Torres) and the response of a major Chilean company (Concha y Toro) to market opportunities and incentives, the development of wine into a major export product was aided by efforts on the part of government and producer associations, which will be highlighted in this chapter.

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[1] Successful exports include wood products, pulp and paper, fruits and vegetables, fishmeal, other ocean products, cultivated salmon, pork, poultry, milk products, and wine.

Over time, Chilean exporters have traveled the distance from bulk, commodity wine to product differentiation in the segment of "good value for money"; now the effort is to consolidate at least part of the industry in the segment of premium wines, where monopolistic competition is fierce. Improving quality and positioning the product in high-price segments are essential for success. For the industry to continue to grow, coordinated efforts among the government, producer associations, and individual firms aimed at quality improvement and marketing will be essential.

The analysis of the emergence of the wine industry focuses on the following questions:

- What encouraged the pioneer—and, later, the leading exporter—to enter the industry?
- Was leadership in exporting associated with foreign investors who had specific product knowledge related to technology, marketing requirements, or access to markets? Or were foreign investors followers rather than leaders?
- Was the basic factor driving new exports the effort to discover costs (the externality identified by Hausmann and Rodrik (2003) or the discovery of demand (the externality dealt with by Vettas [2000])?
- How did export production diffuse from the pioneer-industry leader to followers?
- What was the role of the state and other actors providing sectoral public goods (such as producer associations) in fostering the takeoff and the sustained growth of wine exports?

New Exports, Growth, and Investment

If exports are indeed a distinct class of goods, successful growth performance might require policies that stimulate the increase and diversification of exports. A recent literature has found that export diversification is a powerful contributor to growth. One of the authors of this study has found that export diversification has considerable explanatory power in a cross-country empirical model of per capita income growth (Agosin, 2009). Other recent studies have found that countries that export products normally exported by countries with a higher income per capita tend to grow more rapidly (Rodrik, 2006; Hausmann, Hwang, and Rodrik, 2006). New exports have important externalities: they reveal costs (Hausmann and Rodrik, 2003) or demand (Vettas, 2000) *within* a particular sector; and they also allow *other* sectors with potential comparative

advantage to emerge (Hausmann and Rodrik, 2006; Hausmann and Klinger, 2006). This is largely because sectors related to those that are opened up by a new exporter tend to use similar public goods or nontradable inputs.

What is the specific market failure that should prompt policymakers to target new exports? While Hausmann and Rodrik (2003) emphasize cost-discovery that can later be imitated without incurring the costs of search involved, other externalities have been less noticed in the literature. One exception is a paper by Vettas (2000), who suggests that one source of uncertainty is that demand is unknown and must be discovered. In his model, foreign demand is endogenous and depends on past sales. Due to two types of externalities—the firm's learning and cultivation of the market—the level of entry in the industry tends to be too low. As in the Hausmann and Rodrik (2003) model, other firms free ride on the first mover's investment. This means that the pioneer, while incurring the costs of opening up a new market, is unable to reap all the benefits of his or her investment. This model provides interesting results that apply to the development of the Chilean wine industry.

The Chilean Wine Industry in Historical Perspective

Since 1990, wine has become a major export industry in Chile with a significant international presence. As shown in Table 5.1, while wine has experienced a considerable loss in export share since 2003 (due to the surge in copper prices), during the entire period since 1990, wine export volumes have exhibited the fastest growth of all major categories of exports. In constant (2003) prices, the share of wine in total exports has risen steadily.

Winemaking is a traditional economic activity in Chile that goes back to colonial times. However, the kinds of wines produced by Chilean winemakers up to the mid-1980s were not acceptable to consumers in developed countries, and technological change on a large scale was needed for Chilean wines to sell abroad. Although Chile had exported some wine for several decades, mainly to other Latin American countries, wine exports took off only after 1985.

Currently, Chile is exporting about $1.4 billion. These are 2009 figures; in 2010, both volume and value figures are expected to be higher, in spite of the earthquake that hit the Central Valley on February 27, 2010. The main destination is the European Union (EU)—excluding the United Kingdom (UK)—which takes up about 40 percent of exports, followed by the UK with 20 percent, and the United States with about 15 percent. Latin America accounts for 10 percent of exports. The number of destinations has steadily increased and peaked in 2003, reaching over 100 countries.

TABLE 5.1 | Chile's Main Export Products, 1990–2007

a. Share in terms of total export value (percent)

	1990	1997	2003	2007
Copper	45.0	36.2	31.6	51.5
Other minerals	9.7	7.6	5.6	6.0
Fresh fruit	10.0	9.2	10.6	5.6
Wood, pulp, and paper	10.6	11.9	12.7	8.9
Salmon and trout	1.5	4.9	6.8	4.9
Wine	**0.7**	**3.0**	**4.0**	**2.6**
Other foodstuffs	15.4	15.9	14.3	8.4
Manufactures	7.2	11.3	14.3	12.2
Total (percent)	**100.0**	**100.0**	**100.0**	**100.0**
Total (US$ million)	**7,648**	**13,940**	**16,867**	**48,878**

b. Share in terms of total export value, at constant (2003) prices (percent)

	1990	1997	2003	2007	Annual growth 1990–2007
Copper	35.2	30.3	31.6	24.2	6.3
Other minerals	11.4	8.3	5.6	11.0	8.4
Fresh fruit	11.7	10.1	10.6	10.2	7.7
Wood, pulp, and paper	12.5	13.0	12.7	15.7	10.1
Salmon and trout	1.8	5.4	6.8	4.3	14.3
Wine	**0.8**	**3.3**	**4.0**	**4.7**	**20.6**
Other foodstuffs	18.1	17.4	14.3	13.4	6.3
Manufactures	8.5	12.3	14.3	16.3	12.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**8.6**

Source: Authors' calculations, based on data from the Central Bank of Chile.

The climate of Chile's Central Valley, with its cold, rainy winters and hot, dry summers, is ideally suited to wine production. Wine production in Chile also benefits from the country's natural isolation: its western border is the Pacific Ocean and, to the east, it is protected by the Andean mountain range. This gives Chilean winemaking excellent phytosanitary conditions, avoiding the diseases that can be fatal to vines. For example, during the mid-nineteenth century, Chile remained free of phylloxera, a plague that decimated the European wine industry.

The art of winemaking in Chile dates back to the sixteenth century. Lore hands down the story of the priest Francisco de Carabantes, who brought the first vines to the country to make wine for the celebration of Mass. Due to the favorable climate, the cultivation of grapes spread rapidly through the central region of Chile. During the following three centuries, winemaking used rudimentary techniques and Spanish grape varieties. In the middle of the nineteenth century, the introduction of French varieties brought about a substantial change. Grapes such as the Cabernet Sauvignon, Merlot, and Sauvignon Blanc were introduced, and since then have constituted the bulk of Chilean wine production.

During the nineteenth century, several entrepreneurs—some of them linked to the exploitation of minerals—started growing vines, enhancing their reputations and attaining high social status. These entrepreneurs were also responsible for developing a wide network of irrigation channels that shaped winemaking in the Central Valley of Chile.

At the beginning of the twentieth century, the introduction of an alcohol tax discouraged the development of the sector. By 1938, the area planted to vines was frozen by the government; in addition, the authorities prohibited the use of table grapes for winemaking. These regulations caused the industry to stagnate, a situation that lasted until the mid-1970s. During this entire period, there was little or no technical change in the industry, due mainly to the restrictions imposed on the sector by official policy. Import-substitution policies and the resulting overvaluation of the peso also contributed to an orientation toward the domestic market and the complete neglect of exporting.

As a consequence of the sector's stagnation, the quality and types of wines produced in Chile fell significantly behind the evolution of international demand, which emphasized lighter wines (Bordeu, 1995). Instead, Chilean wines up to the mid-1980s were extremely heavy, with strong tannins and a high alcohol content. White wines were oxidized and red wines were aged excessively in large oak barrels. Exports were largely restricted to markets in which wine quality was unimportant (such as other Latin American countries). The great advantage of Chilean wine was its cost and the absence of serious competition in these markets, which also applied high import duties to wines produced outside the region.[2] Thus, the characteristics of supply obstructed the access of Chilean wines to the world's most relevant markets.

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[2] Since the early 1960s, Chile has participated in regional trade preference schemes.

Innovation and the Export Drive

Perhaps the single most important government support for the industry was the abolition in 1974 of the restriction on vineyards. In 1979, an amendment of the law legalized the production of wine from table grapes and grapes rejected for the export market. These changes allowed producers to plant vineyards again and incorporate new technology, even in the face of increasing competition from substitutes such as beer, *pisco*,[3] and sodas, which had made enormous gains in the beverage market.

Thus, by the beginning of the 1980s, new vines—planted after 1974—were entering into production, despite the decline in the total area planted. The yield per hectare increased through the replacement of old, low-yield vines. Furthermore, the industry went through a process of reverse creative destruction[4] as a consequence of the crisis for existing producers, created by the easing of previous restrictions and the erosion of its position within the domestic beverage market. These developments made producers aware that they had to orient their output to international markets. The sharp, real depreciation of the Chilean peso that ensued as imports were rapidly liberalized after 1974 also encouraged producers to look toward export markets.

Led by Viña Cánepa, a traditional Chilean winery, and Miguel Torres, a Spanish firm that set up production facilities in Chile in 1981, winemakers began to replace wooden vats with stainless steel ones. This has been one of the most relevant technological changes in the Chilean wine industry from the 1980s to the present. Almost at the same time, Miguel Torres introduced the usage of small (220-liter) oak barrels, already in use nearly everywhere else, to replace the old, 4,000-liter *fudres* in which all Chilean red wines were kept. These two innovations revolutionized the industry and raised the quality of Chilean wine, at a time when the industry was redirecting its production to international markets.

As a result of these technological changes and the newfound export orientation of the industry, the area planted grew rapidly and toward the end of the 1990s had attained the levels existing at the beginning of the twentieth century. All the growth occurred in varieties that are used in fine wine:

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[3] A high-alcohol distilled liquor made from grapes.

[4] The process was "reverse" because innovation was triggered by the crisis, rather than the other way around.

Cabernet Sauvignon, Carmenère, Cabernet Franc, Sauvignon Blanc, Pinot Noir, Syrah, and Chardonnay.

The Stainless Steel Revolution

In 1980, Viña Cánepa became the first Chilean-owned vineyard to use stainless steel vats: Vallefondri vats imported from the United States. These vats were very robust, between 4 and 6 millimeters thick; today, vats are built with better technology and are just 2 to 3 millimeters thick. Viña Cánepa bought vats to hold 50,000, 80,000, 100,000, and 200,000 liters. This huge investment was undertaken at a time when the peso was appreciating in real terms, and the dollar had been fixed at a price of 39 pesos. In what would later become the undoing of the firm when the peso depreciated as a consequence of the debt crisis, the investment was financed with foreign credit. Don Pepe Cánepa was the son of an Italian immigrant who kept close contacts with the wine industry in Italy, from where he got the idea of introducing this kind of vat.

Since the vats were bought as components, local assembly was needed. As of 1980, there was no experience in stainless steel welding, so Vallefondri sent an expert to Chile who could train some workers in the task. The firm in charge of the assembly—Marmevit—had been created by a former production manager of Viña Santa Rita, who anticipated the need for well-trained maintenance teams and equipment suppliers in the industry. Almost at the same time, Miguel Torres was also importing stainless steel vats, only to discover that almost nobody in Chile knew how to assemble them. The firm had to rely for technical support on the vats' provider, Herpa S.A.—from Spain—which also trained some Chileans in assembly work. By the mid-1980s, Concha y Toro was also importing steel vats.

Marmevit is still an important supplier of stainless steel vats to the Chilean wine industry. Today, it makes the vats itself and imports only the cooling system from Spain.

The introduction of stainless steel vats, an apparently minor innovation, enabled producers to bring the quality and taste of Chilean wines up to international standards, allowing them to enter new and larger markets. These vats have some important properties that allow wine to be exported safely from a sanitary point of view. Moreover, in contrast to concrete tanks and large wood barrels, the stainless steel vats do not retain wine residues that can affect the taste and smell of the wines the following season. Finally, steel vats allow the producer to control the temperature of the wine during the fermentation

process, which is essential to producing a good quality wine. This quality upgrade was fundamental to the process of discovering and learning the characteristics of international demand, as emphasized in Vettas' (2000) theoretical framework.

Standardizing the Production Line

Concurrent with the stainless steel revolution was another important change in the industry: the emergence of the production line in the first half of the 1980s. Before the production line was introduced, bottling and corking were not standardized; despite the fact that all bottles contained three-quarters of a liter, they were reused and came in different shapes. By the beginning of the 1980s, producers, working through their business associations, achieved several advances: bottle characteristics were made uniform, bottle recycling was eliminated—and with it the residual odors that bottles have when used to store other products, including kerosene—and the modern production line became the industry norm.

Other Technical Improvements

While the process of discovering foreign demand and its characteristics was triggered by the quality upgrade in the mid-1980s, there were other important components of this process. Until the 1990s, most of the industry's innovations were transferred from abroad rather than the result of R&D activities by Chilean firms (Benavente, 2006). Since then, innovation in the Chilean wine industry has evolved along several different lines. The first channel may be called "learning by looking"; it consisted of foreign travel at harvest time by Chilean oenologists and viticulturists to the international centers of winemaking, mainly France and the United States. Indeed, today it is not unusual for a young oenologist to make his first vintage in Chile after having participated in a few abroad. Some of the expenses of this travel abroad were originally defrayed by government development agencies.

Learning by looking also may have been the source of another very significant technological innovation that substantially improved the quality of Chilean wines. Until then, vineyards were not consistent as to the quality of grapes produced. In the early 1990s, Chilean vineyards began planting new plant clones brought from California and France, which makes for a more consistent grape quality. The new winegrowing valley of Casablanca was a leader in this respect.

The second channel has been the participation of foreign oenologists in the Chilean harvest season. Some of them were sent to Chile by supermarket chains and distribution channels. In this way, the oenologists—the main actors in wine production—could exchange knowledge and experience directly. Since then, traditional channels such as participation in professional congresses, international wine fairs, courses, and seminars have become routine activities for Chilean winemakers.

During the 1990s, cooperation between Chilean and international winemakers also grew. But technology transfers have not been limited to the vineyard level. To improve fruit quality, wine producers have transferred newly acquired knowledge to grape growers. It is now common practice that business contracts specify handling procedures, irrigation systems, and performance indicators such as yield per hectare. Wine producers also offer technical assistance in the field, partially subsidized by a government program (discussed below).

Foreign Investment in Wine

The process of learning about international consumer tastes and foreign demand has been helped by foreign investment. Given the natural advantages of Chilean valleys, investors, mainly from the United States and France, have centered their attention on forming joint ventures or investing directly in the country with the objective of exporting. According to the Foreign Investment Committee—the institution dealing with approval and monitoring of foreign investment—foreigners invested less than $4 million from 1974 to 1989 and only $7.3 million from 1990 to 1994. Yet from 1995 to 2000 foreign investment soared to $100 million, and leveled out at nearly $33 million from 2000 to 2005. These relatively modest figures[5] and the fact that most of the foreign direct investment (FDI) took place after the export takeoff are consistent with the notion that foreign investors in this industry have been largely followers. With the exception of Miguel Torres, they arrived on the scene after the export wine boom had started.

At the beginning of the 1990s, Kendall Jackson (USA) established Viña Calina, followed by other vineyards, including Cuvée Mumm (Canada), Domaine Oriental (France), and Canandaigua Brands (USA) (Agosin, Pastén, and Vergara, 2000).

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[5] Total FDI in Chile runs into the billions of U.S. dollars per year.

The industry has benefited from a second type of foreign investment: the joint venture, starting in the late 1980s. Château Lafite Rothschild (France) invested together with the Chilean family Eyzaguirre-Echeñique in the Los Vascos vineyard. Together with the Rabat family, Marnier Lapostolle created Casa Lapostolle. Mondavi (USA) and Viña Errázuriz set up Caliterra. Château Mouton Rothschild (France) formed an alliance with Concha y Toro and created Viña Almaviva, which produces one of Chile's most expensive, super-premium wines.

Joint ventures have different objectives for Chilean and foreign vintners (Agosin, Pastén, and Vergara, 2000). For foreign companies, joint ventures are part and parcel of their efforts to diversify into new product varieties to obtain some market power in different segments of the market. For Chilean firms, prestige and access to distribution networks are the main reasons why they decide to associate with foreign partners. The benefits for small vineyards also include access to foreign technology and markets.

In many cases, a foreign partnership gives Chilean producers not only distribution channels and market access, but also a deeper knowledge of foreign demand. Indeed, the foreign partner or distributor frequently provides information about wine characteristics (color, taste, bouquet) that is useful to position the product in a particular market segment. As noted, this information flow on demand characteristics started in the 1980s, and it continues today.

Some distributors have used an interesting market penetration technique for climbing up the quality ladder. They request that the vineyard establish a presence in at least two price segments: for example, a low- and a high-price wine. In the first stage of market penetration, it might be important to have a "war horse" wine that has an outstanding quality-price ratio that opens the market and creates a brand image. This seems to be a basic requirement on the consumers' side, before they even try a wine in the more expensive segment.

Other Factors Encouraging Exports

In interviews carried out for this study, some firms have stated that important factors promoting wine exports in the early to mid-1980s were the recession, increasing competition in the domestic market from other beverages, and the strong depreciation of the peso (resulting from the financial and balance-of-payments crises of 1982–83). The combination of recession and the depreciation of the peso allowed producers to purchase land that was suitable for wine production at very low international prices. The growth of the industry has also been linked to the discovery and bringing into production of land in new

valleys devoted to growing grapes for winemaking (such as Casablanca by Viña Morandé and Apalta by Viña Montes).

Cost or Demand "Discovery"?

Was the major market failure in the case of Chilean wine producers the lack of incentives for cost discovery (Hausmann and Rodrik, 2003) or for demand discovery (Vettas, 2000)?

Vettas' hypothesis appears to account for the observed behavior of Chilean wine exports, since the basic uncertainty had to do with whether there would be demand for wines such as those that could be profitably produced in Chile. Wine had a long history of being produced in Chile, but it was exported in very small volumes and basically to other Latin American countries. It took the success and demonstration effect of a foreign producer—Miguel Torres—to show that Chilean wines would have a market abroad, given the introduction of modern winemaking technology.

Chilean wine production had to be adapted to international tastes, and technologies used in the major winemaking nations had to be imported to meet customer demand in target markets. Once demand was discovered (or created), many producers jumped on the bandwagon, often using the same marketing channels as the pioneers. Since the pioneers were large firms, they did not face liquidity constraints. The followers, on the other hand, were generally smaller, niche producers that were liquidity-constrained in meeting the large sunk costs of gathering information about and penetrating foreign markets. Associations of independent producers, partially fostered by the government, were instrumental in allowing these smaller firms to enter export markets.

An Industry Dynamics Analysis

The First Mover

The honor of being the first mover of Chilean wine exports goes to the Spanish vineyard Miguel Torres, because it meets two important requirements: consistent introduction of new technology and the subsequent development of an export orientation. The Miguel Torres firm started selling wine in 1870, although the Torres family had been producing wines for about two centuries before that date. Today, Miguel Torres is a winemaker with an international reputation for producing high-quality wines and brandies.

During the 1970s, Miguel Torres—one of the descendants of the original family—went to France to study, and there he befriended Alejandro Parot, a Chilean who convinced him that the Central Valley of Chile presented good investment opportunities in the wine industry. It was a region with the right climate and conditions, it was free of phylloxera, and had a long-standing winemaking tradition, albeit one that had remained backward as regards modern production and consumption trends. In 1979 Miguel Torres made its first investment in Chile, buying the 90-hectare Maquehua farm, suitable to the production of high-quality Merlot and Cabernet Sauvignon. Since then, Miguel Torres has bought four other *fundos* suited to the production of other grape varieties. These investments were fully funded by Miguel Torres from retained earnings. Indeed, an important characteristic of Viña Miguel Torres is that it reinvests 95 percent of its profits and does not rely on outside financing.

Miguel Torres introduced the stainless steel vats to Chile, together with the smaller, 220-liter oak barrels. These changes allowed the firm to produce a wine with international characteristics, in Chile. A fundamental element in the launching of Torres' new products was the presence of a leading oenologist from Spain, a tradition that is maintained today. This was very important, because this oenologist knew the characteristics of international demand and made a Chilean wine to those specifications.

In the first stage, Miguel Torres was oriented toward the domestic market, but by the mid-1980s it started to export. In Chile, Miguel Torres concentrated on the production of premium-quality wines using its brand recognition. In addition, the firm did not require a lower-end product for international markets because it already had one. The output from the Chilean vineyard was marketed abroad through the distribution channels that Miguel Torres already had in its main markets. Thanks to this advantage, Miguel Torres became the first Chilean producer to export premium wines, an initiative that was soon imitated by Concha y Toro in 1988.

Thus, from the early to mid-1980s, Chilean firms were able to witness the introduction of new winemaking technology, the production of wine of much higher quality, and the success of a foreign firm in exporting high-quality Chilean wine. This natural experiment (a pull factor) and the crisis that afflicted the sector at that time (the push factor) were the main determinants of the transformation of the Chilean wine industry.

There was no government intervention whatsoever in the investment decision and further development of Miguel Torres (except perhaps the liberalization of the FDI regime in the mid-1970s, which granted foreign investors

national treatment). Only recently has the firm received government funds to develop irrigation canals and improve the quality of their input providers.

Miguel Torres was the first mover and pioneer of Chilean wine exports. Although both Miguel Torres and Viña Cánepa introduced the new technologies at about the same time, it was Miguel Torres that became the reference point for other Chilean winemakers. Miguel Torres succeeded in launching exports and producing a new wine to international specifications for both export and the domestic market, whereas Viña Cánepa got caught up in the financial crisis that affected the Chilean economy in the early 1980s. Moreover, after the death of one of its owners, the company suffered because of some managerial problems, which led to the vineyard being split into Viña Cánepa and Terramater. Today, Miguel Torres is a leader in the domestic market and its exports reached almost $10 million in 2005, whereas Viña Cánepa's businesses have languished, with exports of about $5 million in 2005.[6]

The Market Leader

Soon after the first signs of success by Miguel Torres, the larger and traditional Chilean winemakers started redirecting their efforts toward the export market. The most outstanding imitator was Concha y Toro, a winery that had started production in 1883 when it was founded by Marquis Don Melchor de Concha y Toro. This firm went public in 1933; that same year, it shipped its first exports to the Netherlands.

From that time until the second half of the 1980s, the value of exports grew at a slow pace. An important event took place in 1965 with the release of what was then a premium wine: Casillero del Diablo, produced by Concha y Toro. However, exports did not take off until much later.

The technological renewal of the production process at Concha y Toro was symbolized with the release in 1987 of what was likely to be the best and most famous Chilean wine, the super-premium Don Melchor. In 1986, samples of Don Melchor were sent to Bordeaux to test its quality; the feedback was that there was great potential in the wines of the company's Puente Alto vineyard, where this wine is made. The firm released the wine the following year.

In 1988, Concha y Toro signed an agreement with Banfi, one of the largest distribution chains in the United States. This led to significant export growth for Concha y Toro and, as Chilean wines gained recognition abroad, for the rest

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[6] It should be noted that Miguel Torres has a worldwide presence and that its Chilean operation is a relatively small component of its total business.

of the industry. In the 1990s, Concha y Toro significantly increased its exports to Europe. Today, total exports of the vineyard are about $455 million, and the firm's stock market value is close to $1,180 million.[7]

With respect to funding, Concha y Toro follows the strategy of reinvesting 60 percent of its profits. In 1994, the company issued ADRs (American Depositary Receipts, a mechanism for listing on the New York Stock Exchange), becoming the first wine producer to be listed through that mechanism. Concha y Toro has also had recourse to credits to finance its growth.

Until recently, Concha y Toro did not receive government aid. Today, it makes use of the government's supplier development program (described below), and is also collaborating in a government-funded, water-management research project.

Followers

The number of exporters has grown very rapidly since the mid-1980s. In 1995, the first year for which export data are available at the firm level, there were 62 exporters; by 2005, there were around 330.[8] The growth in the number of firms has been almost linear. Despite Concha y Toro's relatively large market share, Chilean wine exports exhibit a relatively low degree of concentration. Even in 1995, the Herfindahl index of export concentration was only 0.074; by 2005, it had fallen to 0.049, a level consistent with those found in non-concentrated industries.[9]

A large array of firms participate in the industry. Some firms, including Santa Rita, Santa Carolina, and Viña Cánepa, produce a wide variety of brands: some aimed at the low end of the market, and others at more sophisticated segments. Other firms, including three interviewed for this study (Morandé, Bouchon, and Viu Manent), are small and specialize in wines that can be considered "good value for money"—up to now the staple of Chilean wine exports. Other small producers, such as Montes, are already aiming at the premium niche of the market.

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[7] The 2009 and 2010 Annual Shareholders' Report presentations are available at www.conchaytoro.cl.

[8] Interviews indicate that there were about 60 exporters in the 1980s, but the values exported did not begin to rise above $10 million until the second half of the decade.

[9] However, some export brands belong to a single owner. For example, Concha y Toro exports wines with its own label and under other labels as well (Cono Sur, Maipo, Palo Alto, and Maycas del Limarí).

The Role of Government Policy and Business Associations

Many of the initial problems faced by the export takeoff were solved without government intervention. Against the backdrop of the economic crisis of 1982–83, which included a sharp depreciation in the Chilean currency, the economic conditions of the mid-1980s were favorable to the expansion of new exports, and wine was one of the exemplars. As noted, a foreign producer (Miguel Torres) with technological knowledge and marketing networks had already led the way, soon imitated with great success by the leading Chilean producer (Concha y Toro), a firm with big (and increasing) financial shoulders. Some of the coordination problems—such as the supply of steel vats and the availability of quality grapes—were solved by the wine producers themselves and by the demand stimuli that the export takeoff exerted on suppliers of such inputs.

However, export consolidation and growth, and the diversification of export supply, have been influenced by deliberate policy. The wine industry's use of horizontal policy tools (which were aimed at solving market failures and not explicitly at the wine industry) played an important role. Table 5.2 summarizes the government policies and collective actions of the major business associations that contributed to the takeoff of the wine-export industry. The major message of Table 5.2 is that, as in all cases of launching a new industry from practically nothing, the effort involves the solution of a major coordination problem.

An important, if unrecognized, ingredient in the success of Chilean wine exports has been the efforts to keep Chilean vineyards free of disease. The major instrument for this has been Servicio Agrícola Ganadero (SAG), which maintains a strict vigilance of borders and is in charge of all sanitary and phytosanitary issues related to the food industry.[10]

Another important public good has been the negotiation of a large number of free trade agreements by the economic arm of the Foreign Affairs Ministry (Dirección de Relaciones Económicas Internacionales, or DIRECON). Chile now has free trade agreements with all the major consuming countries, including the United States, the European Union, Japan, the Republic of Korea, and China. While this latter country still has a relatively small presence in world markets as a wine importer, the growth of its wine imports has been phenomenal, and its future potential as a market is obvious. In many of these

[10] However, in recent years the wine industry has been adversely affected by a vine disease, *Lobetia bassiana*, apparently brought from Spain.

TABLE 5.2 | Sector-Specific Public and Semi-Public Goods Provided by Government or Business Associations

Public/Semi-public goods	Agency (public/business associations)	How important
Pure public goods		
Technology investment/Ag. research	INIA	Moderately useful
Negotiating FTAs	DIRECON, Ministry of Foreign Affairs	Very useful
Negotiating sanitary agreements	SAG	Indispensable
Protecting natural assets	SAG	Indispensable
Ensuring quality standards	ChileVid, AVC	Very useful
Promoting country image	ProChile; and ChileVid, AVC	Very useful
Semi-public goods/Services with economies of scale		
Training/technology transfer	Programa Chile California 1965–78 (Ford Foundation/U. of Chile/U. of California)	Very useful
Promoting business associations	CORFO	Indispensable
Quality of input suppliers	CORFO: Supplier Development Program	Indispensable
Attendance at fairs in major markets	ProChile	Very useful
Promoting R&D through joint ventures with universities	CORFO: INNOVA; ChileVid, AVC	New program used by AVC and ChileVid

Source: Authors' compilations.
Note: AVC – Asociación de Viñas de Chile (Chilean Wine Corporation); ChileVid – A consortium of small- and medium-sized wine producers oriented toward exports; CORFO – Corporación de Fomento de la Producción; DIRECON – Dirección de Relaciones Económicas Internacionales; INIA – Instituto Nacional de Investigación Agropecuaria; INNOVA – A business firm that conducts research that is directly beneficial to producers; ProChile – Government export-promotion agency; SAG – Servicio Agrícola Ganadero.

negotiations, obtaining access for Chilean wines to target markets figured prominently. For example, Chilean wine exports to the Republic of Korea skyrocketed after the signing of the free trade agreement between both countries in the early part of the 2000s. Today, Chile is the largest supplier of wines to China.

After 1990, the government development agency, CORFO (Corporación de Fomento de la Producción), initiated the creation of Centers for Business Development (Centros de Desarrollo Empresarial). ChileVid, the consortium of small- and medium-sized wine producers oriented toward exports, was originally funded through this instrument. The other major consortium, the Chilean Wine Corporation (Asociación de Viñas de Chile, or AVC), was also created with support from CORFO. These sector organizations have proven to be extremely

important as providers of public goods that are essential to the industry's success in the long run.

For more than 30 years, the government has had an active export-promotion agency (ProChile). Since the early 1990s, the wine industry has been an important focus of its activities. Although the volume of resources spent has not been very large, ProChile has played an important role in organizing wine-tasting events abroad, promoting Chile's image as a wine-exporting country, and providing marketing information to producers. However, a major criticism of ProChile's work has been its lack of success in establishing a strong, positive association of Chile in the minds of consumers, much as Argentina is associated with tango, good soccer, and steak. In the wine industry, Argentine producers have been very successful in positioning their own variety—Malbec—in the consciousness of international consumers, while Chilean producers have been much less successful with their own variety: Carmenère.

CORFO's Proyectos de Fomento (PROFO) program—run jointly with AVC and ChileVid in the wine industry—has also had a favorable impact on the sector. PROFOs are associations of independent small- and medium-sized producers that work together for various purposes, such as technology transfer and joint, foreign marketing. There are sunk costs in these activities that tend to be very large for small producers, who cannot internalize all of their benefits. The associations' objective is to overcome this size limitation. According to Benavente (2006), there are 16 PROFO projects currently being developed in the wine industry.

The wine industry has made extensive use of CORFO's Suppliers' Development Program (Programa de Desarrollo de Proveedores, or PDP). This is a partly subsidized program to help small producers improve the quality of their products so as to be able to meet the demands of larger buyers. Through the PDP, wine producers have been able to get small growers to supply them with quality grapes needed to produce wines demanded in international markets.

Moreover, the wine sector took advantage of a technology-transfer program directed at the agricultural sector in general; this program was designed to create formal links between producers and government institutions such as INIA (Instituto Nacional de Investigación Agropecuaria; see Benavente [2006]).

A recent activity that could be important in the future is CORFO's sponsorship of R&D activities that attempt to bring together business associations and universities in a business firm (INNOVA) that conducts research directly beneficial to producers. The technological innovations would then be sold to member firms. AVC has been awarded about $3 million to set up such a firm

together with two local universities. The total assets of the firm (VINNOVA) amount to about $5 million. The activities include research into consumer tastes and various ways of improving wines (bouquet, aroma, color, presentation, and market positioning).[11] A similar amount has been awarded to ChileVid, which set up a firm in partnership with three universities. The results of these activities will be shared between these two R&D efforts. In 2008, AVC and ChileVid merged into one association: Wines of Chile.

The business associations have played an important role in moving Chilean wine up the quality ladder. They have been involved in relaying to producers key information about the requirements of foreign markets (quality, labeling, types of bottles required, cork specifications, the move toward bottles that are used only once), and organizing the attendance of producers at major wine fairs throughout the world (these trips have been partially subsidized by ProChile and CORFO programs).[12]

Wines of Chile is mainly in charge of marketing the concept of Chilean wine through fairs and other activities, and providing information on foreign markets. The two business associations have now turned their efforts toward the technological innovations required if the industry is to enter into a new, more sophisticated level of development.

The Performance of Wine Exports

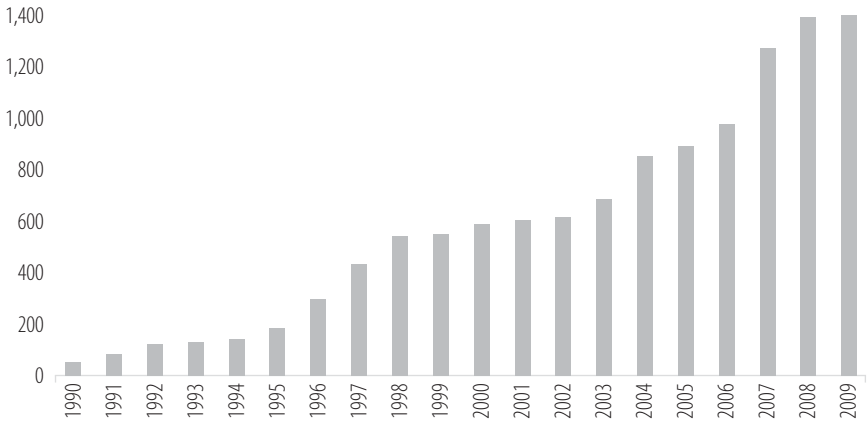
There can be no doubt that wine is one of the great success stories in the history of Chilean export diversification. Since most of the growth in wine exports has taken place since 1990, this discussion concentrates on the period since then. The takeoff in exports began in the mid-1980s and acquired strong momentum in the 1990s. In spite of some ups and downs, strong, long-term growth has occurred almost up to the present. The spectacular growth in current-dollar exports from 1990 to 2008 can be clearly seen in Figure 5.1. In 2009, as the international crisis hit exporters the world over, nominal export value was practically flat, mainly because of a decline in the average price fetched by Chilean wine in export markets.

Export volumes (in millions of liters) have gone up steadily over time (Figure 5.2). Wines with denomination of origin (labeled "fine wine") make up about half of total wine exports; the remainder is ordinary wine (bottled, but

[11] Interview with Ms. Elena Carretero, Chief Executive, VINNOVA.

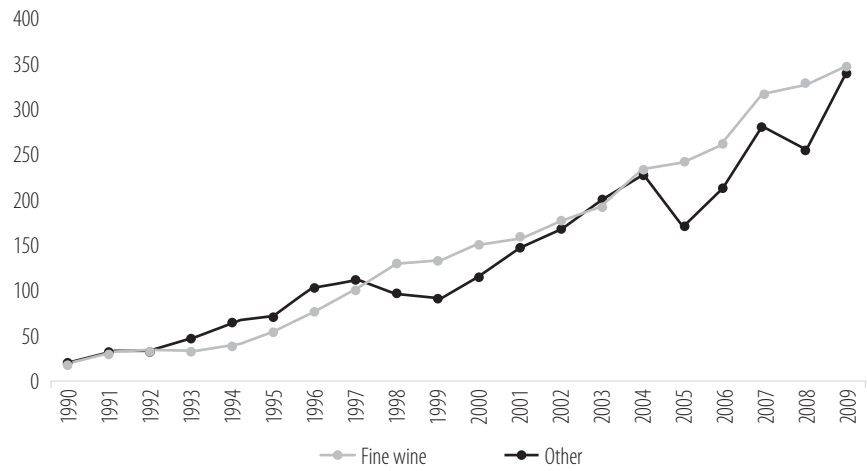
[12] Interview with Mr. Jorge Gutiérrez, Vice President, ChileVid.

FIGURE 5.1 | Wine Exports in Chile, 1990–2009
(Millions of US$)



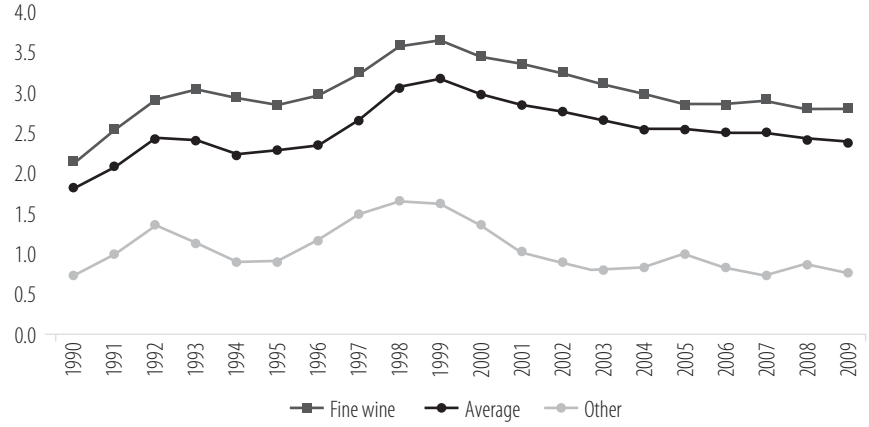
Source: Authors' calculations, based on data of the Central Bank of Chile.

FIGURE 5.2 | Volume of Wine Exports by Major Category, Chile, 1990–2009
(Millions of liters)



Source: Central Bank of Chile, foreign trade database. "Fine wine" refers to wines with denomination of origin; "other" is made up of bottled wine without denomination of origin and bulk wine.

FIGURE 5.3 | Prices for Chilean Wines in 2005 U.S. Dollars, 1990–2005
(Prices per liter, deflated by the U.S. wholesale price index)



Sources: Central Bank of Chile, trade database; U.S. wholesale price index, International Monetary Fund (IMF), *International Financial Statistics.*

without denomination of origin, and bulk wine).[13] In spite of the evident success of the Chilean wine industry, it is symptomatic of the problems it now faces that the growth of fine wines has not been able consistently to outstrip wines of lesser quality, including bulk wine sold under various labels and without indicating Chilean origin.

Price developments for Chilean wines have not been favorable during the 2000s. Figure 5.3 took the dollar prices per liter of fine wines and other wines and deflated them using the U.S. wholesale price index. The results show that Chilean wine prices, in real terms, reached their peak in 1999. Since then, they have been steadily declining. In 2009, stagnation in the value of wine exports was due mostly to price decreases. While volumes kept expanding in the categories of fine wine and other wines, fine wine prices were constant and prices for ordinary wines fell.

The main reasons for the decline in the average real price of Chilean wine exports during the 2000s can be attributed to two factors, one of which has already been mentioned. First, despite the sharp increase in exports, the mix of Chilean wine exports has not shifted decisively toward finer wines; nondescript and bulk wines still account for about half the total liter volumes. Second,

[13] These two broad categories constitute over 95 percent of all exports. The remainder is made up of spiced wines and sparkling wines.

even among wines with denomination of origin, Chilean wine exports are still dominated by brands that are considered good value for money and which sell for under $10 at the retail level, where competition from a growing number of countries (Bulgaria, Hungary, Israel, Romania, South Africa, and Turkey) has led to price stagnation or decline.

Chilean winemakers and their foreign marketing partners have not been able to position their wines in higher niches commanding higher prices. This, of course, does not mean that Chile has non-premium, super-premium, or icon wines. Aurelio Montes, winemaker and owner of Montes, a medium-size winemaker, was the first to dare to sell a wine in the United States for over $10 a bottle, and his wines are now selling the world over in the premium and super-premium categories. With the Baron Philippe de Rothschild Company, Concha y Toro produces Almaviva, which retails for about $100 in specialty stores in the United States. But these examples constitute exceptions showing what Chilean wines can aspire to become.

The Challenge from Argentina

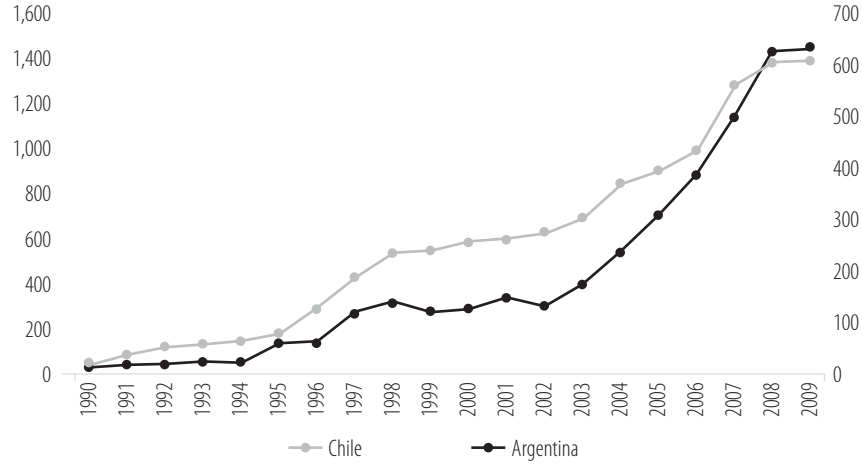
Argentina had a late start in wine exporting. As late as 2002, Argentina's total wine exports totaled only $125 million, compared to Chile's $610 million.[14] Since then, Argentina has been closing the gap fast. The jump from 2002 onward has been spectacular, with exports reaching $631 million in 2009—a fivefold increase in exports since 2002—which works out to an annual growth rate of 25.5 percent. The comparable rate for Chile is about half that: 12.4 percent. The sharp upturn in Argentine wine exports is readily compared to the more modest (but still impressive) export performance of Chilean wines over the same period (see Figure 5.4). To put these figures in context, Argentine wines are at a lower stage in their export development as compared to Chilean wines, and this makes for faster rates of growth.

Argentine average wine prices are still below those obtained by Chilean producers (see Figure 5.5). Nonetheless, average prices for Argentine wines have increased by two to three times in real terms since the mid-1990s, while prices for Chilean wines today are at the level they were 15 years ago. As noted, Chilean wine prices have also experienced a steady decline since 1999.

The uptrend in Argentine average prices is the consequence of market forces and a deliberate strategy of Argentine wine producers of improving

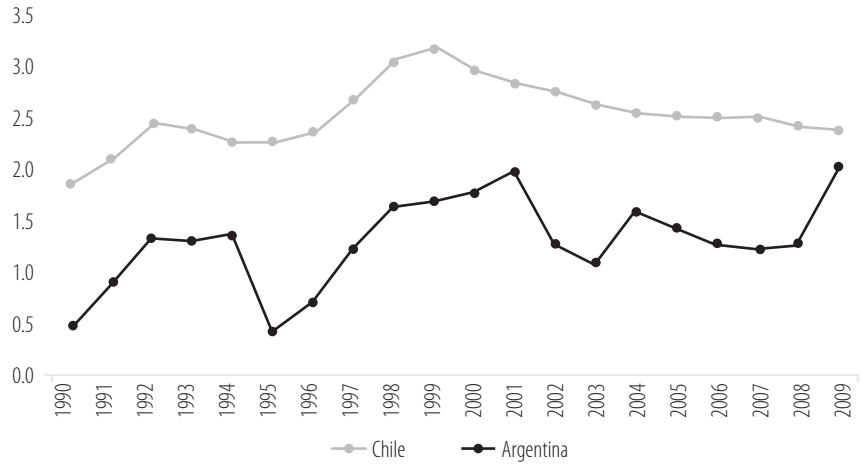
[14] Figures from Argentina's Instituto Nacional de Vitivinicultura.

FIGURE 5.4 | Chilean and Argentine Wine Exports, 1990–2009
(Millions of US$)



Sources: Central Bank of Chile, trade database; and Instituto Nacional de Vitivinicultura, Buenos Aires.

FIGURE 5.5 | Wine Prices, Chile and Argentina, 1990–2009
(In 2005 US$ per liter)



Sources: For Chile, Central Bank trade database; for Argentina, Instituto Nacional de Vitivinicultura; U.S. wholesale price index, used as a deflator for nominal prices, from IMF, *International Financial Statistics.*

the quality of exports and reaching into higher-value market segments. Since 2002, after the depreciation of the Argentine peso, which raised the profitability of exports, the real exchange rate has appreciated, partly as a consequence of an inflation rate that has exceeded international inflation and a policy of the central bank to prevent nominal depreciation. This has rendered the cheaper wines uncompetitive in international markets and encouraged producers to seek to export higher-priced products. On the other hand, Argentine producers have made deliberate efforts to cultivate the international image of their wines and of the country's strongest varietal (Malbec), so far with significant success.

Argentine Malbec shares with Chilean Carmenère the fact that rootstocks were brought to their respective countries before the phylloxera disease hit the French wine industry in the middle of the nineteenth century. In fact, Carmenère has practically disappeared from France. French Malbec is circumscribed to the Cahors region, where it is the main grape and is used in blends in Bordeaux. But, whereas Argentine producers and their organizations have worked hard to position their Malbecs in international markets, Chilean producers have sought to diversify their bets, concentrating on a wider number of traditional varietals with international recognition, such as Cabernet Sauvignon, Merlot, Sauvignon Blanc, and, lately, Syrah and Pinot Noir. The reasoning has been that international tastes change and producers are afraid of being stuck with a wine that is no longer in favor with consumers.[15] Whether the Chilean or the Argentine strategy is best, time will tell. The fact is that, while Carmenère exports in 2009 totaled only $67 million—less than 5 percent of total Chilean wine exports—Malbec, blends of Malbec, and Syrah represented 43 percent of the value of Argentine wine exports.[16] It should be noted that Australian and South African wines, like Argentina's, are best known for their unique varietals (Shiraz and Pinotage, respectively), even though they export a wide array of wines made from many different varietals and blends.

The average price increase of Argentine wines has been very significant and symptomatic of success in positioning the industry in higher-value segments of the international markets. The shift to higher-priced wines was

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[15] An opinion expressed by Eduardo Agosin, a well-known Chilean expert.

[16] Chilean export figures from the ProChile database. For Argentine exports, see Exportaciones Vitivinícolas de Argentina 2009 and Vinos de Argentina 2010, elaborated by Caucasia. Available at http://www.winesofargentina.org/estadistica/exportacion/.

particularly remarkable in 2009, when the average price rose by 48.7 percent, more than compensating for the sharp fall in export volume (31.7 percent), because of a widespread drought.

However, Chilean wines are still ahead. In a revealing sign of the financial and technological strength of the Chilean wine industry, a growing number of Chilean producers have started investing in Mendoza—Argentina's principal wine region—right across the Andes from Santiago. Concha y Toro set up Viña Trivento as far back as 1996. It was followed by Santa Rita in 1997, San Pedro in 1999, Montes in 2002 (which produces Kaikén, a super-premium Malbec), and, more recently, by Viu Manent. Chilean oenologists have been teaming up with their Argentine counterparts in these ventures. But the capital remains firmly in Chilean hands and there are no reports of joint ventures between Chilean and Argentine producers. Recent figures show that 18 percent of Argentine wine exports are produced by Chilean-owned vineyards.[17]

The major attractions for Chilean winemakers have been the favorable, and different, *terroir* found in Mendoza; the potential for adding Malbec-based wines to their export portfolios; and, in the 2000s, the low price of land in Chilean pesos, owing to the appreciation of the Chilean currency and the strong depreciation of the Argentine peso following the debt default of late 2001. Even though the Argentine peso has strengthened in real terms since the sharp depreciation of 2002, the appreciation of the Chilean currency has been even sharper.

The Future of Chilean Wine

The Exchange Rate: An Inconclusive Debate

The sharp currency appreciation since mid-2003, briefly interrupted by the international financial crisis in 2008, was cited as being a very negative factor by practically all the wine executives interviewed. At present, the exchange rate is being influenced by the record-high levels of copper prices and export volumes. Wine exports are already being hit. Several smaller wineries have gone out of business, and the industry has undergone a consolidation.

In addition to the current squeeze on new exporters because of exchange rate appreciation, the problem of the exchange rate goes further. Chile is one of the countries with the highest degrees of real exchange rate volatility in the world. Not only is the exchange rate volatile, but its swings

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[17] Available at http://www.lanacion.com.ar/nota.asp?nota_id=1062702.

have a great deal of persistence. By introducing noise into investment decisions, this volatility may be as adverse a factor as the overvaluation that occurs in any given period.[18]

Over time, monetary authorities have wavered between a "productivist" view of the exchange rate and a more conventional, "financialist" view. The first view emphasizes the use of the exchange rate to assist structural change, basically toward new exports. Those who adhere to the financialist view—who are the most vociferous and numerous—appear to believe that the real exchange rate is not a policy variable, as it depends on fundamentals over which policy has no control.[19] The current, conventional wisdom is that the best exchange rate regime is a free float, which allows monetary authorities to adopt an "inflation-targeting" approach to monetary policy. A more pragmatic approach, balancing the need to control inflation with that of encouraging structural change, seems to be called for in an economy that is still struggling to modernize its production structure and market institutions. The continued profitability of new exports in general, and of wine exports in particular, may well depend on who wins this debate.

R&D, Product Differentiation, and Product Uniqueness

Chilean wine exports are at a crossroads. The adoption of production technologies available in more advanced producing regions (e.g., steel vats, standardization of the production line, assurance of quality grapes, and marketing techniques) have already yielded the results that could be expected of them. Associations with foreign partners have brought knowledge of production techniques and international market preferences. However, Chilean wine is stuck in a market niche ("good value for money") from which it is finding it

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[18] The conventional riposte to preoccupation with the exchange rate would be to recommend the use of futures to hedge for exchange rate appreciation. However, there are no long-dated derivative markets in most countries, and certainly not in emerging economies. Only these would be suitable to investment decisions that tie up capital for several years. These restrictions are particularly applicable to an industry dominated by medium and small producers.

[19] The debate is largely semantic, since changing the nominal exchange rate is ineffectual in affecting the real exchange rate, at least in the long run. But the authorities can affect fundamentals by, for example, using time-varying capital controls, or, in current circumstances, dampening exchange rate appreciation by investing abroad the large increase in copper profits of the state-owned mining giant, CODELCO.

difficult to exit. Moreover, competition in this segment is becoming stiffer. Success in the international wine market for an established producer such as Chile requires strongly differentiating products and appealing to specific qualities that products from Chile may have. Efforts at improving quality and positioning products in higher-value market segments are also essential.

For example, Chile has done little to market its unique variety: Carmenère. But research into this varietal is lagging, and Chilean producers have done little to put out new blended wines with some of the excellent reds that Chile is already producing, such as Cabernet Sauvignon or Syrah. To give another example, Chilean Sauvignon Blanc wines are probably among the best in the world. Again, efforts to position this varietal in international markets have been feeble or nonexistent. New Zealand has done a much better job with this varietal, while Chilean Sauvignon Blancs have nothing to envy their New Zealand counterparts.

Expenditure on R&D is crucial for the next stage of Chilean wine development. The tasks are to improve a certain number of features of Chilean products (e.g., lowering their high alcohol content, improving aroma and distinctiveness, and experimenting with blends) and position Chile's unique wines in higher-price niches.

This new stage will require the collaboration of the industry and the public sector. Government support for R&D has been well-intentioned, but the amounts of financing are too feeble (a few million dollars here and there) to have an impact on an industry that sells almost $1.5 billion worth of wine in international markets. A new tax deduction of 35 percent of R&D expenditures, when undertaken with universities or research centers, has proven too cumbersome to use effectively. It is time that the government and the industry understood that the future lies in product improvement, successful product differentiation, and product recognition at the consumer level.

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CHAPTER 6

Market Failures and Free Trade: Hass Avocados in Mexico

Edgar Aragón

In the past two decades, avocados have grown steadily in the world market and are now considered part of the everyday diet of many countries, rather than an exotic fruit. This trend has been reinforced by the increasing popularity of natural products. Avocado, sold mainly as a fresh fruit, is the main ingredient of guacamole, which is used in salads and dips. Consumption of avocados is recommended to help lower cholesterol, and processed avocado oil is used in the pharmaceutical and cosmetics industries. Worldwide, Mexico is the largest consumer and grower of avocados and, more recently, the largest exporter of avocados.[1] Mexican exports grew from less than $1 million in 1985 to $34.5 million in 1995, and to $620.8 million in 2007 (World Trade Atlas, 2006; FAOSTAT, 2010).

This study uses two complementary methods to explore how avocados emerged as a new, successful export activity in Mexico. First, it describes how Mexican companies, local associations, and governments dealt with market failures (externalities, coordination failures, and the existence of public goods).

[1] The oldest evidence of avocados in Mexico, dating from 10,000 B.C., was found in a cave in Coxcatlán, Puebla. In colonial times, the Spaniards introduced the avocado to the rest of the Americas and to Europe. Between 1950 and 1970, avocado growers in Mexico began planting diverse avocado varieties such as Fuerte, Bacón, Rincón, Criollo, and Zutano.

Then, to highlight the factors that contributed to this success, it compares the case of avocados with a counterfactual case similar to it in many respects, but ending in failure (mangoes).

Fieldwork took place mainly in the avocado-producing state of Michoacán, in central Mexico, between August 2006 and January 2007, and open-ended interviews were conducted with local growers, exporters, heads of nongovernmental organizations, government officials, and one industry consultant. A final round of consultation was conducted in August and September 2010 to assess potential threats to the competitiveness of the industry.

Avocados and the State of Michoacán: A Strong Marriage

The state of Michoacán in Mexico offers some comparative advantages for the cultivation of avocados, especially climate and soil features that allow the trees to produce year-round.[2] A belt across the state possesses the bioclimatic requirements well suited to growing avocados. Michoacán's avocado belt (86,000 hectares) is located in a volcanic area 1,600 meters above sea level, stretching across 20 municipalities, the largest of which is Uruapan. This belt contains volcanic soil consisting of deep, clay-like earth rich in organic substances; it is rich in iron, aluminum, and potassium—most important for avocado cultivation. The belt also has the correct level of humidity and an adequate climate for harvesting avocados. Avocado production requires a great deal of water. In Michoacán, where only about half the orchards have irrigation systems, abundant rainfall gives Mexican growers an advantage in lower water costs compared with other countries. In the areas visited, the orchards required relatively little maintenance, the fruit withstood neglect, and the trees continued to produce.

Michoacán avocado growers benefited early on from genetically improved varieties, which are rich in taste and resistant to disease and extreme weather. In the mid-1950s, a small group of entrepreneurs established the first nurseries of improved avocado varieties, including Fuerte, in the town of Uruapan. During this time, Rudolph Hass, a California mail carrier and amateur horticulturist, developed a stronger avocado variety from Guatemalan trees, whose fruits lasted

[2] The avocado is a fruit that belongs to the Lauraceae family and the species *Persea gratissima* or *Persea americana Mill*. Perhaps the most important feature of the plant is that the fruit does not mature right away on the tree. Avocados can remain unspoiled on the tree anywhere from four to six months, and they will be ready for consumption a week or two after being cut. The tree acts as a natural warehouse.

longer and were more resistant to disease. California's cold weather increased the resistance of Hass and Fuerte plants. In 1957, after the Hass patent had expired, the Uruapan nursery owners introduced these varieties to the region of Michoacán, and they continued to be improved in their nurseries. For example, Vega Vega, an Uruapan grower, imported 5,000 plants from California and created 25,000 more plants under local conditions. Having witnessed the positive reaction of the Hass variety to Michoacán weather, many local growers began to switch from Fuerte and native varieties to the improved Hass variety. Half a million plants were produced and sold in Mexico during this time.

Public efforts were also made to afford small growers access to improved avocado varieties. The state of Michoacán set up nurseries to reproduce avocado trees, starting with 20,000 certified plants from Santa Paula, California. By 1965, the Michoacán State Forest Commission had begun offering free trees to small growers in rural communities throughout Michoacán. As a result, the Hass variety became a strong competitor to the Fuerte and Criollo varieties for the national market.

From an economic point of view, the state nurseries helped to further develop a public good whose benefits spread across Michoacán through the action of private and public institutions. By the late 1960s, Mexican consumer preferences were shifting slowly toward Hass, providing the consumer demand that resulted in a dramatic expansion in Hass avocado orchards in Michoacán. The cultivation area increased from 3,700 hectares in 1970 to 80,000 hectares in 2003. Production increased from 40,000 tons to 1 million tons in the same period. Mexico became the world's largest avocado grower and consumer.

The avocado boom was known regionally as the time of "green gold," and had its first peak in the mid-1980s. The boom effected an important change: The growers with larger farms gradually replaced coffee, banana, lemon, mango, and guava plantations with avocados. At the beginning of the 1980s, new industries and activities developed in tandem with the cultivation of avocados. Picking became specialized. Plants were built for packing fresh avocados, and for manufacturing avocado products such as guacamole paste and avocado oil. Avocado exporters emerged. Avocado production represents 62 percent of agricultural production in Michoacán. According to 2003 figures, avocado production generates 47,000 direct jobs, 70,000 seasonal jobs, and 187,000 indirect, permanent jobs in Michoacán.[3]

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[3] See http://www.aproam.com/. Indirect jobs relate to packing, transport, sales, and technical services.

As noted, Mexico has become the world's largest producer, exporter, and consumer of avocados. Worldwide avocado production in 2008 was 3.6 million tons (FAOSTAT, 2010). Approximately 69.5 percent of this production is concentrated in 10 countries; Mexico's share represented 31.6 percent of total production, or 1.1 million tons, followed by Chile, Indonesia, Colombia, Brazil, and Peru (FAOSTAT, 2010). Peru is the newcomer, with a production of 0.14 million tons in 2008. World exports reached $1.4 billion in 2007; 44.3 percent was exported by Mexico, with a value of $620.8 million.

The main importer of avocados is the United States, whose imports represented 41.6 percent of the world's total, or $553.7 million, in 2007. Most of the U.S. imports (80.2 percent) came from Mexico, reaching $443.9 million that year. Mexico is also the main consumer of avocados, with annual consumption of around 832.6 thousand tons, followed by the United States, with 532.4 thousand tons.

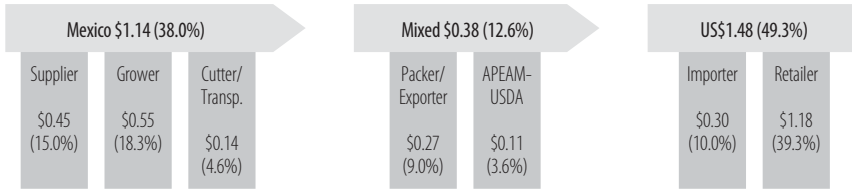
The normal transport of avocados is by sea, which keeps transportation costs low and maintains good quality.[4] In Michoacán, Mexico, there are 6,256 registered growers, 9,058 avocado orchards, and 34 packing plants/exporters certified to export to the United States. In addition, there are 14 industrial firms that process the avocados into guacamole, pulp, halves, frozen products, beverages, and unrefined oil.

Figure 6.1 shows the traditional production and export chain from planting and other production costs through final sale to the customer. For example, in the United States, the final customer pays $1.00 per avocado, or $3.00 per kilogram. Of this, $1.18 (or 39.3 percent of the total value) goes to the retailer or supermarket; $0.30 (10 percent) to the importer; $0.11 (3.6 percent) to export services such as APEAM (Avocado Producers and Export Packers Association of Michoacán) and the USDA (U.S. Department of Agriculture) certification and promotion fees, professional fruit harvesting services, and transportation costs; $0.27 (9.0 percent) to the exporter or packing plant; $0.55 (18 percent) to the grower; and $0.45 (15 percent) to other production costs such as planting, irrigation, and fertilizers. In this traditional chain, Michoacan's cumulative value added amounts at least to $1.14 per kilogram, or 38 percent of the final value. This percentage increases when the packers/exporters are also Mexican.

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[4] For the Hass and Fuerte varieties, for example, sea transportation is recommended in containers refrigerated at 5°C to 6°C in a controlled atmosphere, and with a transit time of 22 to 24 days. Air transportation of avocados is profitable only in exceptional cases, such as when demand is high in an undersupplied market (AGEXPRONT, 2004).

FIGURE 6.1 | Value Added at Each Stage of Production and Export of Mexican Avocados
(Percentage and dollars per kilogram)



Source: Authors' calculations based on interviews.
APEAM – Avocado Producers and Export Packers Association of Michoacán
USDA – U.S. Department of Agriculture
Note: "Mixed" refers to the fact that a significant number of exporting firms operating in Mexico are American-owned, but not all. Likewise, both Mexican and U.S. institutions offer export services. Thus, the value added is generated in Mexico by a mix of Mexican and U.S. firms and institutions.

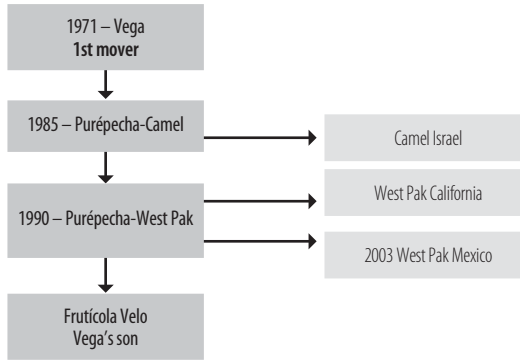
First Movers

Leopoldo Vega

The first avocado exporter was Leopoldo Vega, owner of the Purépecha Group. His export activities began in October 1970, when he successfully sent two containers by ship to Rotterdam (see Figure 6.2). Vega, born in 1935, came from a family of agricultural growers (wheat, corn, and beans) and cattle raisers. When he was a child, the family farm had several avocado trees to provide shade for the coffee plants. At 16, Vega began working in an uncle's firm—Limones de Michoacán—growing lemons, melons, watermelons, and cotton. In the early 1960s, he started the Purépecha Group, farming avocados with the improved varieties. He started his own avocado nursery, and in 1962 and 1965, he planted Fuerte and Hass avocado varieties. Later, Vega set up operation of the first mechanical packing equipment in the region, acquired from the agricultural state of Sinaloa. The main objective of the Purépecha Group was not to export, but to sell to the local market. Due to the size of the Mexican market, the main goal of the Purépecha Group was to capture the Monterrey and Mexico City markets. Its first promotion campaign was carried out in the 1970s through what was the only commercial chain at the time: Comercial Mexicana; it was followed by television advertising on the popular Raúl Velazco Show on Channel 8.

Vega made his initial export contacts through the Mexican Institute of Foreign Trade (Instituto Mexicano de Comercio Exterior, or IMCE) and the

FIGURE 6.2 | Vega's Purépecha Group, 1971–2006



Source: Author, based on interviews.

Mexican Export Promotion Bank, now called Bancomext. IMCE covered 50 percent of an exporter's promotion expenses abroad. Technical assistance and production loans were granted at discounted rates by FIRA, the central bank's branch for agricultural support.

The logistics of the Purépecha Group's first shipment were organized by Adalberto Palma, assistant to Agustín Legorreta, the president of the largest private Mexican bank (Banamex), and a friend of Vega. One container was sent from Veracruz port into the Gulf of Mexico and the other a week later from Houston, Texas, perhaps to diversify the risk. Both containers arrived at the same time, in Rotterdam. Although the client was located in Paris, Vega saw the opportunity to sell the fruit at auction in Rotterdam at $2.00 per kilogram more than the price agreed upon with the client in France.

From 1971 until the peso devaluation in 1976, Vega exported avocados to France. The 1976 devaluation, however, hindered avocado exports because the federal government maintained strict control of peso-dollar exchanges. Vega was required to sell the dollars obtained through exports to the Mexican government at a discount, only to repurchase them at a higher price in order to make the payment to the shipping firm. Devaluation and currency controls stopped Vega's exports.

The real export incentive for Vega came in 1985 when the Israeli Agrexco Corporation supported his efforts to export avocados throughout Europe.[5] The

[5] Vega also tried unsuccessfully to export fresh flowers to the United States.

contact with the firm came through an Israeli engineer who visited Mexico to obtain information and seeds for plants that could grow in dry, salty soil. The engineer met with Sánchez Colín, former governor of the state of Mexico and founder of the research institute of the same name,[6] who in turn introduced him to Vega. In return for his help, Vega obtained marketing assistance and information about clients in Europe, which led to a considerable increase in exports.

The Purépecha Group tended to be self-reliant, avoiding partners and business associations. The exceptional alliance with the Israelis was probably successful because avocado production in Israel and Mexico is complementary. Israel's avocado trees hit peak production from October to April, with Hass trees producing from December to April and ending right when Mexico's production starts. In 1990, the Purépecha Group established another business agreement with West Pak, a California-based, foreign corporation that bought avocados in Mexico for sale in Europe and Japan.

Cooperative Socopaum's Trial-and-Error Strategy

Ten years after Vega sent two avocado containers to Rotterdam, a cooperative of growers started export efforts again, from scratch. In 1977, Cooperative Socopaum was founded in Michoacán by a group of 30 growers. Its original objective was to break the informal monopsony created by local buyers, who until that point had artificially kept avocado farmgate prices down. Having succeeded in stabilizing prices at a 20 to 30 percent higher level, Cooperative Socopaum received an unexpected visit from Agrexco, a public-private Israeli consortium that decided to supply its European clients with Mexican avocados. Israel had suffered from extreme heat that year and lost 80 percent of its avocado crop. Striving to maintain their client bases, Israeli firms such as Agrexco and Hillroom were looking for suppliers in Mexico. However, they were surprised to encounter the austere packing systems and plant facilities of Mexican avocado growers, who lacked even cold rooms for the fruit. Hillroom made an unsuccessful attempt at exporting and Agrexco canceled the project, giving up the idea of transporting Mexican avocados to Europe in jumbo jets.

With no feedback from Vega, Cooperative Socopaum started exporting to Europe in 1980 (Figure 6.3). Intrigued by the idea of exporting avocados to

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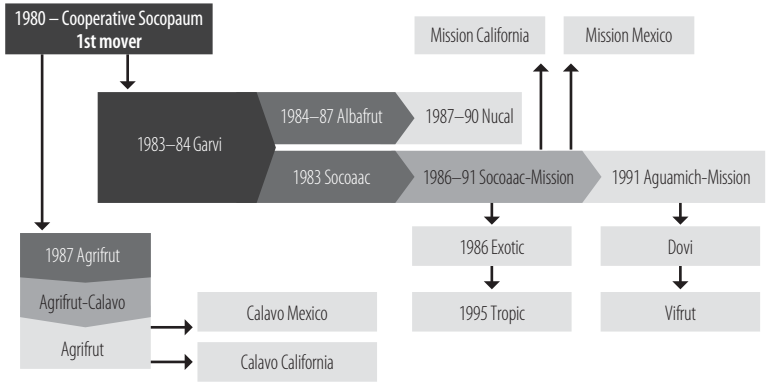
[6] Fundación Sánchez Colín CICTAMEX, S.C., Centro de Investigaciones Científicas y Tecnológicas del Aguacate en el Estado de México.

Europe, Socopaum members found Pascual Hermanos, a Spanish importer with clients in France. Originally from Valencia, the Pascual brothers had experience in handling citrus, such as oranges and lemons, and they were willing to try something new. In November 1980, Socopaum successfully exported two containers to Europe. Perhaps it was good luck, but with the cold weather, the high quality of the avocados, and the right moment in the year, Socopaum sold the fruit at higher prices than expected. Socopaum members decided to begin exporting in part because of Europe's high demand, and also because they were interested in diversifying their customer base. A 1977 forecast study by FIRA, the central bank's agricultural arm, predicted a fall in domestic prices due to the increasing number of avocado farms in Mexico. Both the optimistic news brought by the Israeli firms regarding Europe's avocado demand, and a pessimistic study of the domestic market, triggered Socopaum's exports.

Tempted by the early success, Socopaum members sent 18 containers (540 tons) to France between January and February of the following year. The operation was a failure, largely because of Pascual Hermanos' limited experience in handling avocados. At that time of the year, avocados from Israel and Spain were already in the market, and much of the fruit in the 18 containers was improperly packed.

Early avocado exporters faced three major difficulties when exporting to Europe, according to Ramón Paz, an industry consultant and former exporter. First, the fruit had to arrive fresh for the European consumer, after being shipped from the West Coast of Mexico, through the Panama Canal, and across the Atlantic Ocean, without using temperature-controlled facilities (the whole

FIGURE 6.3 | Cooperative Socopaum and Its Imitators, 1980–2006



Source: Author, based on interviews.

operation took 17 to 18 days, versus five to six days when shipped from Israel). Second, some technical difficulties had not yet been resolved, such as the black spots that appear on the fruit because of cold temperatures during transportation. Lastly, new Mexican exporters had no experience in negotiating fixed-price contracts with European importers, who prefer to sell "on consignment". Adapting their strategy to the local market circumstances frequently resulted in large losses for the Mexican firms.[7]

After the failure, Cooperative Socopaum decided to establish a committee to research the necessary elements to ensure they would be well prepared for exporting. The committee was formed by three of its most active members: Salvador García, Adolfo Barragán, and Carlos Illsley. Both García's and Barragán's families were in agribusiness. García's family came from Zamora, Michoacán, where they cultivated and exported strawberries. García was part of the third generation of strawberry growers. He had immigrated to Uruapan (a three-hour drive from Zamora) to start an avocado farm. Barragán's family was also from Michoacán. They cultivated melons in Apatzingan, Michoacán, and pineapples in the state of Oaxaca.

Illsley's background was a little different. Although he was born in Michoacán and attended school in Uruapan with the sons and daughters of avocado growers, he spoke perfect English, had traveled extensively, and maintained a rich network of international contacts. Illsley's father, an American economist and World War II veteran, was interested in the development of local firms in China and Mongolia. He retired in Mexico and acquired an avocado farm in 1964. Illsley's mother, an American freethinker of the 1960s, was interested in Mexican local customs and traditions. She and her husband set up a cooperative in Uruapan to run, and save from demolition, a textile plant dating from the 1880s. In 1974, Illsley bought a commercial avocado farm and joined the group of growers.

While conducting the review of how to prepare Socopaum for exporting, Illsley met an Israeli engineer who came to town with a Colombian delegation working on Michoacán's cut-flower export project. The engineer provided him with the business information of a firm that had set up several avocado

[7] In the European market, 85 percent of the fruit and vegetable commerce is carried out on consignment. European importers sell the merchandise under the shipper's account, and the grower's final payment reflects product quality and market conditions at the time of the purchase. The importer then deducts 8–10 percent commission, as well as transport costs, tariffs, customs-inspection costs, taxes, and so on, diminishing the final amount the exporter receives.

packing plants in Israel. Representatives of the Israeli firm visited Mexico, and after meeting with the committee, they struck a $25,000 deal to acquire a business plan with plant specifications and machinery. When the plan was presented to Socopaum members, the businessmen believed the project was too costly and voted against the deal. At that point, García, Barragán, and Illsley committed to undertake the task by themselves, and headed to Israel to research Israeli packing plants and their avocado export operations.

What the three men learned in Israel ultimately shaped Michoacán's avocado industry. Among the major innovations on the packinghouses observed were:[8]

- Packing machinery that selected avocados by weight, with electronic scales, and classified each individual avocado. Up to this time, Michoacán's packing plants had relied on experienced female workers who selected and classified the fruit without using scales;
- Precooling and cooling systems to keep the temperature of the fruit constant from the moment it was packed to the time it reached the client. Although the trip from Israel to Europe by sea lasted at most six days, the cooling systems could maintain the fruit's condition much longer, which was ideal for trips across the Atlantic Ocean;
- Harvest systems for collecting the fruit on-site. The procedure allowed the labor force to be concentrated in the process of harvesting the fruit rather than in handling it. The fruit in Israel was collected in half-ton containers that were manipulated by lift trucks. The fruit was better preserved than with the 20- to 30-kilogram plastic boxes then used in Mexico. When the Mexican plastic boxes were stacked, they crushed the fruit, and the plastic boxes were easily stolen;
- Statistical analysis on the historical production of each avocado plot. Records were kept for each farm, along with the most recent production forecasts.

García, Barragán, and Illsley supplied the initial investment for the business plan to set up a packing plant with modern machinery. On their return to Mexico, they decided to pursue the export project. The total necessary

[8] Innovations did not focus on the cultivation methods that could improve production yields per se. Israeli packinghouses are sophisticated in matters of weighing, packing, and cooling avocados, not in growing them.

investment reached $2.8 million, which required that they establish a new firm and invite new investors. Unfortunately, the 1982 debt crisis and devaluation put a halt to the project.

Four years later, Barragán and Illsley founded their own separate firm, called Agrifrut (García had already left the group; see next section). Barragán and Illsley invited two new partners into the new enterprise: Jorge Fernández and Pascual Gally. Fernández's entrance was indirect. He was first hired to construct the packing plant, and then became a partner when Barragán failed to remunerate him for the construction and offered him stock instead. This carried several repercussions for the new firm because Fernández, a civil engineer and construction contractor, lacked experience in the avocado industry. Other potential partners canceled their contributions when Fernández became a partner. Illsley introduced the project to Gally, a Swiss engineer who was in the region because of the fresh-flower-to-export project. Gally liked the avocado business plan and joined the group, providing fresh capital and new marketing channels in Europe. In Switzerland, his family had import-export enterprises.

In 1987, the firm Agrifrut began operations with the first exporter, Carlos Illsley, and the two newcomers, Fernández and Gally (see Figure 6.3). Agrifrut acquired the Israeli business strategy and equipment as planned. Gally opened an importing firm in Switzerland—Sunfresh—to buy avocados from Agrifrut. Sunfresh would then resell the fruit to other Gally family enterprises, acting as an intermediary. For the partners, Sunfresh represented an additional cost because it only received the fruit; however, Sunfresh was selling 26 avocado containers (520 tons) per week throughout Europe. When Illsley and Gally left the firm, Fernández took over Agrifrut, and remains its chief executive officer.

For Agrifrut, the avocado business learning curve was steep. The firm had to perform the following tasks almost simultaneously:

- Learn how to make pallets for boxes;
- Learn the cooling process;
- Determine how to transport the fruit by sea for 18 days;
- Deal with technical problems (e.g., black spots on the fruit, which was still not resolved, although it is now preventable);
- Reach the distribution platforms of clients;
- Learn about product presentation (e.g., 4-kilogram boxes, such as those used in South Africa);
- Deal with being a one-product supplier versus selling several products;

- Take the risk and accept the price of the fruit when the containers reached Europe[9];
- Work with the structure of the firm (e.g., partners with different backgrounds and interests).

Imitators Go after the Feast

Right before the trip to Israel, Salvador García de Alba invited his friend Antonio Villaseñor to join the group. Villaseñor, who would become a large exporter himself, did not have experience in agribusiness; he ran a furniture store, but possessed good business sense. Although Villaseñor did not join the business mission to Israel, he covered his share of the cost in order to buy into the business. Due to differing interests, Villaseñor and García split from the rest of the group. Villaseñor and García then founded the Garvi firm (see Figure 6.3) and adopted the business plan to set up a packing plant.

Garvi was the first modern packing plant set up in the state of Michoacán intended principally for exports.[10] Garvi's owners, who even set up their own "Garvi" brand, exported the fruit to Pascual Hermanos, Socopaum's former client in France.[11] José María Pascual, one of three brothers who founded Pascual Hermanos, came to Mexico and personally supervised the operations. However, the firm experienced some problems with the shipments. Although some arrived well, others did not. The main technical problem seemed to be the previously mentioned black spots that appeared on the fruit when changes in humidity and temperature occurred. Other reasons might have included Pascual Hermanos' lack of experience in selling avocados on consignment. The losses were too great to be shouldered by two people. As a result, Garvi closed down a year later, in 1984. García kept title to the land and the building, and started a third firm named Albafrut (see Figure 6.3). Villaseñor kept the machinery and joined the Socoaac Cooperative.

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[9] That is, not selling it at fixed price that otherwise would allow the exporter to know his profit margin when buying the avocados from the Michoacán growers, as in the case of exporting to the United States and Japan.

[10] Another packing plant, La Tarazca, started operating near Morelia, the state capital. It was even inaugurated by the then state governor and former presidential candidate, Cuauhtémoc Cárdenas. La Tarazca did not export because the domestic market was rather strong; all production was sold domestically.

[11] Pascual Hermanos was later sold to Chiquita.

García's newest firm, Albafrut, came to a tragic end. After three years of operation, the firm was bought by Jewish Iraqis established in Switzerland. Mr. Sushnani, an Israeli technician, and Abraham Cohen, a retired general, ran the new firm, which they renamed Nucal, or New California. In 1990, one member of the board, who was personally involved in the Iran–Contra scandal, died in a plane crash. This episode was known internationally as the "Guacamolegate". The firm did not pay its debts, and ultimately the plant was turned over to the workers and creditors, mainly avocado growers.

Villaseñor's new venture had better luck. Socoaac (Sociedad Cooperativa de Agricultores de Aguacate del Cupatitzio) was formed by a group of 20 new growers in 1983 (see Figure 6.3). The following year, Villaseñor joined the group and sold them the machinery acquired in Israel. Socoaac bought it through a credit from Bancomer, a private commercial bank. The same year, Socoaac became a limited liability company—a private, rural firm—and Villaseñor sold his furniture store to acquire Socoaac stock. Villaseñor became the firm's general manager, and by 1985, Socoaac began to sell avocados in the domestic market.

In 1986, Socoaac received a visit from Mission, a California-based avocado corporation that was interested in indirectly exporting Mexican avocados. Socoaac-Mission exported avocados to Rotterdam to a new firm called Exotic, run by François Teisstre, a former fruit dealer in a French corporation with experience in handling avocados from Israel. Socoaac-Mission shipments increased from one to three containers per week (from 20 to 60 tons) to between three and six containers per week (between 60 and 120 tons). Six months later, Socoaac-Mission started exporting one container per week to Japan.

The relationship with Mission formalized and expanded Socoaac's knowledge of the packing and exporting processes. The diffusion of knowledge was carried out through Mission's local manager, Ezequiel García, who was working full-time in the operations section of Socoaac's packing plant. When García had doubts or questions, he would forward the question directly to Mission's headquarters in California. Thanks to García's follow-up, dramatic improvements were implemented in Mission's Mexico plant. These included:

- Changing harvesting tools to improve quality;
- Establishing uniform weight classes for the avocados;
- Using waxed boxes that are impervious to humidity;
- Affixing plastic corners to secure the boxes in the pallets;
- Utilizing precise wood platforms for pallet bases;
- Storing fruit in cold rooms after packing, rather than after harvesting;

- Maintaining cold rooms at a specific temperature;
- Negotiating fixed-price contracts with importers.

Exporters needed to buy the fruit not only from their own orchards, but from other growers to fulfill export demand. Thus, Mission bought avocados from San Lorenzo, which was owned by Joaquín Barragán, a local grower who also became an exporter (through Frutas del Sol in Tingüindín). Mission also bought fruit from Joaquín Barragán's nephew, Mario Rivas (Global Frut). The fruit from these packing plants was then exported to Japan. Rivas also sold fruit to Fresh Directions, another California-based firm. Today, Rivas is the largest exporter to Japan. According to Rivas, he learned from Mission and Fresh Directions practically the same business specifics as those mentioned by Villaseñor, Socoaac's general manager. The California-based corporations acted as disseminators of production and export knowledge.[12]

By 1991, after eight years in operation, Socoaac had proven to be a sustainable firm, and the partners decided to make it a fully private corporation, changing its name to Aguamich S.A. de C.V. With sales booming, the partners, mainly avocado growers, became more interested in becoming involved in management decisions. For example, they felt they should be included in setting the price at which Aguamich would buy the avocados from their own farms. Not being a grower himself, Villaseñor (who at that time was Aguamich's general manager) did not understand why it would be necessary for Aguamich to pay a higher price when the same product could have been supplied by other growers in the region at a lower price. As a result, Villaseñor left the company in 1993, only to found a new one, Frutícola Dovi, S.A. de C.V., with the Doddoli family. Aguamich had financial problems; it remains closed.

The Doddoli family owned sawmills and managed the harvesting services of pine tree plantations. It got involved in the avocado industry through farms, packing plants, harvesting services, and guacamole exports. In fact, two Doddoli brothers eventually became Villaseñor's brothers-in-law. Therefore, the new firm, Dovi (owned 75 percent by the Doddolis and 25 percent by Villaseñor), was a family business. Dovi operated for only two years because tensions emerged between the grower family, which was interested in selling fruit to Dovi at a high price, and Villaseñor's commercial interest in buying fruit from local growers at lower prices and better quality.

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[12] As in the Socoaac-Mission experience, Agrifrut developed a relationship with Calavo, the largest avocado corporation in California, creating Agrifrut-Calavo.

In 1995, Villaseñor left Dovi to start a new firm, Vifrut, this time with his own sons and no growers or business partners (see Figure 6.3). His son, Antonio Villaseñor-Zurita, moved to Paris to run Vifrut's marketing operations from there. That year, Vifrut was exporting 10 containers (200 tons) per week to France, England, Sweden, and Spain, and one to Canada.[13] However, the market conditions for fruit in Europe quickly and radically changed. The EurepGAP (Euro Retailers Produce Working Group Good Agricultural Practice Assessment) norm required that farms exporting products to Europe comply with a set of food security, safety, ecological, and social security regulations.[14] Some of these norms depended on the actions of the grower (in such areas as health and safety of workers, types of fertilizers, and water treatments) and not of the packing plants or exporters.

In addition to these tougher regulations, newcomers entered the avocado market. Algeria, Chile, Israel, Kenya, Peru, South Africa, Spain, and Turkey all became competitors of Vifrut. For these reasons, and because the North American Free Trade Agreement (NAFTA) opened the U.S. market to Mexican avocados in 1997, Vifrut decided to supply the fruit exclusively to North American markets. As of 2006, Vifrut exported between 15 and 20 containers (between 300 and 400 tons) per week to the United States.

With the opening of the U.S. market to the Mexican avocado, California-based avocado corporations established their own packing operations in Michoacán. Some of these operations, such as Mission, were set up well before the opening of the U.S. market in order to export Mexican avocados to Japan directly. Others, like Calavo and West Pak, had Mexican subsidiaries and partners for the same purpose, although they were not packers yet. With NAFTA, the California-based corporations imported Mexican avocados into the United States using the distribution channels they already had in the country. Among the firms that set up locations in Mexico were Calavo, Mission, Fresh Directions, West Pak, and Delmonte.

The establishment of large U.S. corporations in Michoacán had several impacts on the region. First, the new plants provided approximately 2,000 jobs.[15] Second, they benefited local growers by paying for the crops with

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[13] In 2005, Vifrut even exported avocados to Chile.

[14] The EurepGAP was initially used by supermarket chains in 1997 to use the same standard when dealing with suppliers. In 2004, the norm became obligatory for fruit and vegetable imports in Europe (http://www.exportapymes.com/article864.html; August 9, 2011).

[15] However, many of the workers come from Mexican-owned packing plants currently in operation or from the ones that went bankrupt.

cash on the same day of the operation. In contrast, local packing plants were paying with a lag of seven to 14 days. Third, U.S. firms pressured local packing plants to improve their relationship with local growers to stabilize and secure the fruit supply. Lastly, they also subcontracted local packing plants to conduct *maquila* operations for them when their own packing plants reached full capacity.

A Passage through the Impassable: The U.S. Market

Despite the fact that there are some complementarities between the Mexican and U.S. production cycles,[16] Mexican avocados have traditionally faced great challenges in meeting U.S. standards of product quality and safety. In 1914, California avocado growers claimed that Mexican avocados were infested with various insects, particularly the avocado seed and stem weevil pests. Consequently, the United States imposed a phytosanitary ban that prevented Mexican avocado exports into the U.S. market for over 80 years (APROAM). For most of the last century, the protection of plant health was maintained through a policy of pest exclusion. Beginning with trade liberalization in 1990, the rules have changed. Debate over the North American Free Trade Agreement (NAFTA) in the late 1980s and early 1990s placed trade between the United States, Canada, and Mexico at the top of Mexico's national agenda. Although the primary goal was the phased removal of most tariffs by 2004, the legislation also provided the setting for the harmonization of sanitary and phytosanitary (SPS) measures between trading partners (Bellamore, 2002). This helped to open up the U.S. market to Mexican avocados.[17]

The Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) is the primary government branch charged with implementing the phytosanitary provisions of NAFTA and other trade agreements. In 1992–93, Mexico sent three work plans to APHIS requesting the importation of Mexican avocados into the United States. In July 1993, one of the proposals was approved. The entrance of Mexican avocados into

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[16] The peak season in California and Florida is usually from March to August, while in Michoacán the primary harvest season is October to February, although production is year-round.

[17] The members of NAFTA have also agreed to accept one another's SPS measures as equivalent, provided that the exporting country makes available scientific evidence that objectively demonstrates that its measures achieve the appropriate level of protection of the importing country.

Alaska was authorized under specified conditions (APROAM). During the next two years, Mexico conducted further research and pest surveys. In June 1994, new data were submitted to the United States. On July 3, 1995, a proposal was published to allow the entrance of Hass avocados destined for certain U.S. states under additional phytosanitary requirements. The imports were restricted to the months between November and February (APROAM).

Nevertheless, avocado growers in California and Florida opposed the entrance of the Mexican avocados, arguing that the import posed an intolerable risk of pests to the domestic avocado industry. It took an army of specialists (Mexican trade representatives and avocado association lobbyists hired by Mexican growers and packers) to overcome the U.S. avocado nontariff barrier. The elite producers of the Mexican avocado industry further organized their lobbying efforts by setting up an independent Avocado Commission of the State of Michoacán in 1994.[18] Mexico also agreed to allow USDA-APHIS officials to operate in Michoacán to secure the compliance of health plant standards. Thus, on July 15, 1997, Mexico and the United States signed an agreement in which avocado exports from the Mexican state of Michoacán were allowed into 19 U.S. states.[19] Later, the number of states permitting Mexican avocado imports increased to 32 (APROAM). The price of avocados in approved states fell by between 8 and 41 percent, in comparison with the rest of the states, in which the decrease was between 1 and 3 percent (APROAM).[20] U.S. imports

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[18] This group would later on constitute the export association, APEAM, with which all new exporters must register and pay fees. These resources have been used to maintain lobbying and promotional campaigns in the United States. In economic terms, it seems that the group was able to internalize the "positive" externality of opening the market.

[19] Connecticut, Delaware, Kentucky, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, and Wisconsin. Imports into the District of Columbia were also permitted. Only imports from certain growers were allowed into these states, and only from November to February, when the cold temperature was sufficiently low to eliminate any pests that may have survived the phytosanitary control treatments.

[20] Before NAFTA, the general tariff applied to avocados was 13.2 cents per kilogram. Then, with the Uruguay Round Agreement on Agriculture (URAA), tariffs were reduced to 11.2 cents per kilogram for a six-year period beginning in 1995; due to NAFTA, this tariff was reduced for Mexican avocados too, but for a period of 10 years (WTO, 1994). Mexico loaded a tariff of 20 percent on avocado imports. Under NAFTA, the tariff was phased out over a 10-year period. Canada does not impose tariffs on avocado imports because it does not produce them (WTO, 1994).

of Mexican Hass avocados increased from 4,100 tons in 1997 to 234,507 tons in 2008, when the value of exports reached $497.3 million (FAOSTAT, 2008).

Despite the pest control efforts, the state of California continued blocking Mexican avocados until late 1997 (a year later than agreed). This time, they argued the Mexican avocados had white flakes or *escamas* on the skin. The state of California even sued APHIS, but the legal action failed. APEAM then sued the state of California for delaying the entrance of Mexican avocados, and demanded compensation. California settled, allowing Mexican avocados in at the end of 1997.

Compliance with Health Plant Standards through Coordinated Efforts: USDA-APEAM-JLSV

During the NAFTA negotiations on avocados, the USDA-APHIS demanded the formation of a local organization in Mexico to deal with the expenses of USDA's local office in Michoacán. This motivated growers and exporters from Michoacán to create a new organization where both growers and exporters had equal rights.[21] APEAM's main goal is to deal with the USDA-APHIS on behalf of avocado growers and exporters, and to set up a collection mechanism to pay for USDA permits. APEAM derives revenues from two sources. First, it imposes an entrance fee on new exporters ($160,000) as a contribution for what the organization has already accomplished.[22] This helps address the problem of financing the public good of an opened U.S. market; the first movers—who bore the costs of establishing the public good—can derive some benefit from the imitators.

Second, to cover the cost of USDA certification documents, APEAM charges packinghouses $0.06 per kilogram exported to the United States. APEAM also collects $0.05 per kilogram exported to promote consumption of Mexican avocados in the United States (e.g., through television ads, trade fairs, tasting events, and so on). That is, APEAM collects $0.11 per kilogram from packing plants to cover certification and promotion activities. To date, APEAM has spent more than $7.5 million on promotions.[23] Due to significantly increased exports, APEAM has a surplus of more than $10 million. APEAM members are

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[21] APEAM was formed by two growers—Rito Mendoza and Gonzalo Moreno—and two exporters: Jorge Fernández Barragán (Agrifrut) and Ricardo Vega López, son of Vega Vega (the first mover of the Purépecha Group).

[22] In 2010, the fee was $250,000.

[23] In addition, the federal government, through SAGARPA, matched APEAM funds for promotion. By 2006, the federal government had contributed a total of $4 million.

debating how to utilize their excess funds, and are contemplating investment in R&D rather than short-term spending.

The Local Plant Health Boards (Juntas Locales de Sanidad Vegetal, or JLSV), an organization formed exclusively by local growers, executes the federal Phytosanitary Law, which regulates production, pesticide use, and imports of agricultural chemicals. For example, specific articles in the legislation required growers to register their use of insecticides, herbicides, and fertilizers with the Ministry of Agriculture, Ranching, Rural Development, Fisheries, and Food Supply (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, or SAGARPA). The Phytosanitary Law established the legal and normative procedures for the standardization of avocado production in the industry. At the same time, the legislation provided some teeth for local growers and state authorities to enforce compliance with these standards through the issuance of mandatory certification permits for growers planning to sell their crops to local packing plants for export. Certification permits are currently issued only by the JLSV, under SAGARPA's supervision.[24] Formation of the JLSV was already foreseen in the 1973 federal law, *Ley de Sanidad Fitopecuaria*. The law was updated right after NAFTA in 2004, and reviewed in 2007 without significantly modifying the JLSV's role in helping to eradicate plagues and pests. Box 6.1 describes the way growers establish a JLSV, how pests and plagues are controlled, and how orchards and freights are certified.

JLSV inspectors report directly to SAGARPA officials, who in turn conduct all communication with USDA-APHIS. Thus, the relationship between JLSV and USDA inspectors (who are also Mexican) is informal; they work side by side certifying freights at packinghouses, learn from one another, and tend to develop friendly relationships. JLSV inspectors, who have been in the field longer, show their colleagues the way to the orchards and share with them working documents and information on orchards that have been "liberalized." The JLSV's role is quite similar to that of the USDA. At the federal level, however, the situation is different; SAGARPA would like USDA to exit Mexico, but local growers

[24] Although the phytosanitary regulations are overseen by SAGARPA, the Economics Ministry supervises compliance with export Norm 016 for avocados. Norm 016 establishes quality standards for the fruit, including color, size, and texture. Courses for certifying officials on Norm 016 have been given at a local university in Michoacán, where approximately 100 officials have been trained. In a political maneuver, the plant health boards and committees hired these officials to provide Norm 016 certification for their farms. Currently, the boards and committees manage both phytosanitary and Norm 016 certifications.

BOX 6.1 | Operation of a JLSV (Local Plant Health Board)

Setting up a JLSV

- Inscription. Growers register their orchard deeds and plans with the JLSV, and pay an annual fee of $54 per hectare (or $648 per 12 hectares, the average size of an orchard).[a] Growers then receive an inscription code for every orchard they own. By December 2009, 6,256 growers had registered with a JLSV.[b]
- Board election. All JLSV members get together once every two years to select the board through an open election. The board consists of a president, a treasurer, and trustees. Board members can serve a second term if they are reelected.
- JLSV staff. The board then hires a general manager and technical and administrative staff, mainly agronomists. In total, between 10 and 15 people run the JLSV for operational purposes.
- Crops. If there are several crops in the region with pest and plague control programs, then the board should include growers from different crops. There is only one JLSV per municipality, regardless of the number of crops in the regions.

Fighting Pests and Plagues

- Orchard visits. The technical members of the JLSV visit the orchards to review the health of the plants and to make recommendations to the growers. They are specifically concerned with eradicating the avocado seed and stem weevil pests. For this task, the technicians develop a "working plan" with detailed specifications on measures to fight pests and plagues.
- Checkups. The technicians return to the orchard to see whether the recommendations and suggested measures have been implemented. Samples are collected and statistical tests run. If everything is in order (no signs of pests or plagues), they file a "liberalization" report with SAGARPA, and send a copy to the local USDA office.
- Road controls. To bar avocados from entering the plague-free zones of Michoacán state, the JLSVs set up road controls to check every truck transporting avocados.

Certifying Orchards and Freight

- USDA visits. After receiving the report from the JLSV, the SAGARPA local office notifies the USDA local office. USDA inspectors then visit the orchard to check the health of the plants and fruits (avocados).
- Orchard certification. If USDA officials find everything in order, the grower then receives permits and plates from the JLSV (on behalf of SAGARPA).[c] The permits and plates, which bear the orchard's JLSV inscription number, allow the grower to transport the fruit to the packinghouse.[d] The truck should be sealed and the inscription number visible on every avocado box. JLSVs provide permits and plates on a daily basis. They are the mechanism to control supply.
- Verification of certification numbers. When the truck arrives at the packer/exporter, both a USDA and SAGARPA inspector verify the plate, seals, and inscription numbers before the avocados are unloaded.
- Statistical samples. USDA and SAGARPA inspectors on-site conduct statistical samples to check the condition of the fruit before the avocado boxes are carried inside the packinghouse.[e] If seals are broken, boxes lack a registration number, or traces of

(Continued on next page)

BOX 6.1 | Operation of a JLSV (Local Plant Health Board) (*Continued*)

plague or disease are detected on the avocados, the entire truckload is sold in the local market; it cannot be exported.[f]

- Freight certification. If everything is okay with the shipment, SAGARPA issues the international phytosanitary certificate needed to export the fruit to the United States. Other countries do not require that certificate.

[a] Exchange rate of $13.0148 pesos per dollar on August 27, 2010 (http://www.banxico.org.mx/).
[b] Growers who wish to export to the United States must belong to the JLSV. If they export to other markets, they do not have to belong to the JLSV, but the trend is for all growers who export to join the JLSV, and for packers/exporters to buy the entire day's freight from one certified orchard.
[c] There were 9,058 orchards registered (53,400 hectares) by December 2009.
[d] If several trucks are to be loaded in one orchard in one day, the growers should request additional plates from the JLSV.
[e] By December 2009, there were 34 certified packinghouses that could export avocados to the United States.
[f] Going "local" has strong financial implications for the producer, who will earn 60 percent less (i.e., US$0.77 per kilo instead of US$1.92 per kilo).

and exporters do not. USDA has helped organize the sector. Without USDA, first JLSVs could be subject to corruption, because the price difference in selling to the domestic market ($0.60 per kilo) versus selling to an exporter ($1.80 per kilo) is too large. Second, without formal control, the U.S. market might be saturated with Mexican avocados quite rapidly.

JLSVs operate plague and pest control programs for any plant (or animal). For example, some JLSVs deal with problems with mangoes in the states of Michoacán, Jalisco, Nayarit, and Sinaloa; with lemons and citrus fruits in Michoacán and Colima states; and with coconuts in Michoacán. In the Uruapan and Tancítaro municipalities in Michoacán state, the JLSV deals only with avocado because it is the only crop for export that currently has pest and plague control programs.

The elimination of pests in the avocado region of Michoacán was considered a striking success.[25] However, by regulating the weekly (or even daily) permits, which specify the names of the orchards and the quantity of tons

[25] It took at least two years for growers from other states, such as Jalisco or the state of Mexico, to eradicate pests after they began following the advice of Michoacán growers. Otherwise, the pest problem in these states would never have abated.

that can be sold to packing plants for export, JLSVs and committees are, in fact, regulating supply. That is, JLSVs issue daily permits to avocado orchards, and only orchards with these permits can sell avocados to the packers/exporters that day.[26] Packing companies, which are not represented on plant health boards and committees, often complain that growers use these organizational bodies to reduce output and reach their target price floor of $1.00 per kilogram (see Figure 6.1). The growers, who do not feel pressured to sell the avocados quickly (because the fruit can remain on the avocado tree for several months and be ready for picking without spoiling), are willing to wait to harvest until the price is right. Ultimately, both the growers and packing companies (exporters) agreed that, despite their differences, regulating supply was not detrimental to them because prices have remained stable in the United States.

The Counterfactual Case: Mangoes—Too Sweet, Too Cheap

Many interviewees who succeeded in exporting avocados attempted and failed to export mangoes. Even José Luis Gallardo, current president of the State Committee on Plant Health (Comité Estatal de Sanidad Vegetal), is transforming his company—Anguiano's Mango Plantations—into avocado orchards. Why is it difficult for multinational corporations to succeed at exporting mangoes when the same, or similar, firms can export avocados?

First, compared with the avocado, mangoes are highly perishable, and this makes the jobs of the growers and packing companies more difficult. Avocado trees can maintain fresh fruit up to six months once it is ripe; mango trees hold the fruit for less than a week. Growers then must be ready to sell the fruit to packing plants, which in turn need to process it and sell it rapidly in international markets. They must accept the current price. Prices can easily drop as entire mango regions come into full production. In addition, Mexico's mango market is small, unlike its avocado market, which makes it difficult for growers and packers to recover lost revenues by releasing surplus quantities into the market.[27]

Moreover, in contrast to avocados, mango production is geographically dispersed, making coordination among growers and other actors more difficult.

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[26] A parallel, local grower organization has been set up, sometimes with the same board as the JLSV, to keep the JLSV from being blamed for controlling supply.

[27] A possible solution would be to find a way to keep mangoes fresh during the final export stages, before they reach the consumer; this is the case for kiwi fruits and apples which, once harvested, can be stored for months.

There are several mango-producing regions in Mexico. The main mango growers are the states of Colima, Guerrero, Michoacán, and Nayarit. The season starts in the southern states of Chiapas and Oaxaca and ends in Sinaloa, in east-central Mexico. This means that packing plants in each region are active only two months per year, making investment in packing plants unprofitable, and pests hard to control. Some entrepreneurs have attempted establishing their packing operations in a more central location, such as Guadalajara, with little success.

The geographic dispersion of production goes hand in hand with differences in production practices that affect quality and commercial relations. Roughly speaking, avocado growers and exporters from Michoacán comply with norms, while mangoes that are produced in a diversity of regions lack operational and quality controls. While avocado-harvesting procedures have been standardized and pesticides and chemicals controlled, mango operations do not have standardized procedures that would secure the same quality levels throughout the harvesting months in each region and across plantations.[28]

More fundamentally, mango growers are not as organized as avocado growers. The growers do not even participate in EMEX, the mango organization that covers the expenses of the USDA inspectors (the equivalent of APEAM in the avocado industry). That is, "Mango packing plants look out only for their own individual interest," said the head of a State Committee on Plant Health. For avocados, the organization of growers was essential, not only to eradicate pests and isolate the production region against potential phytosanitary threats, but also to keep prices stable.

The flip side of the lack of sectoral organization is the individualism, or even opportunism of individual growers, and the problems such opportunism causes large processors. Multinational corporations such as Calavo have an annual business plan to follow, with specific export volumes to meet. Calavo found it difficult to comply with its mango-export program because although agreements had been reached with growers, they often would not honor the contracts. In other words, contracts are not enforceable. For example, close to the harvest day, the grower would receive offers from outside (U.S.) firms that would pay slightly more than what Calavo had agreed upon as the purchase price in the contract. When Calavo would arrive to pick up the

[28] The standardization of harvesting procedures and the control of pesticides respond to plant health standards imposed by JLSVs to prevent plagues. Unlike production activities, such as irrigating, fertilizing, and pruning trees, they have little impact on production yields.

fruit, it would be gone. "Contract agreements in the Mexican countryside do not mean much," said one senior executive of Calavo. In the case of avocados, producers have no option but to sell the product to registered exporters. That is, an outside firm cannot simply come on harvest day, buy the product, and export it to the United States. Only packing companies certified by both the plant health boards and committees and the USDA are able to export fruit from the region. Regarding other markets, it is unlikely that French or Japanese buyers would show up at avocado orchards to buy the fruit. However, avocado growers are free to sell the fruit to the domestic market when the price is right, notably when shortages can raise the domestic price above international levels.[29]

Lastly, it seems that some mango growers and packers are involved in money laundering, buying the fruit at high prices and selling it cheaply, eroding margins and making the mango business unattractive to potential new investors. In the avocado-exporting industry, most growers and exporters know one another, and organizations such as APEAM are constantly monitoring prices in the United States, with representatives stationed there. If an exporter is selling at a lower price than the rest (dumping or money laundering), it will soon be detected. Previous experiences with dumping to compete in the European avocado market taught exporters the importance of stable markets. The interaction between grower and exporter associations in Michoacán to comply with USDA regulations has so far created the checks and balances needed to maintain a healthy industry. It is hard to know whether money laundering is such an important source of income that mango growers have no interest in improving mango production (and every motive to avoid the scrutiny that comes with sectoral organization), or whether failed efforts at sectoral coordination reduced mango income to the point where growers were vulnerable to the appeal of money laundering as a "complementary" activity.

Conclusions and a Threatening Prospect

This study identified several market failures during the first export and dissemination processes. To deal with these failures and related problems, several public goods were generated in the region, such as the introduction and improvement of avocado varieties that were resistant to cold weather;

[29] Avocados in Monterrey, Mexico were sold to the final consumer at $4.00 per kilogram, while the price in Japan was $3.00 per kilogram during the same period. Monterrey even had to import avocados from California during the fall of 2006.

regions in Michoacán that were declared disease-free and export-certified; a pool of workers that moved from company to company; and access to the U.S. market for certified orchards and packinghouses. Exporters enjoyed some positive externalities generated by the government, such as the free distribution of avocados in the 1960s, creating over time a variety of avocado growers (14,000 growers) that was sufficient to provide the product all year long for the local and export markets. Promotional support was provided through a federal matching fund of $4 million and the direct involvement of Bancomext, the foreign trade support bank. Asymmetric information problems generated between growers' potential expansion plans and private banks were resolved through FIRA (a branch of the Mexican central bank), which provided collateral to private banks and technical assistance to growers. Lastly, coordination failures generated by the need to follow strict measures to prevent the spread of disease in orchards and packing plants were dealt with through the formation of APEAM, the work of the private, municipal JLSV, and public-private State Committees on Plant Health. They have successfully coordinated with USDA-APHIS to comply with U.S. phytosanitary standards.

Local organizations played a key role in shaping the avocado industry. After a period of uncertain land ownership and political co-optation, organizations focused on specific tasks, such as eradicating diseases, complying with USDA fees, forming credit unions, and accessing the U.S. market. The most relevant organizations today are perhaps APEAM and the JLSV. APEAM is the association of growers and exporters that works with the USDA to ensure compliance with phytosanitary regulations. APEAM collects $0.11 (recently reduced to $0.07) per kilogram exported to the United States to pay for the USDA inspectors and for promotions in the United States. APEAM also charges $160,000 ($250,000 in 2010) to new exporters seeking access to the U.S. market. This approximates the level of cost that the first exporters to the United States had to pay—that is, to "internalize the externalities."

The JLSVs—grower organizations that execute federal and state phytosanitary laws—have been able to eradicate avocado seed and stem weevil pests in specific municipalities in Michoacán. They play a key role in educating growers on how to improve plant health, certifying orchards on behalf of SAGARPA, and verifying that USDA-APHIS regulations are followed. They also indirectly control the supply of avocados from the orchards to the export packinghouses, allowing for price stability and a secure price per kilo of avocados to growers. The interaction between JLSV and USDA officials, which developed in a friendly way, guarantees compliance with U.S. standards and thus access to the U.S. market.

Avocado trends for Michoacán growers and exporters look good for the immediate future, but prospects are uncertain for the longer term. As of 2007, Mexican exporters were able to export avocados to all U.S. states, resulting in a 146 percent increase in U.S. imports of Mexican avocados. The medium- and longer-term prospects seem more complex. On the one hand, market conditions in the avocado industry are getting tougher. For example, the EurepGAP norm requires that orchards exporting to Europe comply with a set of food security, phytosanitary, ecological, and social security regulations. Although the JLSV and State Committees on Plant Health oversee some of these issues, not all EurepGAP regulations have been covered by current procedures. It is likely that other countries, such as Japan, will follow the European example. This would put exporters in a difficult position because it would require a commitment from the growers.

In the long term, new, highly efficient entrants such as Australia, Chile, New Zealand, Peru, and South Africa, with state-of-the-art technology and favorable soil and climate conditions, may well put pressure on, or even displace, Mexican growers and exporters—not only in the international market, but in the domestic market as well. Developments in Peru highlight the risks. Peruvian avocado plantations yield between 26 and 30 tons per hectare on average, with the most efficient producers attaining 40 tons per hectare. In the Mexican avocado belt, average yields are between 10 and 15 tons per hectare, with the best growers reaching 30 tons per hectare.

The difference in yield is due to the density of planting. In the traditional cultivation method, there are about 100 trees per hectare (10 rows, with 10 trees per row, or a spacing between trees of 10×10 meters). The Peruvians, perfecting techniques developed in South Africa, plant 830 trees per hectare (25 rows, with approximately 33.3 trees per row, or a spacing between trees of 3×4 meters). This intensified cultivation heightens the demands on managerial capacity. The trees must be irrigated seven times per day with a broth that includes all the nutrients needed by the plants. Pruning must be much more frequent and precise. The dense packing of trees, and pushing productivity to genetic limits, greatly increase the risks of new plant diseases and pests, thus requiring constant vigilance to identify and mitigate new risks before they produce calamities. Peruvian producers can manage these challenges in part because they are vertically integrated and quite large. They produce, pack, process, and market several products—including avocados—therefore they have the resources and experience with orchard production needed for intensive cultivation.

In theory, despite their relatively small size (the average orchard size in Michoacán is 12 hectares; in Peru, it is 100 hectares), Mexican growers could adopt more intensive cultivation methods. The forms of cooperation (and not least the cooperatives) developed in part to meet phytosanitary standards could be extended to joint investment in and management of the necessary irrigation systems (whose costs could easily be prorated); new pruning regimes could be developed; initial efforts at statistical analysis of the production of each avocado plot could be extended; and so on.

However, the current organization and market circumstances of the industry create disincentives to taking the risks associated with intensive cultivation, at least in the short to medium term. First, growers in Mexico are not primarily exporters: They cut the fruit for export only when they feel the price that the packinghouses are offering is right. They can afford to bide their time because the fruit can be "warehoused" on the tree for four to seven months; and, in any case, they can sell their product domestically. Second, returns in the industry are currently so high that it is hard to see the need for costly, risky investments in new techniques. Michoacán's extremely good weather and soil keep avocado production costs low. The cost per kilo is about $0.30 (including amortization and depreciation), while the domestic price is at worst between $0.50 and $0.60 per kilo (sold on the tree). The international price at the pick season is about $1.70–$1.85 per kilo. The upshot is that growers get returns on their investments ranging from 75 percent to 500 percent. Moreover, changing to the new system might be quite expensive for current growers because it would require replanting trees and waiting several years to restart production. "Why complicate life?"—as one industry consultant put it—is thus a reasonable answer to the question of why growers do not attempt to emulate the Peruvian example—and an explanation for the limited R&D efforts in the industry.[30] Whether it turns out to be the right long-term response to an emergent threat is another question. Put another way, it remains to be seen whether the export success of the avocado industry in Mexico has been an occasion to develop new capacities that can be deployed elsewhere in the economy, or whether it has been a—highly lucrative—occasion to pick low-hanging fruit.

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[30] Some R&D has taken place at local universities in Michoacán, but programs are underfunded. APEAM has successfully collected funds for collective purposes, such as lobbying and marketing campaigns in the United States. More recently, it has started to allocate some resources for R&D, but not in a significant way.

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Paz Vega, Ramón, Managing Director, International Business Unit, Coliman Group, (consulting firm); former grower, packer, and partner, Fresh Directions, September 5, 2006, Monterrey, Nuevo León; November 21, 2006, Monterrey, Nuevo León; November 27, 2006, Monterrey, Nuevo León; August 26, 2010, Monterrey, Nuevo León.

Perfino Mejía, José G., General Manager, Comité Estatal de Sanidad Vegetal en Michoacán (State Committee on Plant Health), August 22, 2006, Uruapan, Michoacán.

Rivas, Mario A., Owner, Global Fruit (packing plant), August 21, 2006, Uruapan, Michoacán.

Scheidt, Marcos, Managing Director, APEAM, August 21, 2006, Uruapan, Michoacán.

Torres Corona, Salvador, Technical Manager, Asociación Agrícola Local de Productores de Aguacate de Uruapan, Michoacán (AALPAUM), August 22, 2006, Uruapan, Michoacán.

Vega Esquivel, Leopoldo, President, Grupo Purépecha Corporativo Hass Avocados (packing plant and grower), December 5, 2006, Uruapan, Michoacán.

Vega López, Ricardo F., General Manager, Frutícola Velo (packing plant), August 23, 2006, Uruapan, Michoacán.

Villaseñor, Antonio, Owner, Aztecavo (packing plant), August 23, 2006, Uruapan, Michoacán; December 5, 2006, Uruapan, Michoacán.

Villaseñor-Zurita, Antonio, Director of Marketing, Aztecavo (packing plant), August 23, 2006, Uruapan, Michoacán.

Zamora, C., Manager and Facilitator, Comité Nacional Sistema-Producto, December 4, 2006, Uruapan, Michoacán.

CHAPTER 7

Soybeans in the Savannahs of Brazil

Joana Monteiro, Angela da Rocha, Beatriz Kury, and Alexandre Darzé

Soybeans are one of the best examples of Brazil's competitiveness in agribusiness. Brazil ranks second in the world in terms of soybean production and is the world's second-largest soy exporter. It exported more than $17 billion in soybeans in 2009 (Figure 7.1), compared to the United States, with exports of $21 billion. Soybeans are Brazil's second-largest export, accounting for around 10 percent of total Brazilian exports. Between 1994 and 2003, soybean exports almost doubled, and they more than doubled between 2003 and 2009. Two-thirds of Brazilian production was exported in 2009, consisting of grain (66 percent), bran and flour (27 percent), and oil (7 percent).

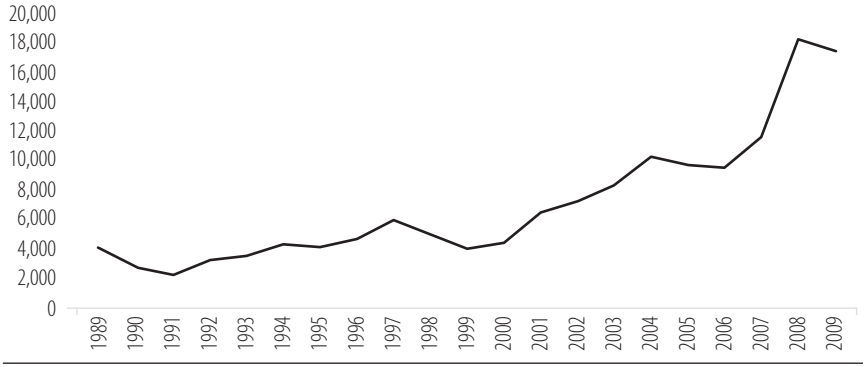
Brazil's spectacular performance is due in part to the technology developed by EMBRAPA, a government research institute that promoted a dramatic expansion in the Brazilian agricultural sector and helped generate continuous growth in productivity. Other factors such as public support, international demand, and trade policies have also influenced the sector's development.

The Discovery and the Diffusion Process: A Historical Overview

The process of discovery and diffusion of soybeans as an exporting crop was led by the Brazilian government, which developed and implemented a whole set of policies and actions to promote its development.

In the 1970s, the Brazilian government aimed to expand the agricultural frontier to make the country self-sufficient in food products. The government viewed the expansion of agricultural output as a requirement to supply

FIGURE 7.1 | Exports of Soybean Products, Brazil, 1989–2009
(Millions of US$)



Source: ALICE System/SECEX (http://aliceweb.desenvolvimento.gov.br).
Note: Soybean products include grain, bran, flour, and oil.

export-oriented industries and to serve the food consumption needs of an increasing urban population (Bertrand, Bret, and Drouler, 1987). The target was to develop the Brazilian *cerrados* region (savannahs)—mostly located in tropical areas—which covers a considerable part of the country's territory, and which up to that point had not been used for commercial agriculture. The task was not easy; the savannahs had low-fertility soils and irregular rainfall.

There were two other motives for the decision to develop the savannahs. First, a window of opportunity in international markets opened in 1968–70, when a worldwide decrease in key crops—such as maize, potatoes, and wheat—forced up prices. This was combined with the 1971–72 drop in Peruvian production of fish flour (caused by El Niño), and a drought in Central Africa, with similar consequences for the production of peanuts, which were critical ingredients in animal feed (Warnken, 1999). This price increase made the Brazilian production in the savannahs profitable, despite its low productivity at the time.

Second, the development of Brazilian agriculture was considered a strategic issue, and several government officials wanted to invest public funds in agricultural research. Such vision turned into concrete actions during President Geisel's government (1974–78), which named Alyson Paolinelli, a former secretary of agriculture in the state of Minas Gerais, as the minister of agriculture. Paolinelli had experience with programs to exploit the economic potential of the Brazilian savannahs. He was one of the main supporters of EMBRAPA, the Brazilian federal agency for agricultural research under the aegis of the Ministry of Agriculture. As a government official, he directed large sums of public funds

into EMBRAPA's human capital development. During Paolinelli's mandate, more than 1,500 EMBRAPA researchers enrolled in graduate programs abroad.

At that time, foreign markets were avid for a new source of protein to substitute for fish flour in animal feed. Soybeans were already cultivated in the South of Brazil, a region with a temperate climate. However, there was not enough land available for the expansion of production in the South. Large extensions of arable land could be found only in the savannahs of the Center-West, but this land was not considered suitable for agriculture because of the poor quality of its soil and irregular rainfall. Furthermore, soybean was considered to be a temperate climate crop. Thus, it was necessary to overcome two challenges to make large-scale soybean production viable in the savannahs: to create new soybean varieties adapted to low latitudes (the tropics), and to develop better soil conservation and handling techniques, along with better fertilizing and plowing processes to increase soil fertility.

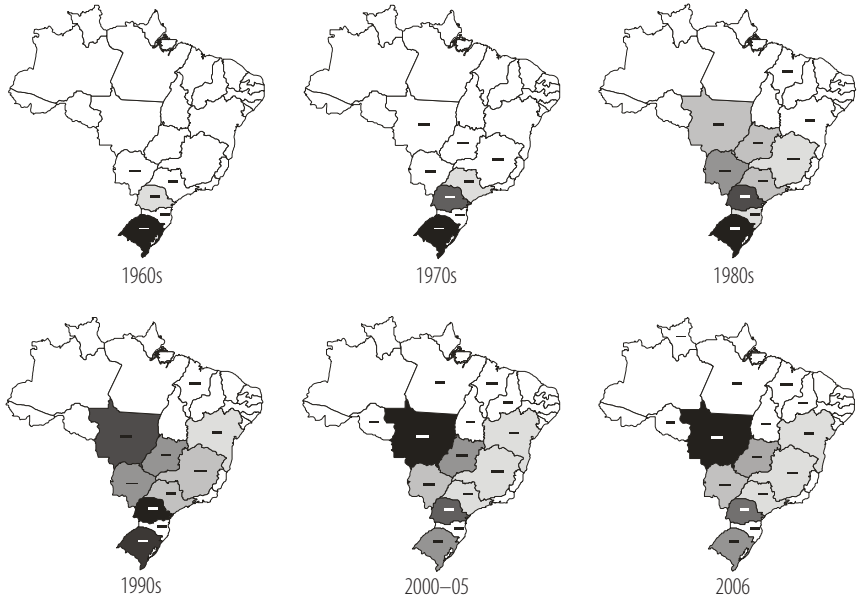
The development of soybeans as a large-scale crop in Brazil proceeded in two main phases. The first started in the 1970s during the military regime and ended in the 1980s; it was marked by heavy state intervention and support. The second phase began in the early 1990s with economic liberalization and continues today.

The systematic expansion of the soybean sector in Brazil started in the early 1970s. The development of soybean varieties suitable for the savannahs and techniques of soil conservation and handling made it possible for the agricultural frontier to move toward the Center-West. This phase was characterized by substantial expansion of the cultivated area (Figure 7.2), which doubled in 15 years from 6.9 million hectares in 1976, to 12.9 million hectares in 1989 (CONAB, 2006). The agricultural frontier began to expand from the state of Rio Grande do Sul to the state of Paraná—a transition in climate zones from temperate to tropical climates—and, to a lesser degree, to the state of São Paulo. In the 1980s, soybean production spread to the states of Minas Gerais, Mato Grosso do Sul, and Goiás, but the southern states (Rio Grande do Sul and Paraná) remained the main soybean producers. Technological development was the first step in the exploration of the savannah region, which also rested on several other public policies aimed at attracting entrepreneurs, as discussed later in the chapter.

The First Movers and the Precipitating Factors

No individual or company can be singled out as the first mover in the soybean sector, or at least there are no written records or testimonies of such. Yet it is possible to identify the type of rural grower who initiated the migration process

FIGURE 7.2 | Geographical Distribution of Soybean Production in Brazil, 1960–2006



Source: Figure obtained from Amélio Dall'Agnol, researcher at the EMBRAPA SOJA (EMBRAPA Soybeans Research Center) in an interview.
Note: The dash indicates the Brazilian states that produce soybeans. Darker shades indicate larger volumes.

that shaped the movement to the *cerrados*: the *gaúchos* from the northern part of the state of Rio Grande do Sul. The *gaúchos* had a tradition of migrating to other parts of the country, and of being adventurous and entrepreneurial. They were individual settlers, sometimes banding together as entire families, with a higher-than-average level of education.

The production of Brazilian soy during the 1960s and 1970s was concentrated in the northern part of the state of Rio Grande do Sul, where the productive unit was the small, family-owned farm (with a maximum of 50 hectares). The continuous division of land in the South gave rise to very small properties—called *minifúndios*—that were too small to be productive, or even to generate enough income for a family of average size. As a result, the high cost of land in the South was prohibitive to many young people trying to establish their own families. This led to the expansion to other states.

The first soy growers who left Rio Grande do Sul migrated to Santa Catarina and Paraná. However, the land available was insufficient to serve all their needs. Starting in the late 1960s, producers from Rio Grande do Sul started to occupy the southern part of the state of Mato Grosso do Sul. This area was known as the

Dourados region. It was located at similar latitude, and was appropriate for soybean cultivation. In the *cerrados*, growers could buy plots of land 20 times larger than in their home states for the same price (De' Carli, 2005).

This movement intensified in 1973 with the explosion of the soybean price in the Chicago commodity exchange; the price of a ton of beans increased 150 percent in less than three months. As a researcher from EMBRAPA SOJA (EMBRAPA Soybeans Research Center), Amélio Dall'Agnol, explained in an interview:

> "There was a great frustration with fish flour from Peru, the main protein source to feed animals then available. When the volume of fish flour decreased, the demand for soybeans exploded. At that time soybean production was still much smaller than today... When this demand suddenly increased to 12 million tons of soy flour... one can understand why the price increased."

Price increases led to more demand for land in the *cerrados* region. It also led to investments by larger producers from Rio Grande do Sul. The larger producers from the southern part of Brazil had holdings that ranged in size from 500 to 1,000 hectares. The group of settlers that moved to the *cerrados* region was formed by large and small farmers, but it was a very selective group. Both small and large farmers were efficient producers, differentiated only by the amount of capital they had to invest. Larger producers had achieved substantial profits after the increase in soybean prices in the early 1970s, which were then available to invest in new land.

The first movers had some experience with these crops in the southern part of Brazil, a region with a favorable climate and adequate conditions for soybean agriculture. They had extensive experience with farm production and equipment, and knew how to handle machinery and inputs. And they were not reluctant to adopt new methods and techniques (Macêdo, 1998). Such experience and technical capabilities allowed them to experiment with soybean cultivation in other regions of the country at a time when international markets started to demand higher volumes of soybeans. The *gaúchos* also had experience with and knowledge about distribution channels for the product, since soybeans had already been sold in foreign markets using international trading companies, cooperatives, and national processors.

In the 1970s, a large part of the soy exported from Brazil was commercialized by cooperatives. At the same time these events were taking place, international trading companies were very actively increasing their participation in soybean trade, becoming the most important marketers in the country. In addition, large,

national processing firms, such as the Maggi Group and Caramuru, started to sell their output, and to buy and resell the production of smaller farmers.

In the very beginning, growers were unsuccessful with their crops, as the soybean varieties that they planted matured prematurely. Growers then switched to rice because it was more compatible with weak, infertile soils. After one or two rice harvests, growers started to gravitate toward soybeans, putting pressure on research institutions to help develop varieties suited to the region's environment, as well as techniques to improve the soil. The partner institutions included the Research Department of the Ministry of Agriculture, national agricultural research companies, and later, EMBRAPA. The creation of EMBRAPA in 1973 was especially useful in bringing together research that was already available in other public research institutions and universities, and transferring this knowledge to farmers. Its creation also proved to be valuable in showing growers that production was possible by means already available.

The Immediate Followers

Word of mouth and personal connections assured the continuity of migration. Once the news got out to the home municipalities of the first settlers that the land was good and that soybeans could be cultivated and exported, their relatives, friends, and neighbors followed, reestablishing the original ties of kin and community in the new land. Indeed, to a large extent, the original social environment was transplanted to the new physical environment in the savannahs. These people followed the footsteps of the pioneers. The following extract from an interview with an EMBRAPA researcher illustrates this trend:

> "As a member of a family of Rio Grande do Sul moved to the *cerrados* and did well, the whole family would follow. This was a normal process. I know this because I am from a small community in Rio Grande do Sul, and I know that the fever started in the eastern part of Paraná. It was the first fever. Everyone would go and buy land because one person would go and confirm that the land was good. They would say that the terrain was flatter and that the land was fertile. This soon attracted one person after the other. From a community of 100 families, 50 would go to the same place. This is what happened."

The migratory process of farmers to the *cerrados* in search of cheap land that had started during the 1960s and 1970s continued throughout the 1980s.

The Diffusion Process

Despite the initial challenges, soybean producers persisted. Large soybean production remained restricted to four countries: the United States, Brazil, Argentina, and China. Only the first three were exporters. These factors encouraged Brazilian producers to bet on soybean production. By the end of the first phase, soybean production had succeeded in Brazil. Soybean production increased 10 times between 1970 and 1980. By the 1980s, Brazil had already become the world's second-largest soybean producer, and had a market share of 18.7 percent—much larger than in 1970, when Brazilian soybean production accounted for only 3.6 percent of the world's production (Santos and Bacha, 2003).

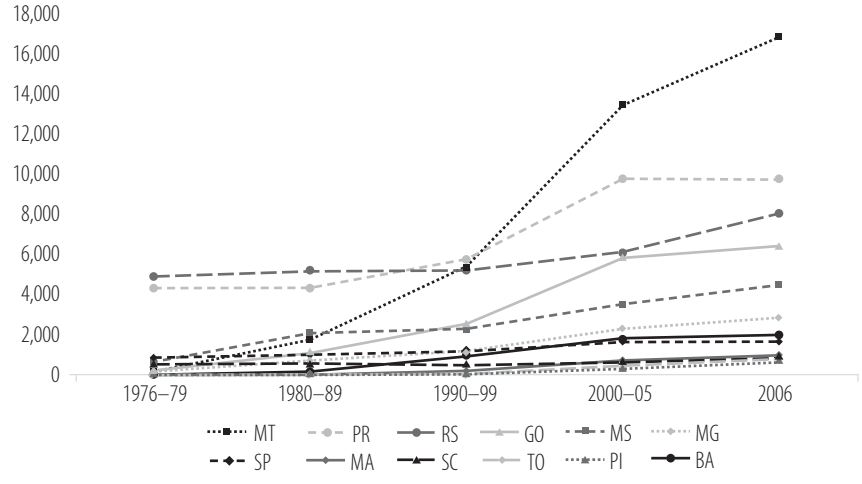
The success of the soybean production also led to several spillovers for a range of inputs and services. As a result, between 1970 and 1982, the production of vegetable oils, fertilizers, seeds, chemical products, machinery, animal feed, chicken, pork, and transportation and storage services rose dramatically. The increasing demand for those products and services led to the assembly of a robust, agricultural infrastructure (De' Carli, 2005). This was the starting point in the creation of a huge industrial complex for seed crushing, as well as for oil extraction and bran production. The availability of large supplies of soybean and corn bran allowed the development of modern pork, beef, chicken, and milk production, which in turn increased the profitability of the grain value chain. Several new municipalities were created around the different production and processing areas of soy (De' Carli, 2005).

The second phase, starting in 1990, is characterized by three factors: a substantial increase in productivity, which rose from 1,740 kilograms per hectare in 1989–90 to 2,329 kilograms per hectare in 2003–04; the prominence of the state of Mato Grosso as the leading soybean producer in the country (Figure 7.3); and a reduction in government support.

The deregulation of the Brazilian economy and the opening of the domestic market to foreign competitors in the early 1990s forced soybean producers to increase their competitiveness. Production subsidies, which guaranteed minimum prices for soy, disappeared and subsidized credit was drastically reduced, from more than 35 billion *reais* in 1980 to less than 10 billion *reais* in 1990, declining to almost zero by 1998 (Bernardes and Freire Filho, 2005). Producers were forced to increase their productivity, since the productivity level of the 1980s no longer guaranteed profitability.

A reduction in government investment capacity also negatively impacted rural extension services. EMATER, the main federal, agricultural extension

FIGURE 7.3 | Evolution of Soybean Production in Brazil by State of the Federation
(Thousands of tons)



Source: CONAB (Companhia Nacional de Abastecimento), (2006).
Note: MT = state of Mato Grosso; PR = state of Paraná; RS = state of Rio Grande do Sul; GO = state of Goiás; MS = state of Mato Grosso do Sul; MG = state of Minas Gerais; BA = state of Bahia; SP = state of São Paulo; MA = state of Maranhão; SC = state of Santa Catarina; TO = state of Tocantins; PI = state of Piauí.

services organization, ceased its activities in 1991.[1] With the demise of EMATER, smaller farmers had to use state rural extension services, whose quality varied considerably from one unit to another, and which, in any case, lacked the resources to meet the surge in demand. The private sector started to fill the government's role in rural expansion (both in extension and working capital). Farmers allocated their own personnel to keep in touch directly with EMBRAPA in order to learn about new technologies being developed. Producer cooperatives were another relevant source of technology diffusion in some regions.

In the mid-1990s, the appreciation of the Brazilian *real* brought new challenges to the sector by making Brazilian commodities less competitive in international markets. In addition, the tight monetary policy used to restrain inflation caused the interest rate to reach historic highs, thus increasing the cost of credit. This new context called for efficiency gains. To become more

[1] Other state extension services remained but at drastically different levels, depending on the state.

competitive, farmers invested in machinery and industrial equipment, typically using subsidized credit from BNDES, the National Economic and Social Development Bank. The incorporation of technology became a continuous process. As a result, there were substantial gains in productivity, which became the main drivers of increases in soybean production.

During this new phase, the state of Mato Grosso became the main producer of soy in Brazil. This was due to its natural advantages, including the perfect climate for summer crops, low prices of land, and better soil than other parts of the *cerrados*; together, these factors favored the mechanization of production. Mato Grosso's success as a soy-producing state triggered the development of other sectors, such as agricultural machinery and animal production. This process had many positive spillovers. The poultry and beef industries and large soy processing and crushing companies migrated toward the region to reduce transportation costs. These trends started during the 1980s and increased during the 1990s and early 2000s. The planted area continued to increase, almost doubling between 2005 and 2009 to reach 21.5 million hectares (Lovatelli, 2009).

Many companies developed, especially after 1995.[2] Four soybean-processing multinationals (ADM, Bunge, Cargill, and Dreyfus) purchased 12 Brazilian firms and increased their crushing capacity to 43 percent of total industry capacity in 1997, compared to 31 percent in 1995 (Jank, Leme, and Nassar, 2001). These multinationals took over the role of financing soy production. The importance of the sale of soy futures by these crushing companies is illustrated by their role in the state of Mato Grosso; in 2005, they financed 70 percent of soy production in that state. These companies achieved this market share despite charging higher interest rates than Banco do Brasil because they offered more relaxed underwriting conditions for larger loans.[3]

By the end of the 1990s, other external factors benefited the sector. First, in 1997, the government eliminated export taxes on commodities, cutting costs by 10 percent to 20 percent. Second, the world price of soybeans increased in 1996–97. Finally, the devaluations of the *real* between 1999 and

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[2] Despite the fact that soybean production in Brazil is mainly oriented toward export, the growth of industries based on meat and high internal consumption of soy oil for cooking meant that domestic production was also large (historically around 30 percent of the entire soy crop).

[3] Banco do Brasil, the largest bank in the country, is responsible for financing the poultry sector. The crushing companies extended loans carrying annual interest rates ranging from 15 percent to 17 percent, while Banco do Brasil charged between 8.75 percent and 13 percent (Bernardes and Freire Filho, 2005).

2002 strongly increased the competitiveness of Brazilian soybeans in foreign markets and brought substantial gains in *reais* to Brazilian growers.

With the relative increase in land prices in the *cerrados* of Brazil's Central region, new areas of the *cerrados* in the Northeast became attractive to soybean producers during the 1990s. This was especially true in the states of Bahia, Maranhão, and Piauí. The growers that explored these new cultivation areas were initially the same *gaúchos*, or generations that followed the pioneers.

In 2002, Brazil became the world's leading exporter of soybeans, with 31 percent of global exports. Argentina, the United States, and Brazil, together, had around 90 percent of global exports. This performance of Brazilian exports of soybeans in the early 2000s was also the result of climatic problems affecting U.S. crops, and the expansion of Chinese protein consumption (Análise Editorial, 2006: 183). Positions in the global ranking changed again in 2004 with the appreciation of the *real*, with the United States leading again. By 2009, Brazil was the world's second-largest exporter of this commodity.

The Role of Support Institutions

The Brazilian government played a very important role in the "discovery" and diffusion of soybean production and exports. A large amount of federal resources were allocated to the development of this crop. Two specific federal government agencies—EMBRAPA and EMATER—played a role in this process. The most important government action was undertaken by EMBRAPA, which deserves a large share of the credit for successful soybean cultivation in the *cerrados* of Brazil (Franco, 2001). As noted, EMBRAPA was created in 1973. By 2010, it had a budget of around $1 billion and 8,900 employees (of whom 2,024 were researchers—71 percent of them with PhDs), and it ran 44 research centers.[4]

In 1975, EMBRAPA SOJA (a division of EMBRAPA dedicated to soybeans) was created with the mission of "tropicalizing" the soybean. Similarly, in 1975, EMBRAPA CERRADOS (a division of EMBRAPA dedicated to the savannahs) was created to develop better soil-handling techniques to make commercial agriculture viable in the savannah region. Other EMBRAPA units joined efforts, such as EMBRAPA Agropecuária Oeste (EMBRAPA Agribusiness West). In 1980, EMBRAPA SOJA succeeded in creating the first soybean variety exclusively developed for the Brazilian savannah soil. This variety supported the first phase in the soybean production expansion that lasted until the end of the 1980s. Over

[4] See www.embrapa.br (accessed August 8, 2010).

the years, EMBRAPA developed other varieties that were even more productive and adaptable.

To illustrate the role played by EMBRAPA, soy crop yields rose by 65 percent in Brazil between 1988 and 2003, from 1,693 kilos to 2,800 kilos per hectare (CONAB, 2006). In the United States, the world's largest soybean producer, productivity increased by only 6.5 percent in the same period, to around 2,500 kilos per hectare (Lovatelli, 2009). Such gains in productivity, coupled with an increase in the planted area, enabled Brazilian soybean production to grow by an average of 20.7 millions of tons per year. Examples of technologies developed by EMBRAPA during its 37 years of existence that have been applied to soybean production include the development of 200 different types of soybeans; the introduction of nitrogen-fixing bacteria before sowing, which serves as a substitute for nitrogen fertilizers; and the development of fungus-resistant varieties.

The government's role in the development of soybean production and exporting was not restricted to technology development and diffusion. One of the main government policies for soybean development was the creation of special, subsidized credit lines that allowed farmers to finance investment and adopt new technologies during the first phase of soybean development. Credit was granted exclusively to farmers willing to adopt the technologies developed by EMBRAPA. These credit lines facilitated the adoption of new technologies and were supported by EMATER, the public agency responsible for rural extension. The technology diffusion process was managed by EMATER until 1991, when the agency closed. The diffusion of EMBRAPA's research was also done by extension agencies in the states. The government trained agents to transfer technology packages, which consisted of a number of technologies for a particular agriculture-producing area after careful study of the resources available and the characteristics of the area. Large rural producers had sufficient resources to hire their own staff and did not need to use public services for rural extension.

In addition, the government invested in basic transportation infrastructure (Coelho, 2001)[5] and set policies for price control, which affected almost all

[5] When development of the savannahs started, there was basically no transportation infrastructure available that could support the development of agriculture in the *cerrados* area. During the 1970s, the government built a number of roads connecting the new capital of Brazil—Brasília—to several cities in the *cerrados*, making possible the huge increase in agricultural output. However, even at the time these investments were made, they were barely enough to support the tremendous growth in economic activity in the region. Unfortunately, during the 1980s the conditions of these roads deteriorated. Lack of efficient transportation remains a serious problem for producers in the *cerrados*.

producers. It also created several programs aimed at stimulating production. The first set of programs was launched in 1971. This included the Center-West Development Program (Prodoeste), which focused on fostering the region's integration and on developing its infrastructure, and the Brazilian Savannah Development Program (Polcentro), whose objective was to modernize local agricultural plantations by means of rural credit (Mueller, 1990). Proagro, established in 1973, consisted of a type of crop insurance for the producer, with an additional amount paid to the producer to defray agricultural costs and losses in cases of natural disasters, infestations by pests, and sicknesses that could affect assets, herds, or harvests. Another program—the Japan-Brazil Savannah Development Program (Prodecer)—was formalized in 1978. It planned the settlement of landless farmers in new productive areas in the Brazilian savannah region. Programs such as Prodecer, Polcentro, and Prodoeste also provided subsidies to remove vegetation from the *cerrados* and buy fertilizers, and offered other financing options for the construction of silos, as well as tax benefits.

Cooperatives were another form of organization supported by the government for the development of soybean cultivation and of the savannah area. Soybean cultivation in the Brazilian savannahs is widely cited as an example of the consolidation of cooperative enterprises in the 1970s. *Gaúcho* farmers used to organize into cooperatives to buy large properties and divide them (Macêdo, 1998). The Agricultural Promotional Company (Campo), with resources from Prodecer, organized these cooperatives, providing land, tools, and a supply contract with the Japanese government. These programs were supported by the Ministry of Agriculture and financed by the Japanese government.

During the 1990s, the government substantially reduced its support to the soybean sector. Nevertheless, the role of the Brazilian government in this process cannot be underestimated. By supporting soybean growers until the economic liberalization in 1991, it permitted an infant sector to grow, encouraging individual entrepreneurs to accept risks that would otherwise be difficult to deal with. Moreover, the end of government protection permitted the industry to become fully competitive.

An exception to the reduction of government incentives and subsidies was Moderfrota, the credit program for agricultural mechanization created in 2000 and managed by BNDES. Until the program was created, heavy agricultural machinery was financed by BNDES using a special credit line (Finame) created in 1996. Moderfrota brought producers more advantageous conditions: a lower-than-ever interest rate (between 9.75 percent and 12.75 percent per year, compared to Finame's interest rate of 13.95 percent). Moderfrota played a crucial role in the modernization of Brazilian agricultural machinery by having

a direct impact on productivity, which increased from 2.18 tons per hectare to 2.60 tons per hectare between the harvests of 2000–01 and 2003–04, and to 2.75 tons per hectare in 2007–08. By 2003, the program had already facilitated the renewal of around 20 percent of the agricultural fleet and, by 2005, it had financed approximately $5.84 billion (Lopes, 2005).

Discussion

This case study did not identify a specific first mover. Rather, a large group of individuals migrated from the South of Brazil to the *cerrados* region in search of new land. This internal migration can be seen as a continuous wave of settlers to that region, in search of cheaper land and opportunities. The discovery in this case was basically the gradual use of the *cerrados* region to produce soybeans for export. This "discovery" would not have been successful without government intervention, especially by EMBRAPA, in developing soybean varieties adapted to the *cerrados* climate and soils. The case of soybeans can be seen as a government-led effort to expand Brazilian production and export of this crop. The government invested heavily in this region, with a strategic vision of expanding the agricultural frontier. Heavy federal investments during the 1970s and early 1980s allowed for drastic cost reductions, making possible the exploration of the *cerrados*. However, settlers responded to government actions first, followed by industrial firms, requesting more services from government.

To some extent, the *cerrados* region was a sort of agricultural El Dorado, attracting people of all ages to try a new life in a different environment. These newcomers to the *cerrados* were especially suited to develop the new land because of their level of education, openness to new technologies, previous knowledge, and experience. Other groups, migrating from different parts of the country and with different backgrounds, might not have been as successful as the *gaúchos*. The success of these adventurers spread by word of mouth and through personal mechanisms of network diffusion, such as friends and kin. *Gaúcho* pioneers inspired the movement of other populations from the Southern regions of the country to the Center-West regions and, more recently, to the Central and Northeast regions of Brazil.

Imitators were no different from the original settlers in the *cerrados* region. They were also *gaúchos*. In fact, they tended to come from the same regions, and often from the same towns and surroundings; in this way, family and neighborhood networks were transplanted to the new environment. This type of migration reduced uncertainties and difficulties for the followers, given

that they could quickly learn from first movers. Also, first movers were more open to transferring their experiential knowledge since they were connected by bonds of kinship and friendship to the newcomers. As a consequence, there were no specific differences between the strategies of first movers and followers. On the contrary, they were essentially similar, since imitators learned with first movers, copying their experiences, with the advantage that these experiences had already survived the test of time. The similarity between the two groups, drawn from the same population, can also explain the convergence of their choices.

First movers reaped the benefits of their pioneer move to the *cerrados*. They had access to the best land available, and at lower prices than their followers. There were no histories of failure and bankruptcy, although some must have occurred. In general, however, positive word of mouth and the growing number of followers suggest positive outcomes for the pioneers. In this case, however, the extent to which pioneers benefited more from their early move than followers is probably less relevant, since kinship and friendship bonds favored the transfer of whatever knowledge or differential advantages the pioneers had built in the early years.

Although economic occupation of the savannahs was a successful enterprise from the beginning, the hardships involved in transplanting a large group of people and their culture to an inhospitable environment should not be underestimated. First movers had to face the challenge of transplanting a crop that worked very well in the good soil and temperate climate of Rio Grande do Sul to the *cerrados* region, which was much drier and warmer, and where the soil was considered to be of poor quality at that time. Indeed, land was cheap in the *cerrados* precisely because of these characteristics. In addition, there was also the challenge of creating a new society in the *cerrados*, which was met by transplanting the social networks of the *gaúcho* pioneers.

External Events Influencing Discoveries and Diffusion

The growing international demand for soybeans was probably the most important external event in the early phase of soybean cultivation in the *cerrados*. Together with price increases, it stimulated farmers to accept risks. Currently, the expansion of the Chinese economy and China's huge demand for protein permit the sector to continue to expand, despite the negative impact of the appreciation of the *real*.

Even in the initial phase of soybean production in the *cerrados*, there were several positive spillovers. For example, between 1970 and 1982, there was a

substantial increase in the production of various upstream and downstream industries such as vegetable oils, fertilizers, seeds, chemical products, machinery, animal feed, chicken, pork, and transportation and storing services. In some cases, these industries were suppliers to the soybean industry. In other cases, soybean products were inputs in other industries' value chains. Altogether, this extension permitted the creation or expansion of a large variety of new economic activities. There were also spillovers to unrelated activities, in the form of advantages from technological advancement in various other production processes, such as oil extraction from other types of seed-crushing plants, and advances in fertilization technologies that could also be applied to other crops. Finally, the migration created a number of new municipalities, which required infrastructure and all kinds of support services, public and private.

Final Considerations

The extent of the *cerrados* experience involved a very large number of settlers and generated an extraordinary amount of positive spillovers for the country. Despite the substantial growth in soybean exports from Brazil, the sector faces a number of important challenges.

The most important barrier to the expansion of Brazilian exports of soybeans (and, for that matter, to exports of grains and other agricultural products) is transportation. More than two-thirds (67 percent) of the soy exported from Brazil is shipped by truck, 28 percent by train, and 5 percent by water. The cost of transportation is $23.50 per ton in Brazil, compared to $16.00 per ton in Argentina, and $15.50 per ton in the United States (Lovatelli, 2009). Brazil compares favorably with the United States and Argentina in terms of cost of land. Labor costs are not very important, since production is highly automated.

Another challenge relates to environmentally sensitive issues (Brandão, Rezende, and Marques, 2005). The continuous growth in soybean agriculture has been linked to the invasion of new forest areas by cattle farmers. International concern has increased as soybean has become one of the most important raw inputs for producing biodiesel, thereby further increasing demand—and pressure on new development in environmentally sensitive areas. In 2006, the industry association signed an agreement not to commercialize soybean in deforested areas of the Amazon (Lovatelli, 2009). These problems do not constitute a threat to the sector, but rather show a need to respond to legitimate social concerns.

In sum, the case of soybeans in Brazil presents a prime example of the transplantation of an agricultural crop that was extremely successful. The introduction of the soybean culture in the *cerrados* changed the face of one of the world's last agricultural frontiers by transforming previously sterile, unproductive land into one of the most competitive and technologically advanced agricultural areas in the world. In the process, Brazil became the second-largest exporter of soybeans in the world.

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CHAPTER 8

Pork in Brazil

Regis Bonelli and Armando Castelar Pinheiro

Since the mid-1990s, Brazilian exports of pork have increased from very low levels, as domestic producers have become more internationally competitive in response to the: (i) opening of the Russian market; (ii) strong demand for pork exports associated with mad cow disease (which cut off some traditional suppliers); and (iii) growth in world demand. Until 1978, Brazil exported relatively high volumes of pork to many countries, including some in Europe. But because of sanitary problems (the so-called "African swine disease"), it was kept out of the world market from the late 1970s until approximately 1995.

Today, Brazil is the world's fourth-largest producer and exporter of pork, accounting for 3.0 percent of total world output and 15.2 percent of total world exports as of 2005. In that year, Brazil exported 27.2 percent of its pork production. But the foreign market has only recently become an important destination for Brazil's producers: in 1990, total exports amounted to a mere $22 million, while by 2005 they had grown to $1,123 million (about 1 percent of total exports) (FAOSTAT, 2006).

Since exports began their current boom, the export basket of pork meat and by-products has not changed much because certification restrictions in the importing countries have been an impediment to more processed pieces. Carcasses and meat remain the main exported items, but notably, the share of processed pieces of meat is increasing, thus increasing value added. Exports of all types have expanded significantly since the mid-1990s. But in value terms,

the bulk of the expansion has been concentrated in boneless pig meat and carcasses, which together accounted for 90 percent of 2004 exports.

The productivity of Brazilian pork producers (81 kilograms per animal, as of 2005) compares well with that of other large players in world markets. It surpasses that of producers in Argentina (75 kilograms per animal) and Australia (73 kilograms per animal), and is not that much lower than that of U.S. producers (90 kilograms per animal) (FAOSTAT, 2006).

Unlike what has happened in Brazil's agriculture sector—in which rising yields, rather than an expansion in agricultural area, have underpinned output growth—in the case of pork, average productivity (measured as weight per animal) has not grown in the last 15 years—although, as discussed later, important firms and industry leaders, such as SADIA, have achieved significant improvements. Despite such exceptions, the increase in output, on average, has stemmed entirely from the expansion in the number of animals slaughtered (Table 8.1).

Despite being highly competitive, Brazilian pork producers find it difficult to enter most developed country markets. Tariffs are usually very high, but the biggest impediment is not typically formal trade barriers or subsidies to other competitors. Rather, nontariff barriers in the form of sanitary restrictions are the main impediment. Thus, imports of pork from Brazil are banned in Japan and the United States due to the presence (or alleged presence) of foot-and-mouth disease and swine fever. Virtually all exports of carcass pig meat go to Russia, which operates a tariff rate quota (TRQ) system under which Brazilian exporters pay an over-quota ad valorem equivalent (AVE) rate of 89 percent. Russia is also the main market for noncarcass pig meat, with a TRQ system that translates into an AVE tariff of 80 percent at the margin. Other countries outside the Organisation of Economic Co-operation and Development (OECD) impose few tariffs, but sanitary and phytosanitary (SPS) regulations are still the main impediment in many cases.

TABLE 8.1 | Output and Productivity in Pork Production, Brazil, 1990, 2000, and 2005

Output and productivity measure	Unit	1990	2000	2005
Slaughtered/production animals	Million animals	12.5	35.7	38.4
Carcass weight per yield	Kilograms per animal	84.0	73.0	81.0
Production	1,000 Metric tons	1,050	2,600	3,110

Source: FAOSTAT (2006).

As to the structure of the domestic industry, next to the large leading companies, others are considerably smaller. Medium-sized companies also operate in the market, adopting production systems that are similar to those of the leading companies. That is, the industry is an oligopoly with a competitive fringe, since smaller firms compete with the leading companies, but with organizational structures that are compatible with their resources, qualifications, and strategies. The two main firms, SADIA and PERDIGÃO, accounted for 12.2 percent and 11.4 percent of total pork production in 2005, respectively (SADIA, 2005; PERDIGÃO, 2005). Other large producers are Chapecó Companhia Industrial de Alimentos, Cooperativa Central do Oeste Catarinense (CCOC), Frangosul, Frigorífico Riosulense, and Seara. Most of their production facilities are located in the southern states of Santa Catarina and Rio Grande do Sul, near the largest concentration of farms supplying pork. But production is gradually spreading to the Center-West region, following a similar movement in corn and soy crops.

The Pioneer

The first firm to export a non-negligible amount of pork from Brazil in the more recent period was SADIA. PERDIGÃO was a close follower and was chosen as the main imitator for purposes of this study. As to the choice of counterfactual—to identify facts that did or did not contribute to export success—there were two possibilities initially: to consider poultry exports or to analyze the not-so-successful cases of firms such as CCOC and Chapecó.[1] Poultry exports are examined in some detail as a precursor of pork exports, while observations about the less-successful pork producers are also included. One crucial issue is why poultry exports expanded earlier and faster than pork exports, even though both are undertaken primarily by the same firms.

SADIA benefited from an interrelated array of factors that include the following: early compliance with sanitary requirements; appropriate product and process technology; good brand building; proper identification of distribution channels and destination markets; and, related to the last two, its success in poultry meat exports. The development of a specific, export-oriented logistic system was also important, as were previous attempts at selling the product abroad and, especially, the fact that these attempts addressed the need to satisfy importers' sanitary requirements and customers' tastes.

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[1] Actually, Chapecó is not a successful case at all because it went bankrupt.

In searching for the first mover, this study concentrated on the main product exported (HS 0203–29, other pork, frozen). An analysis of the performance of the 10 leading firms from 1990 to 2002 revealed that SADIA was the first firm to export. It began to export pork even before 1990.[2] SADIA was soon followed by CCOC, which began to export in 1992. But this firm's exports failed to keep pace with those of SADIA, as well as other followers.

SADIA has more than 11 industrial plants (two in Santa Catarina; one in Rio Grande do Sul; five in Paraná; and one each in Rio de Janeiro, Mato Grosso, and Minas Gerais), two agro and cattle units (Santa Catarina and Mato Grosso), and distribution centers in 14 states, in addition to commercial branches in Argentina, Chile, England, Germany, Japan, Russia, Turkey, the United Arab Emirates, Uruguay, and Venezuela. In 2005, it employed 45,400 people and worked in a supply chain of 10,000 chicken, turkey, and swine agro units. It exported to Asia (16 percent), Europe (24 percent), the Middle East (26 percent), the Americas (13 percent), and Eurasia (21 percent) (SADIA, various years).

Currently one of Brazil's largest exporters, SADIA started to sell to foreign markets in the late 1960s after focusing exclusively on the domestic market in the 1940s and 1950s. In 1967, the company sold several tons of swine and beef to the European Common Market and Switzerland, and in the early 1970s these sales were expanded with sales of beef and pork to Spain, France, Italy, and Portugal. These pioneering exports were low in value but provided technical learning, contacts with European firms and experts, and knowledge about the eating habits of different countries.

SADIA became more export-oriented beginning in the mid-1970s, reflecting changes in Brazil's external economic policy. While in the 1960s exporting required convincing the Brazilian authorities to expand export quotas, in the 1970s, notably after the first oil shock, the government stimulated exports. The stimulus took the form of tax and credit incentives and direct negotiations with foreign countries, notably the Middle Eastern countries, with which it tried to make a quid pro quo arrangement involving Brazil's oil imports.

Thus, SADIA's exports gained momentum only when it started to sell frozen chicken to Middle Eastern countries. In 1975, it exported $6.5 million; in 1976, sales reached $21 million. In the following years, the company expanded and consolidated its export activities, notably of chicken to the Middle Eastern countries (in 1980, most of the company's sales went to Bahrain, Kuwait, Qatar,

[2] Although it exported in small amounts, exports of HS class 0203–29 in 1990 totaled only $4 million.

Saudi Arabia, and the United Arab Emirates). But new markets were also developed in the Far East. In 1976, with the establishment of production facilities in the Center-West, the company diversified its export basket and began to export beef to Europe, the United States, and, together with poultry, to Middle Eastern countries. Still in the 1970s, SADIA also began to export soybeans and soy products, an activity that expanded substantially in the first half of the 1980s.

In 1980, when it established SADIA Trading to coordinate its foreign trade businesses, SADIA generated $106 million in exports, which accounted for 15 percent of its gross revenues. SADIA had made a transition from being a sporadic exporter to making selling in foreign markets an important and permanent part of its activities. Between 1981 and 1990, SADIA's exports rose from $160 million to $280 million, reaching 19 percent of the company's revenues. At the end of the 1980s, SADIA had become Brazil's largest poultry exporter, as well as one of the country's main exporters of pork, beef, soybeans, and soy products. Its trade representatives offered a basket of 70 different products in 40 countries.

SADIA's exports continued to expand, reaching half a billion dollars in 1994. In the following years, the company redefined its business strategy and ceased producing beef and soybeans and soy products, consequently discontinuing the exports of these products. In spite of a narrower product focus, SADIA continued to expand its exports and diversify destinations to Europe and Eastern Europe. It expanded its exports to Europe (a traditionally closed market), which came to account for one-fifth of the company's exports in 1997–99. SADIA also entered new markets in the late 1990s, such as those in Eastern Europe. Starting in 2000, it sought the external market more aggressively, trying to establish partnerships with local retailers, and it consolidated its position as Brazil's largest poultry exporter, accounting for 30 percent of such exports. In 2005, SADIA reached a record of $1.7 billion in exports (Table 8.2),

TABLE 8.2 | SADIA: Sales of Pork in Domestic and Foreign Markets and Total, 2001–05

	2001	2002	2003	2004	2005
Domestic (tons)	77,384	63,892	47,760	49,426	34,334
Foreign (tons)	50,015	87,140	103,689	79,052	105,818
Domestic (US$ millions)	66.8	46.8	42.2	52.9	60.9
Foreign (US$ millions)	81.0	107.8	144.5	146.9	243.4
Total revenues (US$ millions)	1,709.7	1,605.7	1,902.7	2,501.3	3,421.0
Total exports (US$ millions)	646.6	670.9	864.2	1,225.4	1,674.5

Source: SADIA (various years).

ranking among Brazil's 10 largest exporters. Currently, it exports about 1,000 items to over 100 countries.

Exports represented about 50 percent of SADIA's gross sales in 2004–05, nearly the same share as PERDIGÃO's. SADIA exports mainly poultry, with pork making up an important but smaller part of its business. In 2005, pork accounted for 9 percent of SADIA's revenues and 15 percent of its exports (Table 8.2). Its exports of pork have accounted on average for almost one-fourth of total Brazilian pork exports. In contrast with the company's other businesses, which are still mostly directed to the domestic market, pork is sold mostly in foreign markets: in 2005, 80 percent of SADIA's pork sales came from exports. In fact, exports tripled from 2001 to 2005, largely due to the boom in pork exports to Russia, where the firm had entered with poultry exports in 1989. As noted in one of the company's reports, "[a]ttention and agility in reacting to opportunities and impacts that stem from the international market, resulting from socioeconomic, cultural or political facts, played an important role in the company's external sales."

This was the case with expansion of pork exports to Russia. Benefiting from its earlier presence there, the company was well positioned when the Russian market was opened to foreign producers. Russia is the world's third-largest importer of pork, and when it returned to the market to buy animal protein in 2000, after the interruption caused by the 1998 economic crisis, SADIA rapidly spotted new possibilities for Brazilian meat exports, particularly pork.

SADIA's successful export drive in pork relied on a four-pronged strategy: strong emphasis on R&D investment and technological self-sufficiency; low vertical integration (outsourcing many phases of production), while stressing knowledge, logistical, and marketing-intensive activities; strong emphasis on high-quality and low-cost logistics; and large investments in branding. In these four dimensions, it relied on previous learning in the domestic market, as well as in exporting poultry meat, to leverage its export competitiveness.

Thus, since the 1950s, the firm has invested in technological improvements aimed at raising the quantity of meat per animal slaughtered (such as encouraging hog farmers to use balanced animal feed), and investing in modern confinement facilities. Early on, it imported pigs of the "Duroc-Jersey" breed from the United States and the "Landrace" breed from England, Germany, and Sweden, from which it developed an advanced genetic program that resulted in a high-quality Hiper-SADIA hybrid. With this accomplishment, SADIA succeeded in moving from a fat-producing pig—the norm in the mid-twentieth century—to a meat-producing one.

TABLE 8.3 | Changes in SADIA's Pork Productivity, 1975 and 2005

	1975	2005
Meat per carcass (percent)	46	59
Slaughter weight (kilograms)[a]	94	119
Feed conversion rate (kilograms)	3.6	2.6
Production cycle for each 100 kilograms of animal (days)	179	146

Source: SADIA (2005).

[a] Data are higher than those shown in Table 8.1 (which are based on FAOSTAT [2006] data for all Brazilian producers), implying that SADIA has higher-than-average and growing productivity.

In 1978, SADIA established a research center for animal genetics, biotechnology, and soil treatment. In the 1980s, the company invested extensively in technical expertise, training, and facilities to adapt products to the needs of foreign markets. R&D has been successful in improving the quality of meat, increasing gains in productivity in the operational area, and enhancing the genetic excellence of breeding stock—through projects such as the SADIA Swine Genetic Improvement Program, which has enabled the creation of genetic strains of swine that are especially adapted to Brazilian conditions and have allowed independence in the production of breeding stock.

Currently, the company is technologically self-sufficient, since imports of equipment and raw materials account for only a small share of total production costs. In the pork sector, the herd is originated from purely domestic lines and there is no dependence on genetic materials from other countries; SADIA relies on its own program of genetic improvement—the Hiper-SADIA—mentioned above. Overall, productivity increased by roughly one-third between 1975 and 2005 (Table 8.3).

Although tight, vertical coordination of the supply chain is critical, SADIA is not vertically integrated. Instead, it relies on partnerships with hog farmers, who supply the company with the animals to be slaughtered and processed in its industrial plants. Farmers are given material, veterinary, and technical support, and they also have to follow a tight schedule, including dates for animal feed delivery and hog pickup. In addition, SADIA also provides the herd's reproducer (*matriz*), whose genetic features were perfected in the company's laboratories. The company also produces and supplies the animal feed used by farmers. These inputs are often sold to farmers on credit, which is repaid when farmers sell their pigs to the industrial companies.

The firm's logistical expertise has facilitated its entry into foreign markets, where its strategy resembled in part the one it used in the domestic market.

Thus, as part of its internationalization process, in 1991–92 SADIA established commercial subsidiaries in Buenos Aires, Milan, and Tokyo. In 1994, with the objective of learning about the Chinese market, it established a restaurant in Beijing in association with a Chinese company. But its first distribution center abroad was established in Buenos Aires, in 1993. In 2000, SADIA had subsidiaries in Argentina, Chile, and Uruguay; commercial offices in England, Italy, and the United Arab Emirates; and representation offices in Bolivia, Japan, and Paraguay—in addition to the restaurant in Beijing.

SADIA's efforts to maintain its leadership in both swine and poultry exports were reinforced in 2006 and gained momentum in 2007 as it made huge new investments in plants and equipment. Despite exchange rate appreciation and the effects of the bird flu, SADIA invested R$1.06 billion in 2006[3] and R$1.10 billion in 2007 (compared to an average of R$180 million in 2000–05).[4] In 2006, SADIA attempted to take over its leading competitor, PERDIGÃO, through a hostile bid, but failed (see postscript).

The Decision to Export: Uncertainties and Coordination Problems

The decision to begin exporting pork was provoked by a host of factors. The first, from a domestic standpoint, was the intense competition and relatively small size of the domestic market (together with the accompanying need to increase scale so as to reduce costs), along with the slow growth in domestic sales and the previous knowledge of clients and marketing channels (because it already exported poultry on a significant scale). The second, from a production standpoint, was the low marginal cost of the operation due to the existence of a logistic infrastructure already in place to export a similar product (poultry). The third, from a macroeconomic standpoint, was a favorable (devalued) exchange rate in the early 2000s. The fourth, from a risk reduction standpoint, was producers' need to increase foreign exchange revenues to hedge against exchange rate risk (because input prices reflect commodity prices fixed abroad).

Recall that the decision of SADIA—as well as other producers, notably PERDIGÃO—to export poultry to Middle Eastern countries after the first oil shock in 1975 originally had been motivated, and likely facilitated, by direct

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[3] Given the average exchange rate of R$2.15/US$ in 2006, this means approximately US$490 million. Data from SADIA's Web site include "investments made during fiscal years."

[4] This amount includes a planned increase in the internationalization of its operations in Kaliningrad, Russia.

intervention from government officials as part of a "barter" effort aimed at increasing trade with the Middle East in exchange for crude oil. The recent boom, by contrast, had no direct intervention from the government.

Thus, especially since the 1990s, the takeoff of swine exports was not directly stimulated by public incentives. Rather, public support took the form of technological support for production and credit (working capital), especially during the initial phase of exports. Price support policies (with respect to corn production) were also important, as they affected feed prices. Given the decision to begin exporting, two sector-specific triggers stand out as most relevant.

The first trigger stemmed from competitive pressures in the domestic market. The Brazilian pork sector is very competitive, with the 10 largest producers accounting for only half the total number of hogs slaughtered. There are also competitive pressures stemming from the fact that the basic inputs—soy, corn, and labor—are easily accessible to all producers. Despite differences in technical expertise, the general production technology is, broadly speaking, common knowledge. Firms operate at different levels of productivity, but not necessarily of price competitiveness: less-productive firms can resort to informality, lowering costs by forfeiting the payment of taxes and compliance with sanitary rules. "Formal" producers saw exports as a way out of this unfair competition because export firms must comply with both tax and sanitary regulations. Particularly in a sector with so many inspections from foreign sanitary authorities, exporting offered a natural barrier against unfair competition from informal producers.[5] Thus, while the ability of the larger, more productive companies to grow by selling in the domestic market was curtailed by informality, exports offered an opportunity for them to expand that was limited only by the high trade barriers imposed by OECD countries.

The second trigger was comparative environmental advantage. The opportunity for Brazilian firms to export pork arose partly as a consequence of the difficulty of European producers, the world's leading exporters, in expanding output to meet growing world demand because of their inability to mitigate the environmental consequences of hog excrement. This created space for Brazilian exporters to enter markets previously supplied only by European producers. Another consequence of the environmental limit was that some European firms are partly relocating their pork production to Brazil.

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[5] It is worth noting that earlier attempts to export pork, in the 1970s, failed to some extent because of the poor sanitary conditions maintained by Brazilian firms. The return to the international market demanded large investments in this area.

Interestingly, what was previously a major environmental nuisance in Brazil has become a source of income to hog farmers. SADIA has developed bio-digesters, with which Brazilian producers earn income by selling carbon dioxide credits (on an industrial scale) under the Clean Development Mechanisms of the Kyoto Protocol. This program is self-sustaining and provides hog breeders with the resources necessary to implement proper waste control systems and use bio-digesters installed on their hog farms.[6]

The main difficulty that had to be overcome by the first mover in order for this export discovery to take place was meeting sanitary requirements. Pork production suffered a severe setback in the late 1970s with the appearance of classic swine disease, which was still remembered in the early and mid-1990s. Big firms like SADIA and its main follower, PERDIGÃO, were able to create commercialization channels quickly due to their administrative and managerial capacities, thereby enabling them to supply the international market with products of the required quality shortly after sanitary requirements were fulfilled. Once again, pork exports benefited from the previous experience with poultry exports.

During the planning stage, the main uncertainties were related to the required capacity to supply pork of high, constant quality (customized product) and how to overcome sanitary barriers. As noted, there were no major surprises in the initial stages of the export activity, as SADIA was well established in most countries with commercialization channels and establishments as a result of poultry exports.

As to the degree of learning and productivity increase, SADIA was successful in achieving three essential targets: quality control on the farm, quality control in the manufacturing plant (slaughterhouse), and the establishment of efficient distribution channels. The fact that the firm had already produced for the domestic market (for a long time) and had developed a reputation for the quality of its products led to reliable export products and increased exports. The main legacy from SADIA's leadership is its ability to supply a reliable product.

The main coordination problems stemmed from: the need to organize the production of hundreds of small hog farmers, who must abide by specific

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[6] With bio-digesters, hog excrement undergoes anaerobic fermentation in sealed tanks, thus avoiding gas emissions and eliminating odor and the proliferation of flies. The process also allows for the extraction of a bio-fertilizer and the production of biogases, which can be used as a source of energy. To date, SADIA has installed about 3,000 of these bio-digesters for farmers, who pay them back through carbon credits. SADIA sells the credits collectively, avoiding the transaction costs of small-scale contracts.

nutritional, sanitary, and logistic requirements; the ability to put a perishable good on supermarket shelves in a foreign market without any deterioration in quality; and the necessity of avoiding contamination within the hog herd. The experience with producing and selling in the geographically large domestic market was critical in allowing the company to deal with the first two challenges. In particular, reliance on independent but supervised hog farmers was instrumental in controlling contamination.

SADIA overcame coordination problems by investing in very specific production lines via a careful selection of plants (slaughterhouses) and farms. This was possible due to strict control of quality and sanitary conditions in plants and farms selected—something that was not achieved by many of its followers, whose exports did not keep pace with those of the first mover.[7] Coordination also came about by forming and joining the Brazilian Pork Industry and Exporter Association (Associação Brasileira da Indústria Produtora e Exportadora de Carne Suína, or ABIPECS) (see discussion below).

Among the positive spillovers brought about by the first mover (and main follower) that may have benefited followers were the inducement to utilize greater productivity techniques and the adoption of better sanitary conditions on the farm (upstream). In addition, SADIA, having learned how to operate in exchange rate markets, was able to control an important part of commercialization. Those exporters that improvised in this area (by speculating on exchange rate movements, for instance) were less successful. However, research for this study could not ascertain whether the first mover anticipated these spillovers in such a way that this had any influence on investments in exports. It nonetheless appears that these spillovers indeed had an influence, given the proximity of the plants and the flow of information among the main exporters, especially those who joined ABIPECS—which is also an instrument for dealing with coordination problems, as discussed in more detail later.

The Diffusion Process

SADIA's main (and close) follower is PERDIGÃO, whose supply chain includes approximately 10,000 producers of poultry, hogs, and cattle. Its operating model is similar to SADIA's, although PERDIGÃO has invested less than SADIA in pork genetics R&D. PERDIGÃO is located reasonably close by in the state of Santa

[7] This is not to say that these less-successful followers did not export at all; rather, they faced organizational and managerial difficulties and, in some cases, exported only small amounts.

Catarina, and was established at about the same time. The two firms operate in similar ways. In particular, PERDIGÃO's exports also rose substantially since its first sales of poultry to the Middle East, although until recently it put less stress on the external market than SADIA. Like SADIA, PERDIGÃO enjoys economies of scope in commercializing poultry and pork. The company exports to more than 100 countries, and has offices in Dubai, England, the Netherlands, and Singapore. In 2005, the regional distribution of its exports was as follows: Europe (28.3 percent); Far East (26.0 percent); Eurasia (21.6 percent); Middle East (18.4 percent); and the Americas, Africa, and others (5.7 percent).

The success of this particular follower resulted from its being a large producer for the domestic market—meaning that it possessed the managerial and organizational skills associated with successful big business concerns—as well as a group of interrelated factors. Foremost among them, in descending order of importance, were the following: experience in exporting other kinds of meat (poultry and beef); agglomeration economies and the increased competitiveness that arose from them; and association with foreign firms.

PERDIGÃO and SADIA made an attempt in the early 1990s to create a joint venture to open and exploit new markets abroad; however, the initiative failed because of the two firms' very different managerial cultures. As mentioned, in mid-2006, SADIA attempted a hostile takeover of PERDIGÃO, but it did not succeed (see postscript).

There has been little cooperation among pork firms regarding the provision of public goods, marketing, or technological activity, except for building laboratories for common use. The main firms, however, have joined together in an association of producers/exporters, ABIPECS. The association has prospected new markets, shared experiences, negotiated sector-specific policies and measures with the Brazilian government, created funds for sanitary guarantees, hired specialized consultants, and jointly administered reference labs. Considering the diffusion process and how the first mover faced competition from the new entrants, SADIA was able to withstand competition because of internal productivity increases, the realization of agglomeration and scale economies, and low logistic costs. Diffusion did not significantly affect the pioneer's export activities, as no noticeable cost increases were observed. Although farms supplying inputs are located reasonably close to one another, strong competition keeps input prices under control. Export prices also benefited from strong world demand in recent years. Thus, SADIA was able to keep the best market shares, and it also created firms abroad (in Italy, for instance) to improve logistic operations. Product differentiation, albeit limited by the very nature of its output, helped the company maintain and even increase its market shares.

Initially, all firms tried to explore the same markets. But they soon found that to expand exports, new markets had to be developed. This aspect of diffusion was slowed by strong competition among the incumbents (including firms in third countries) and by the uncertainty inherent in the exploration of new markets. Nonetheless, diffusion generally led to increases in all firms' export volumes, though in different proportions.

A host of factors, however, limited the first mover's ability to expand even faster than it did and to capture a larger market share. Exchange rate risk was one of these factors; financial constraints were another, as export activities placed increased demands on working capital needs. Strong competition from followers posed a further constraint. Finally, almost every new market carries with it a renewed degree of uncertainty.

Thus, even the first mover proceeded cautiously when expanding its exports. Among the spillovers from the first mover that were important for diffusion was the fact that it opened many channels in terms of knowledge of countries, size of markets, and tastes of foreign consumers. On the other hand, the entry of followers did not increase the costs of the first mover in any remarkable way, as mentioned. Contracts with hog farmers (who receive swine-specific technical support from the main incumbents) guarantee that agreed-upon amounts be supplied at specified times: These are long-term, bilateral relationships that have not been subject to (short-term) competition. Moreover, labor costs have not been an issue, since hog producers are independent, small-scale farms scattered around the producing region, and processing plants can easily hire new workers. In-house training, which results in a more specialized workforce, helps keep workers in the firms where they were trained, even though this kind of learning is not firm-specific.

Diffusion took place very quickly. PERDIGÃO and other, less-important followers were able to export to Russia, since information about the opening of the Eastern European market spread almost instantaneously. In this sense, this information and the steps required for certification (sanitary conditions) were sector-wide public goods within the producing regions in the country. Certification required bringing foreign experts to visit and inspect production facilities. Thus, certification is plant-specific, within regions previously cleared with respect to diseases. In general, firms above a certain size—which usually implies a minimum stock of managerial and organizational abilities—were capable of supplying the Russian market as soon as sanitary requirements were fulfilled.

One interesting aspect of the diffusion process is the evolution of export prices (Table 8.4), which suggests that changes over time were in the expected

TABLE 8.4 | Average Unit Values of Pork Meat Exports, 1996–2006 (November)
(US$ per ton)

Year	HS 0203–21	HS 0203–22	HS 0203–29
1996	1,989	1,345	2,229
1997	2,488	1,458	2,562
1998	1,784	797	2,061
1999	n.a.	499	1,551
2000	1,159	588	1,468
2001	1,196	947	1,564
2002	806	784	1,262
2003	858	646	1,294
2004	1,350	939	1,687
2005	1,527	1,409	2,146
2006[a]	1,671	1,349	2,215

Source: FUNCEX database, based on SECEX/MDIC.
Note: n.a. = not available.
[a] January–October.

downward direction. This seems to indicate that initial diffusion did reduce prices somewhat, though the amounts exported were still very small. Once the Russian market was opened, market prices soared. Thus, an opposite movement occurred some time after 2000, as pork prices in the international market increased substantially. This, in turn, helped diffusion to take place, as it enabled less-efficient firms to enter the market. Strong world demand played its part in pushing average prices up.

Consider the case of product 0203–29 (the most important in value terms, as mentioned previously) (Table 8.4). Prices stayed above the $2,000 per ton mark for only a couple of years during initial export operations (of low volumes, as noted).

As diffusion proceeded, prices fell substantially, to a little less than $1,300 per ton (similar trends characterized HS classes 0203–21 and 0203–22, as shown in Table 8.4). Strong demand after 2002, as well as fears associated with mad cow disease—which diverted consumers to pork—brought average prices (average unit values, more precisely) in 2006 back to levels of the same order of magnitude observed 10 years earlier, in nominal terms. A similar, but less clear, pattern characterizes product HS 0203–21. Therefore, strong, international competition was an impediment to higher pricing because it forced incumbents to compete with producers abroad—and amongst themselves.

TABLE 8.5 | SADIA's Share of Exports, HS Class 0203–29, 1990–2003 (First Half)

Measure/Unit	1990	1992	1994	1996	1998	2000	2002	2003 (First half)
Total (US$1,000)	20.0	65.0	65.6	116.3	146.2	143.5	288.8	168.3
SADIA (US$1,000)	4.0	10.5	13.9	19.4	17.0	23.7	59.2	44.5
SADIA/Total (percent)	20	16	21	17	12	17	21	26

Source: FUNCEX database.

The diffusion process has not harmed the pioneer in the quantity dimension either, as can be inferred from export values: SADIA's share of total exports of HS class 0203–29 has fluctuated since the early 1990s, with a fall in the late 1990s, but then increased substantially until 2002–03, as shown in Table 8.5. Its share of total pork exports has also fluctuated more recently. Still, SADIA accounted for 22 percent of total pork exports in 2005.

A Precursor: Poultry Exports

Many pork producers did not succeed in following the first mover. One of them was Chapecó Companhia Industrial de Alimentos, which stopped exporting in the early 2000s.[8] Other examples include Cooperativa Central Agropecuária Sudoeste, Frangosul, and Cooperativa Central do Oeste Catarinense (CCOC). The reasons for the disappointing performance of these firms are the same: a combination of technical, administrative, and managerial inefficiency (e.g., inability to comply with sanitary rules and obtain the required certification to export); poor financial planning (e.g., inability to operate efficiently in foreign exchange markets); and mistaken strategy (e.g., targeting the wrong market). Thus, Chapecó and CCOC could have been chosen as possible comparators against which to contrast the experience of SADIA (and PERDIGÃO as well, for that matter). These two processing firms are (or were, in the case of Chapecó) large producers that have also engaged in exporting pork, but with much less success than SADIA and PERDIGÃO. The main reasons why CCOC and Chapecó were less successful are the following: inability to adopt new technologies; inability to comply with sanitary and certification requirements of importing countries; failure to develop a good brand reputation; and especially (and

[8] Actually, it went bankrupt and closed operations altogether, as noted.

comprehensively) failure to develop a minimum degree of managerial efficiency. In general, producers incapable of adopting new technologies either exited export markets or exported only small volumes.

As mentioned previously, the very successful activity of poultry exports can be used as a precursor. Counterfactuals are useful for appraising why diffusion occurs in some cases and why it does not in others. But in the current case, due to the dearth of usable counterfactuals, the use of frozen and refrigerated poultry exports provides an interesting precursor in the sense that this activity, very much associated with pork exports, took off much earlier and more successfully.

One important aspect in the case of poultry exports is that consumers in different countries have specific needs and preferences. Thus, in Japan, special parts of white poultry meat are required in specific cuts, while in Middle Eastern countries poultry pieces must be cut into different sizes and shapes because of religious requirements (for halal meat). Producers must therefore meet special preferences in the markets they target. Successful targeting of this kind is why poultry exported by SADIA has been so widely accepted. Once a distribution logistic system was in place, and production custom-designed for the cuts and sizes required abroad, all depended on regularity of delivery—timely delivery being considered a substantive "quality" asset—and price.

Here is where dynamic, comparative advantage enters the picture. First, consider animal production. SADIA (and its followers, such as PERDIGÃO) developed an extended network of suppliers around their slaughterhouses over a long period of time. They were quick in learning how to cut poultry quickly and efficiently, something that could be adapted to swine slaughtering and processing. Therefore, capabilities developed for the poultry business were instrumental for pork success later on. Efficient packaging also helped reduce costs. Another characteristic feature of the leading firms has been the attainment of high meat quality and hygienic standards. But markets for pork abroad were mostly closed to large-scale exports until Russia opened its market, which allowed Brazilian exports to surge.

As mentioned previously, SADIA was able to cope with brand building, had developed efficient logistic systems, and was a leader in animal R&D activities before entering the pork-export business in earnest. Despite the fact that large-scale pork production—like poultry production—was already a long-established activity in Brazil, poultry exports took off much earlier than swine exports (even though both types of production had essentially been undertaken by the same firms). The main reason for this phenomenon is that poultry exports were initially directed to Middle Eastern countries, which had

less-stringent phytosanitary requirements, and where a large portion of their populations do not eat pork. Barter provisions in oil purchases offered by the Middle Eastern countries further boosted poultry exports.

Another reason why swine exports lagged behind poultry exports was the difficulty in complying with sanitary requirements. This also involved an element of luck, in the sense of being able to tap the Russian market as soon as restrictions began to be lifted, and as the fear of mad cow disease spread. This point is discussed below.

Apparently, there were uncertainties involved in exporting pork that had already been overcome for poultry exports. These uncertainties were mostly related to market access and were due to the inability to comply with sanitary standards of the importing countries (as well as to bad memories of export failures owing to disease outbreaks in the 1970s), as suggested. How were they overcome?

It seems certain that the opening up of the Russian market represented a unique opportunity to be quickly tapped by the pork producers that were already incumbents in the related poultry business. This occurred, however, only when strict, phytosanitary conditions were fulfilled. When the opportunity provided by the opening up of the Russian market became apparent, few firms in Brazil possessed the means to apply for inspection from foreign inspectors, after complying with regional rules controlled by the Brazilian authorities. SADIA was one of them, however, and its managerial efficiency made it especially suited to take the leading role. Therefore, its success in exporting pork resulted from a combination of within-firm characteristics and exogenous events.

The Role of the Public Sector

Direct involvement by the public sector in the discovery process was nil in the case of pork exports. But note that barter provisions in oil purchases made it possible for the poultry sector to succeed, and bartering in turn was a key element in the success of the pork sector. Therefore, the public sector did have an indirect impact. Nearly the same can be said of public sector involvement during diffusion. There were no specific fiscal incentives—or research, infrastructure, financing, or regulation—that might have facilitated the discovery and diffusion. Research carried out at EMBRAPA helped,[9] but was not specific

[9] EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) is a successful, state-owned, agricultural research company dedicated to the development of new seeds.

to animal production. It would, however, have been important in such issues as how to deal with the treatment of effluents from slaughterhouses. Entities such as nongovernmental organizations (NGOs) and academic/research organizations have not played a significant role in diffusion. The exceptions are the actions taken by the exporters' association, ABIPECS, that facilitated the exchange of information and thus aided the diffusion process.

As suggested, government policy and incentives were deemed by all interviewees to be of lesser importance during the initial steps of the exporting process. Even so, interviewees attributed some importance (but not much) to credit and to public financing of investments geared toward the export of pork and government-sponsored research programs. Technological infrastructure, commercial negotiations, and government-sponsored attendance of commercial fairs (through APEX, for instance)[10] were deemed of no importance at all during the initial export phase. Government was likewise viewed as unimportant in the opening up of new markets through commercial and trade agreements, or the exit of former competitors.

Thus, the Brazilian government has contributed less to fostering pork exports than other products, such as aircraft (see Chapter 9) and cell phones. Still, it has played important roles in two aspects. First, it is a source of export finance for hog and pork producers, especially through BNDES.[11] Second, it is up to the public sector to negotiate sanitary agreements that establish with each individual country the sanitary rules with which producers have to comply. Because phytosanitary trade barriers are so fundamental, success in bilateral negotiations is critical in creating market access. Much of the certification (such as certification of origin) required by importing countries is under the aegis of the Ministry of Agriculture, which is also responsible for the control and prevention of diseases—or fears of disease—that function as a major trade barrier in the main importing countries.

Reasons for Success

Many factors explain the improvement in competitiveness in pork production, including the previously mentioned economies of scope (poultry and swine). From the production side, two factors stand out: ample availability of grain (soy

[10] APEX (Agência de Promoção das Exportações) is a trade and investment promotion agency sponsored by the federal government.

[11] BNDES is Brazil's National Economic and Social Development Bank, a federal government institution that supplies investment loans on favorable terms.

and corn, used as feed) at competitive prices (see Chapter 7, on soybeans); and production technology. Yet significant export levels were possible only after adaptations were made to comply with technical and phytosanitary requirements from importing countries. Promoting the brand was also deemed to be of critical importance with respect to prospective consumers, wholesalers, and retailers. No less important was the development of an export-oriented logistic system, as well as the establishment of distribution centers in the main destination markets. These aspects are discussed next.

Comparative productive advantage. Brazil's comparative advantage in soy and corn production (from which animal feed is made), and the availability of low-cost land and skilled labor, give SADIA (and the follower, PERDIGÃO) a cost advantage. The importance of low-cost animal feed, including transportation costs, may be assessed by the fact that these firms are transferring a large part of their industrial facilities to the Center-West region, where an increasing share of the soy and corn crops are grown. It is cheaper to feed and slaughter hogs locally, and then transport their meat, than to concentrate the production process closer to the consumer centers. Also, hog-raising is labor intensive. Thus, the specialized, low-cost labor made available by the integrated production process is another source of cost competitiveness. Climatic conditions are also very favorable, not least because they do not require animals to remain confined.

Accumulated learning in the domestic market. SADIA and PERDIGÃO had long been large companies, with half a century of experience in producing and selling pork in the highly competitive domestic market when they embarked more seriously on exporting pork. In particular, both had very sophisticated logistic systems for delivering refrigerated, perishable products all over the country. This expertise proved valuable in exporting. From the very beginning of their operations, both firms had to invest heavily in operating with low logistic costs in order to compensate for the long distance between their locations and the main, domestic consumer centers. SADIA, in particular, seems to have replicated its earlier domestic strategy in the export market, operating with local distribution centers. This happened initially with poultry exports, but the accumulated knowledge was used when exporting pork. Both companies have logistic systems that allow them to trace where each product is at any time.

Technology and brand name control. SADIA, more so than PERDIGÃO, invested intensely in genetic research and the development of its own animal breeds.

In particular, productivity growth in this sector depends on technological innovation, notably in genetics. Both firms invested heavily in strengthening their brands, both domestically and in foreign markets. Indeed, it seems fair to assert that the two companies' main assets are in knowledge—of genetics, production, and logistics—and in brand name. Their main role in the integrated production system is to develop and apply technology while organizing the production system and selecting animal feed. Both companies operate research centers in animal genetics and manage sophisticated logistic systems, although they do not own the trucks used to transport their output. In addition, ownership of technology and brand names allowed them to export anywhere they wished, without the kinds of limitations faced by cell phone exporters, for instance.

In the model of the discovery process advanced by Ricardo Hausmann and Dani Rodrik (2003), firms face uncertainty about local costs of production before they begin exporting and must sink capital into experimentation to find the actual costs, unless they already know the costs from some related activity (which, incidentally, is the case with pork and poultry exports). Many kinds of uncertainty may be present in the process of investing in the development of a new export activity. As suggested by Hausmann and Rodrik, and augmented by additional research, the production of new goods is subject to uncertainties such as production costs, foreign demand, and logistic and other commercialization costs (including upgrading to meet technical and consumer requirements abroad).

There are clear economies of scope in the two types of exports (poultry and pork), including the fact that they can rely on similar distribution channels and brand names. Indeed, both SADIA and its main follower see themselves more as exporters of poultry than of pork—first because chicken represents a larger share of their revenues, and second because chicken represented their entrée into exporting. Thus, pork exports were undoubtedly leveraged by the knowledge accumulated in exporting poultry and by well-established brand names and distribution channels. In this regard, SADIA started to sell poultry in Russia in 1989 and was thus well positioned to enter the pork market when the Russian government opened this market to foreign producers in the mid-1990s. Knowledge and past experience with the distribution channels, in particular, are a critical factor. Another clear advantage was their previous business with meat wholesalers and retailers, including supermarket chains.

Several main lessons emerge from the experience of the first mover. First, improvement of phytosanitary requirements was a critical factor—together with technological modernization and genetic improvements—that led to enhanced

competitiveness and represented positive externalities generated from the first mover's exports. Second, the first mover increased knowledge of destination markets' requirements (especially important as far as customers' tastes are concerned) as it acquired further experience, which in turn helped it enhance its brand. Third, the first mover did not benefit from government support in any substantial way in any of these areas. Fourth, the first mover's experience shows that failure to control sanitary risks by some firms in Brazil could have a devastating impact on exports of all firms, including those that in fact do maintain proper sanitary control of their production, because customers do not separate out which producers comply with sanitary requirements and which do not.

Postscript

SADIA was a victim of the 2008 economic and financial crisis, not because of its industrial operations and marketing, but due to poorly structured financial operations. As a result of substantial losses, it was sold to its main follower, PERDIGÃO, in May 2009, forming a new giant firm: Brasil Foods (BRF). The new firm has sales of R$24.4 billion (US$14 billion), 110,000 employees, and 64 industrial plants. PERDIGÃO has control of the new firm, but SADIA has the strongest brand. The merger process is under review by the Brazilian authorities in charge of enforcing competitive behavior (Administrative Council for Economic Defense, CADE).

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CHAPTER 9

The Aircraft Industry in Brazil (Embraer)

Armando Castelar Pinheiro and Regis Bonelli

Embraer (Empresa Brasileira de Aeronáutica S.A.) is the company responsible for Brazil's success in becoming a large aircraft exporter. It focuses on specific market segments in three areas—commercial, defense, and executive aviation—and is the world's third-largest civil aircraft manufacturer, representing a successful case of entry into a closed oligopoly dominated by U.S. and European firms. Embraer and its main rival, Bombardier, a Canadian manufacturer, are successful cases in the sense that they were able to profitably enter the aerospace market with a niche strategy in mid-range jets, forcing incumbents such as Saab (Sweden), Fairchild (United States), and Fokker (the Netherlands) to exit (Goldstein and Le Blanc, 2003).

The first Brazilian airplane to be exported was the Paulistinha, a single-engine, lightweight airplane produced by the Companhia Aeronáutica Paulista, a firm established in 1942 (Forjaz, 2005). However, only in the second half of the 1970s did Brazil's airplane exports start to climb from their low values, reaching $500 million in 1989, in the wake of Embraer's successful entry into the U.S. and European markets. In the early 1990s aircraft exports declined considerably, to less than half the 1989 peak, only to expand once again after Embraer's privatization in December 1994. In the 1996–2000 period, exports of Brazilian airplanes, parts, and components recorded an eightfold rise, from $0.4 billion to $3.2 billion; they have stabilized at that level since then.

The Pioneer

The undisputed pioneer of Brazilian aircraft exports is Embraer. Its business consists of designing, assembling, and selling airplanes, as well as executing technical services related to the production and maintenance of aeronautic materials. The company has also started to manufacture airplanes in China. It currently employs close to 17,000 people, 95 percent of whom are based in Brazil. The company is publicly traded on the New York and São Paulo Stock Exchanges, and the firm's capital is only partly owned by Brazilian interests. Investment conglomerate Companhia Bozano (based in Brazil), the pension funds PREVI and SISTEL (based in Brazil), and Grupo Europeo (Dassault Aviation, EADS, Safran, and Thales) each have 20 percent of the voting shares. The federal government owns a small block of shares, and the rest are freely floated on the stock exchanges.

The tale of Embraer's export success starts in the late 1940s with the construction of the Aerospace Technological Center (Centro Tecnológico Aeroespacial, or CTA) and, within it, the establishment of Brazil's first school of aeronautical engineering, the Technological Institute of Aeronautics (Instituto Tecnológico de Aeronáutica, or ITA), and the Institute of Research and Development (Instituto de Pesquisa e Desenvolvimento, or IPD) in the early 1950s. In the mid-1960s, the IPD developed the prototype model IPDIPAR 6504, an eight-passenger turboprop plane that flew for the first time in 1968. Various versions of the plane were developed until the EMB 110C, called the Bandeirante, was created. This small, 15-seat, non-pressurized plane was used for civilian aviation (earlier models had been used for military purposes).

Embraer was founded in 1969 as a company controlled by the federal government, under the aegis of the Ministry of Aeronautics.[1] The company was initially established to manufacture the Bandeirante, starting with a batch of 80 airplanes for the Brazilian Air Force. The plane's size, robustness, and costs made it suitable for regional aviation, serving Brazil's medium-sized cities (which often had poor airport infrastructure, such as short and poorly maintained runways) with reasonable flight frequencies and affordable airfares. These cities had been left without access to air transportation as a result of the restructuring of the civil aviation industry in the 1960s, with a

[1] The following paragraphs on Embraer's history and development draw on Pinheiro (2002) and Goldstein (2002).

reduction in the number of air carriers and the increasing use of large planes. These large airplanes had substantial cost advantages over the earlier models but required a large volume of traffic to operate with profitable load factors. Since Brazil had a much smaller market than those of the United States and Europe—the focus of the leading aircraft manufacturers—the introduction of larger planes led to a substantial decline in the number of cities served: from 335 cities (roughly 4 percent of the total) in 1958, to 45 in 1965, before increasing again to 92 in 1975.

From the 1970s onward, Embraer reached new technological thresholds as it brought to the market, together with the Bandeirante, two agricultural planes: Ipanema and Urupema. In 1974, Embraer signed a license contract with Piper to produce a host of planes, including the twin-engines Navajo and Sêneca, and the six-seat, single-engine Sertanejo and Minuano. In cooperation with the Italian manufacturer Aermacchi, Embraer subsequently produced the military training plane, Xavante, as part of a technology-transfer program. A new technological breakthrough came with the Xingu, the first pressurized airplane built in Brazil. In the 1980s, Embraer climbed another technological step in producing the military model AM-X, a two-seat, single-engine, subsonic attack jet for advanced and fighter lead-in training, developed in a joint venture with Italian aircraft manufacturers Aeritalia and Aermacchi. The first units were delivered to the Brazilian Air Force in 1989.

Starting in the mid-1980s, government ownership went from being a support for the firm to becoming a major burden for Embraer's competitiveness, for at least two reasons (Pinheiro, 2002). First, public controls on the company's management activities became much more cumbersome: all-important decisions had to be approved in Brasília, often by both the executive and legislative branches. Second, the government forced the company to enter into unprofitable projects such as the CBA 123, a joint venture with Argentina's Fábrica Argentina de Materiales Aeroespaciales (FAMA), which was technologically sophisticated but commercially unviable. A decline in exports and domestic sales reduced the total number of planes sold from 211 in 1989 to 81 in 1992. Morale was down and losses accumulated fast. In 1990–92, Embraer accumulated net losses of $775.7 million, out of a total of $1,060.2 million in net revenues. Embraer's longtime president, Ozires Silva, was brought back in 1991 in an attempt to reverse the company's downfall, but to no avail. However, Silva was instrumental, together with the rest of Embraer's management, in pushing for the company's privatization. Embraer was included in the privatization program in January 1992 and sold

in December 1994, to a consortium of banks and pension funds that bought 55.4 percent of the voting shares for $182.9 million.[2]

The company benefited tremendously from privatization. When Embraer was a state-owned enterprise (SOE), it had focused on technology and technical matters, with comparatively less emphasis on management practices, especially as administrative restrictions and political interference expanded in the 1980s. Privatization led to a complete turnaround in the company's management practices and finances, accounting for a significant part of its later success. In particular, it enhanced Embraer's profit orientation and freed it from the myriad of restrictions and controls to which Brazilian SOEs are subject. The new owners managed to keep the company's technological strengths and made a large capital infusion that allowed the EMB 145 project, originally launched in 1989, to be completed.

Embraer became an exporter in 1975, selling units of the Bandeirante and the Ipanema to the Uruguayan Air Force and Ministry of Agriculture, respectively, collecting $5 million in exports. Two years later, the first Bandeirante was sold in France, followed, in 1978, by sales to the United States. In 1981, Embraer won its first large, international procurement bid, selling a batch of 41 Xingu airplanes to the French Ministry of Defense.

With the relatively good penetration of the Bandeirante in foreign markets, Embraer concentrated on developing a new generation of airplanes. In the military training category, Embraer launched the Tucano, which incorporated technically sophisticated and creative solutions. Developed in just two years under a contract with the Air Force, the Tucano was an export success, generating larger sales in foreign markets than the Bandeirante. The second airplane directed at regional passenger aviation was the Brasília. A fast, pressurized airplane, the Brasília was derived from the Bandeirante and had the capacity to transport 30 passengers. This airplane was another export blockbuster: a total of 356 units were sold in 14 countries, with the first plane certified and sold in the U.S. market in 1985.

In the early 1990s, world recession, the government's decision to discontinue a number of export finance and incentive schemes, and the loss of competitiveness in the military aircraft market led to a significant fall in exports, which recovered only after the privatization and completion of the EMB 145

[2] Embraer's financial health deteriorated to a point that, before privatization, the government had to make a capital infusion of $190.1 million simply to make the company salable.

development project. Directed at the regional aviation market, the EMB 145 was the company's first commercial jet. Certified and first exported in 1996, it was largely responsible for lifting the company's exports. Recently, Embraer has begun to sell a new series of commercial jets: the EMB 170, EMB 190, and EMB 195, with 70, 90, and 110 seats, respectively. Embraer has also been very active in exporting executive jets and military planes. In 2006, the first five units of a batch of 25 Super Tucanos, an upgraded version of the Tucano, were delivered to the Colombian Air Force for a price of $235 million.

To become a leading aircraft exporter, Embraer had to overcome several barriers and uncertainties. The most noteworthy, of course, was the ability to develop technologically and commercially viable planes. Developing a new aircraft takes about three years and costs about $1 billion. In particular, the initial project had to be developed while no revenues were accruing; and given the level of technological mastery in Brazil in the 1960s, there was a reasonable risk that it would not be successful. Four main instruments were used to foster the company's technological upgrade.

First, the government directly financed the initial technological investment that led to the development of a twin-engine turboprop airplane that would eventually become the Bandeirante. Thus, Embraer was created to manufacture a plane that already existed. The first plane projected and built by Embraer was the Xingu, which first flew in October 1976.

Second, the company engaged in a number of technological partnerships with more advanced firms, such as Piper and Aermacchi, some of which explicitly incorporated technological transfers. These transfers were organized through offsetting clauses in military contracts; when winning a bid, a supplier had to agree to buy some of its inputs from domestic manufacturers.

Third, through military procurement, the government has supported Embraer's efforts to produce more sophisticated planes. Examples are the Tucano and, more recently, the Super Tucano, developed jointly between Embraer and Brazil's Air Force. Technological advances in the military area have been passed through to the manufacturing of commercial planes.

Fourth, in the early 1990s, Embraer began to transfer the cost and risk of the development of new projects to suppliers. Based on a general blueprint defined by Embraer, suppliers carry out and finance the necessary R&D and then share the profits.

Embraer could have avoided technological uncertainty if it had decided to license the technology of a foreign manufacturer, rather than develop its own. But then it would not have been able to export—at least not to the main foreign markets of interest to the licensing firms. Without exporting, Embraer

would have been forced to operate on a small scale with high costs, and thus remain dependent on a continued inflow of public subsidies and/or trade protection to stay competitive in the domestic market. Previous experiences with the establishment of local aircraft manufacturers had shown that lack of scale was a critical limitation to the ability to compete with incumbent manufacturers, domestically and abroad.

These circumstances highlight the role of commercial as well as technological uncertainty. It was thus important that the Bandeirante was a low-cost, durable, and easy-to-maintain airplane; in addition, Embraer's planes are usually priced very competitively. But success was not necessarily guaranteed, as exemplified by the CBA 123 Vector project. This 19-passenger, pressurized turboprop included what were expected to be revolutionary features for this category, such as a super-critical wing profile and engines at the rear of the fuselage. These would increase passenger comfort and the plane's speed, which would come close to 650 kilometers per hour, almost the speed of commercial jets. The CBA 123 flew for the first time in 1990, but it was an expensive, commercially unsuccessful plane.

The "solution" to this kind of uncertainty came from two practices that differentiated Embraer from most other Brazilian SOEs (Pinheiro, 2002): its early and intense focus on export markets, forcing it to operate in a competitive environment; and its low degree of vertical integration, acquiring systems, parts, and components from whatever supplier offered the best alternative.

Another important uncertainty was whether a plane manufactured in a developing country would sell in the markets of industrialized countries—the only ones large enough to allow production at an efficient scale. To overcome this barrier, the company first sold these planes domestically and in other Latin American markets. But the national certification of Embraer's planes by the CTA was not accepted by the authorities in the United States and Europe—then the largest, potential export markets. This required the government to reach certification agreements with these countries, which demanded intense training of the staff of CTA, the institution in charge of the international certification of Brazilian-made planes. Only then was the Bandeirante certified in U.S. and European markets.

Another difficulty was overcoming the reluctance of potential clients. Usually planes are manufactured on demand and take a few years to be produced. Airlines prefer to buy several planes of the same model at once to guarantee equipment compatibility—another barrier to entry originally faced by Embraer. To overcome these difficulties, Embraer brought potential clients to

Brazil to visit its headquarters, fly in its airplanes, see its manufacturing plant and operations, and learn about its products in general. Another important move was the establishment of subsidiaries in the United States and Europe in charge of technical assistance and supplying replacement parts, as well as reliance on parts bought from large, well-known international suppliers.

In these ways, Embraer worked to overcome an important market failure, stemming from the information asymmetry involved in the introduction of a new technologically sophisticated product by a developing country manufacturer. This has generated positive externalities to other Brazilian firms, including those outside the aeronautical sector, but the main beneficiary of this brand-building process has been the company itself.

Another uncertainty regarded the trade barriers that could be imposed on Embraer's exports. The low degree of vertical integration in manufacturing helped mitigate this risk, for the company's suppliers were allies in fighting these barriers. But a big "lucky break" was also important: the Bandeirante was certified in the U.S. market right when President Jimmy Carter signed the Airline Deregulation Act of 1978. This was a landmark in the history of the U.S. air transportation sector, leading to the establishment of the hub-and-spoke system, and the creation of a large number of commuter airlines.

It was against this backdrop that Embraer launched the Bandeirante in the U.S. market, offering an attractive combination of size, efficiency, robustness, and price. It was the right airplane at the right time and place. Like Brazil, the United States was experiencing a shortage of planes of the appropriate size, as traditional plane manufacturers increasingly concentrated on large airplanes, which were too expensive and/or forced a low flight frequency in connecting small and large cities. A smaller airplane allowed for greater flight frequency, with superior load factors.

A final, important uncertainty stemmed from Embraer's status as a state-owned enterprise. In general, SOEs in Brazil suffered from political interference and multiple objectives that often compromised their competitiveness. Hence, it was critical that the company had:

- A private sector culture, strong leadership, and the ability to deflect the worst bureaucratic controls stemming from public ownership. Although Embraer was an SOE, it always tried not to behave like one. As one longtime employee stated, "Embraer was distinct for the fact of not wanting to be an SOE. There was always a culture of a company with a differentiated role—something special, to design and manufacture airplanes. There was always a feeling of being part of

something special, of the big challenge that designing and manufacturing airplanes entailed."

- Administrative continuity, strong esprit de corps, loyalty among its employees, and strategic focus. Dr. Ozires Silva and his executive directors managed the company continuously from 1969 to 1986.
- Early and strong export focus, which "permitted longer production runs, stimulated customers to bring new ideas for technical change, and demanded exacting performance standards" (Goldstein, 2002: 101). Only a few years after its creation, Embraer was already exporting planes. Exporting was totally dissociated from the original government program—which envisioned Embraer's role as focusing on the domestic market and supplying military planes—and helped strengthen the company's private culture, reducing its dependence on government funds.

Embraer succeeded where others had failed, in part due to the solution of coordination problems that helped defeat previous attempts to manufacture planes in Brazil. The most important challenge by far was the development of human resources and research facilities that could support the company in developing its own airplane projects. In this sense, the company owes much of its success to the sequencing adopted in developing the Brazilian aeronautical industry, particularly the earlier establishment of the CTA and ITA. To this day, most Embraer engineers are ITA graduates.

Another major coordination problem was producing a competitive plane in a country that manufactured virtually none of its components. Had Brazil insisted on substantial vertical integration, Embraer would have almost certainly failed. By relying on international outsourcing instead, it was able to concentrate on plane design and assembly, while using the components with the best cost-benefit ratio. This process of international outsourcing required significant coordination skills, especially under the prevailing conditions of information access and transport in the early 1970s.[3]

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[3] See Oliveira (2005) for a discussion of the increasing sophistication and the coordination challenges of Embraer's supply chain. Also important was the establishment of the drawback regime in the mid-1960s, which exempted companies from paying import tariffs and value-added taxes on imported inputs used to manufacture exports. Although not specific to the aeronautical sector, this arrangement was critical to facilitating Embraer's export competitiveness, given the company's high reliance on imported aircraft parts.

The Diffusion Process

Embraer did not generate a diffusion process like the one described by Ricardo Hausmann and Dani Rodrik (2003), in which similar exporters emerged to compete and form a cluster. The same static and dynamic economies of scale that underlie the oligopolistic structure of the world's aircraft industry (Baldwin and Krugman, 1988) worked against this outcome. In addition, the Brazilian state possessed neither the motivation nor the resources to support the creation of similar companies, and it is doubtful whether a cluster of firms would have been able to go through the initial learning and brand-building stages without public support, considering the underdevelopment of Brazil's capital market.

Yet Embraer is not the only company in the Brazilian aircraft industry, which overall employed approximately 18,000 people, including aerospace companies, in 2003. In that same year, 322 companies operated in the aircraft and aerospace sector, most of them located in the more developed areas of Brazil's Southeastern region (WTO, 2004). Approximately 89 percent of the sector's output (including the space industry) is sold in foreign markets.

Embraer initiated a vertical diffusion process in the 1970s when it outsourced the production of light planes and parts to smaller, local aircraft manufacturers. In 1974, Neiva, then an independent company, became a subcontractor for the manufacture of some of the four-seat, single-engine planes produced under license from Piper. Later on, Neiva also produced the Carajá, a different version of the Navajo. In that same year, Embraer subcontracted some part production to Aerotec. Also in the 1970s, Embraer outsourced production of the seats of some of its planes to Aeromot. Likewise, in the 1980s, the joint program between Embraer, Aeritalia, and Aermacchi to produce a military jet led to the opening of about 20 Brazilian companies to serve as suppliers; this created an opportunity to absorb cutting-edge technology, including the manufacture of sophisticated equipment. These events significantly aided the development of the domestic aerospace industry.

A new, more structured wave of vertical diffusion occurred after privatization, particularly in the first years of the current decade, and has been largely characterized by the substitution of locally based supplies for foreign manufactured inputs. As a consequence, a new range of parts is now locally produced and/or assembled. By 2005, about 40 percent of a typical Embraer aircraft was locally manufactured, about one-third more than two years earlier. This has led to the creation of a regional, high-tech cluster (Goldstein and Le Blanc, 2003), which represents an important knowledge spillover. This reinvigorated diffusion resulted from a combination of factors: Embraer's increased output

scale, which made local manufacturing of a number of items demanded by the company internationally competitive; the more competitive exchange rate that prevailed in 2000–05, particularly against the euro; and an explicit government stance favoring an increase in the domestic content of the company's aircrafts, which included pressure on Embraer, as well as loans from BNDES (Brazil's National Economic and Social Development Bank), on favorable conditions to suppliers willing to produce locally.[4]

In value terms, the most important part of this diffusion process was the local establishment of Embraer's foreign suppliers. Some of these local subsidiaries have started to export, although this is still an incipient process. An example is the export of hydraulic systems for airplanes by ELEB, a joint venture between Embraer and Germany-based Liebherr.

A second and, in a sense, more interesting strand of this diffusion process involved nationally owned suppliers originally created to supply Embraer with parts and services. Embraer works with about 400 direct suppliers and 600 indirect or subcontracted ones.[5] These national suppliers include about 70 small- and medium-sized companies, largely formed by engineers who left Embraer as part of an outsourcing program implemented after privatization. Of these, 26 are small companies headquartered in the Paraíba Valley, in the vicinity of Embraer's plant. In 2002, those firms recorded combined annual revenues of about $20 million, 85 percent from sales to Embraer and 15 percent from products and services supplied to the automobile industry. Several of these companies export as well, and three initiatives facilitated their entry into the international market: formation of the High Technology Aeronautics (HTA) Consortium; subcontracting by Embraer's foreign suppliers because of demands imposed by the company itself, as a means to increase domestic content; and offsetting clauses in military procurement.

Their decision to seek the international market followed a simple logic: if what they produced was good enough for Embraer, then it should also be good enough for other aircraft manufacturers. By exporting, these companies expected to scale up their production and reduce both unit costs and their dependence on Embraer. Exports would be a means to raise capacity utilization and absorb other technologies, as they did from Embraer, and possibly secure manufacturing licenses from foreign companies.

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[4] Since BNDES is by far Embraer's main financier, it has some influence on its decisions. The bank has used this influence to press for an increase in local content.

[5] The following discussion on the HTA Consortium draws partly on Frischtak et al. (2002).

While some of the companies that formed the consortium already exported, most of them would not have considered searching for new customers abroad without the formation of the HTA Consortium (Frischtak et al., 2002). According to the companies, the HTA Consortium allowed them to: share common costs of prospecting the international market, including participation in fairs and other marketing activities; combine their expertise to supply more sophisticated products in accordance with the demand of foreign clients; develop a well-known brand; increase their bargaining power when negotiating with suppliers and customers; and access financial institutions and development agencies.

HTA started to export only in 2006, reaching $5 million in foreign sales. By 2001–03, though, some of the companies that formed the HTA Consortium had $824,000 in exports to Canada, France, and Spain. All these operations were tied to Embraer's contracts with foreign suppliers. In this sense, they were all "bought" products and services; that is, they resulted from specific demands made by importers, rather than from the sale of services and products offered by these companies.

The well-established reputation of Embraer's technological mastery has benefited these companies in two ways. First, being known as Embraer suppliers convinced foreign aeronautical companies of those firms' quality. Second, and more broadly, this attested to the quality of Brazilian engineers and scientists working in the industry. Thus, according to a manager at ThyssenKrupp Autômata, "the Brazilian tradition in the aeronautics area has been an important differential" to attract clients such as Bombardier and Rolls-Royce. The competitiveness of these companies also relied on comparatively low labor costs, especially after the 1999 devaluation and the appreciation of the euro, and favorable conditions in the world aircraft industry.

Embraer itself absorbed part of the positive spillovers generated by this vertical diffusion process. The local establishment of foreign suppliers and, in the case of the HTA Consortium, the adoption of more efficient and flexible productive processes and the ability to provide more sophisticated solutions, has allowed Embraer to substitute national parts for imported ones. Thus, the company has been able to raise the domestic content of its planes while simultaneously complying with government demands, facilitating the coordination of production, reducing its inventories, and lowering transaction and financial costs. Moreover, the HTA Consortium as a whole is able to supply more complex parts than the companies could produce on their own. This has increased competition among suppliers and exemplifies the benefits to Embraer stemming from the creation of the HTA Consortium. This last point is illustrated

by the consortium's participation in the bid to manufacture the simulator for the Super Tucano, which also exemplifies the synergies created by the HTA Consortium. Finally, Embraer will indirectly benefit from the absorption of technology and lower unit costs that exporting has facilitated—even for the products already supplied by these companies.

There was no indication of negative spillovers from the vertical diffusion process described above. In particular, the firms that make up the HTA Consortium are too small to generate significant pressures on the price of Embraer production factors, particularly salaries. Moreover, Embraer remains their largest client. On the other hand, while they have achieved agglomeration economies, these gains have also been proportionately small.

The main barrier to a deepening of this vertical diffusion process is the risk-sharing arrangements adopted by Embraer in the development of new aircraft models. Once construction of the plane is under way, these partners have the exclusive right to supply Embraer with those parts. The lack of capital to finance such large, up-front outlays has displaced some Brazilian suppliers, which have been replaced by foreign companies willing and able to make such development investments. This was the case for Aeromot, a Brazilian company that had supplied Embraer with plane seats since the 1970s but had to suspend its business with Embraer. The company was replaced by C&D, a U.S. manufacturer that established a factory close to Embraer's main assembly lines. The tax system also penalizes local companies that use imported inputs and sell to domestic clients (including Embraer and its suppliers), as the drawback regime does not apply in this case.

Comparator

In considering comparators, one relevant aspect of this case is that the concept does not strictly apply to a monopolist, although one could conceivably try to compare some of the case's dimensions, such as the role of policy, to examples in other sectors. Yet the fact that Embraer is not Brazil's first aircraft manufacturer and exporter suggests that some lessons may be drawn from looking at why it succeeded where others failed. Moreover, the fact that the company's productive performance changed so markedly after privatization suggests that lessons can be drawn from the reasons for its success by comparing the firm to itself, before and after privatization. Although the importance of dynamic scale economies in the industry recommends caution with simple before-and-after comparisons of export volumes, privatization occurred after more than 20 years of operation, time enough for a large share of this learning process to take effect.

Brazil's first commercial aircraft manufacturer was a private company called Companhia Nacional de Navegação Costeira, which in 1935 produced a biplane (used for training purposes), and later a plane known as the Paulistinha.[6] During World War II, on demand from the Brazilian Army and Navy (the Ministry of Aeronautics still did not exist), the German company Focke-Wulf Flugzeugbau GmbH established an assembly plant called Fábrica do Galeão in Rio de Janeiro, where a number of planes, more technologically sophisticated than those manufactured by the Companhia Nacional de Navegação Costeira, were assembled. A third company, the Companhia Aeronáutica Paulista (CAP), was established in 1942; unlike the other two, it focused on the civil aviation market. CAP, Brazil's first aircraft exporter, sold its planes in Argentina, Chile, Italy, Paraguay, Portugal, the United States, and Uruguay. All three companies closed their doors soon after World War II, unable to compete against foreign manufacturers, which resumed their sales in the Brazilian market after the war.

Other attempts at building aircraft manufactures in Brazil failed before production began. One was a joint venture, in 1935, between the Ministry of Transport and Public Works (Ministério da Viação e Obras Públicas) and a French aeronautical engineer (René Couzinet) to build a factory in the state of Minas Gerais. The other was expected to emerge from negotiations between the Brazilian and U.S. governments during World War II; the United States was to provide capital and technology for the installation of the Fábrica Nacional de Aviões de Transporte in exchange for Brazil's support of the U.S. war effort.

The most successful of these pioneering Brazilian aircraft manufacturers was the Sociedade Construtora Aeronáutica Neiva, a private company established in the 1950s. This company was the first to manufacture an entirely metallic aircraft on an industrial scale in Brazil, and its focus was on manufacturing airplanes to be sold to the government. Neiva had operated in the aeronautical sector since 1954, initially in Rio de Janeiro, and since 1956 in Botucatu, São Paulo. In 1960, the company started operations in São José dos Campos, to interact with the CTA and expand its R&D activities. In 1975, Neiva and Embraer started a formal relationship, and in that year it began to manufacture planes for Embraer. In March 1980, Embraer took control of Neiva, transferring to it all the engineering and manufacturing activities related to the production of its light airplanes, and discontinuing Neiva's operations in São José dos Campos. Overall, Neiva has manufactured more than 3,500 planes since its creation.

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[6] This historical account draws on Forjaz (2005).

The comparison between these early attempts and Embraer draws attention to factors that, combined, explain Embraer's success (Forjaz, 2005). Before the establishment of the ITA and the research institutes in the CTA, Brazil had an insufficient level of scientific and technological development to manufacture airplanes with the same quality as foreign competitors. Moreover, reliance on foreign technology, as illustrated by the Fábrica do Galeão and the stillborn Fábrica Nacional de Aviões de Transporte, left Brazil at the mercy of the interests of the owners of the technology used. The licensing of foreign technology also operated as a barrier to export, and Brazil's domestic market was simply too small to allow for production at a competitive cost. Pioneering manufacturers were further constrained by excessive dependence on government demand, which subjected them to political and budgetary instability. Finally, these early experiences illustrate the limitations imposed at that time by private ownership, given the large volume of capital that had to be invested up front in project development.

The before-and-after privatization comparison highlights the importance of sequencing to Embraer's success. While a state-owned enterprise, the company benefited from public support, including its symbiotic relationship with the CTA and the educational and research institutions associated with it—a link weakened by privatization (Oliveira, 2005). However, as noted, the public governance environment in which the company operated worsened in the 1980s, making its organizational model dysfunctional.

In this regard, the CBA 123 project is a good comparator to the original organizational model that allowed Embraer to successfully enter the international market, for several reasons. First, it was selected based on political considerations, rather than on the identification of a market niche in which the company could be competitive. Second, it required Embraer to coordinate its efforts with an unsuitable partner, chosen for political reasons rather than technological and/or competitive considerations. Third, it overemphasized the project's technological sophistication at the expense of its commercial viability. Finally, it was atypically dependent on public financial support. Moreover, this support was not provided up front, but rather promised upon completion of the project, leaving the company on its own to secure the resources necessary to undertake the project.

Thus, it is unlikely that the Embraer example could be replicated in the public governance environment that has prevailed in Brazil since the 1980s. But even without these changes, it is unlikely that Embraer could have expanded as much as it has since the mid-1990s had it remained state-owned: it would be more vulnerable to allegations of receiving unfair public subsidies

and would have lacked a balance between engineering/technological activities and the more prosaic commercial and financial functions. Thus, the main challenges faced by the new owners were exactly to:

- Recover the company's competitiveness and strategic focus. To this end, the new owners made a capital infusion of $500 million and invested heavily in the development and marketing of the EMB 145 model, then renamed ERJ 145.
- Revamp the company's management, retaining its positive features—most notably its engineering and technological capabilities and good penetration in world markets—and correcting weaknesses, primarily in the financial and administrative areas. After privatization, the company became more concerned with costs, productivity, and quality, as well as more client-oriented and commercially aggressive.

In sum, more than showing which form of organization is best or more likely to lead to an export discovery, the before-and-after privatization comparison calls attention to the relevance of proper sequencing in a discovery fraught with the type of market failures and internalities observed in this case. In a sense, it leads to a conclusion that, in general terms, is akin to that drawn from the model of Aghion, Dewatripont, and Stein (2005):[7] state ownership and hierarchical relations with public research institutes are more functional at the initial stages, in which learning and brand building are more critical, whereas private ownership and arm's-length relations with the public sector should prevail afterward.

The Role of the Public Sector

The main market failure that warrants government intervention in this industry is the existence of static and dynamic scale economies, stemming from the large, up-front costs of project development and learning economies that characterize the technology of aircraft manufacturing. In particular, given Brazil's underdeveloped financial markets, notably in the late 1960s, this left the public sector as the only viable investor.

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[7] Conceptually, an internality is like an externality, except that it concerns unforeseen effects between two parties of a transaction (as opposed to a third party not involved in the transaction, as in an externality).

A subsidiary reason is the presence of information asymmetries associated with the process of brand building. That is, there is a role for the state to support the pioneer until it becomes well known by the market (Calomiris and Himmelberg, 1994).

In practice, these conceptual arguments combined with three government objectives: having a domestic aircraft industry for national defense purposes, a strategic goal that had also inspired earlier attempts in this direction; increasing the number of cities served by air transportation; and substituting the imports of planes, particularly light planes, of which Brazil had traditionally been a large importer.

Overall, government support was critical in five dimensions. First, up until the time of privatization, most of the technological development that led to the creation of the Bandeirante and later to larger, more sophisticated airplanes was directly or indirectly financed by the public sector. Second, the creation of the regional aviation segment established an important market for the company's planes. Third, the Brazilian Ministry of Foreign Relations played a decisive role in securing the certification of Embraer's aircraft with local authorities in foreign markets. Fourth, the government financed human capital investment through the ITA, a public university that has produced a steady supply of first-rate engineers, many absorbed by Embraer. Finally, Embraer's export competitiveness has depended on the low-cost, export-financing programs provided by the public sector.

The government also played an important role in the diffusion process, both in encouraging foreign suppliers to establish operations locally and supporting the export drive of local firms. In these cases, government intervention was largely justified by the goal of establishing a domestic aeronautical industry. In particular, Brazil's Export Promotion Agency (Agência de Promoção de Exportações, or APEX) supported the formation of the HTA Consortium, financing half of its export promotion expenses, including items such as certification, participation in international fairs, training, and consulting services. According to the companies that formed the HTA Consortium, without the support of APEX, the consortium would not have been created (Frischtak et al., 2002).

Can the production of airplanes in Brazil be sustained without government support? The answer to this question depends on whether it is assumed that other aircraft manufacturers would continue to benefit from government involvement. If they did but Embraer were denied this benefit, the company's competitive position would obviously weaken. But currently its export competitiveness depends only on public incentives that are also provided by other

governments, thus making them acceptable to the rules of the World Trade Organization (WTO). Therefore, it can be argued that public intervention has indeed created a comparative advantage for Brazil in the manufacturing of small- and medium-sized aircraft and, more recently, of some goods and services used in their assembly.

It is harder to ascertain whether Embraer would sustain its current competitiveness in a world in which no aircraft manufacturer received any kind of public support whatsoever. In that case, following the logic of Baldwin and Krugman (1988), there might be room for a single world supplier of small- and medium-sized jets. It is possible that Embraer could be that sole survivor. The company currently holds a leading position in its market segment, which would undoubtedly leverage its competitive position in the scenario described; it also benefits from comparatively lower labor costs. It is also likely that Embraer receives smaller public subsidies than other aircraft manufacturers, in part as a result of Brazil's difficult fiscal situation, which helped to bring about the company's privatization. The relevant kinds of direct public support are favored export credit conditions, which are becoming less important as the firm's cost of capital declines, and some favoritism in military procurement, although this is done through international competitive bidding.

Export Triggers and Reasons for Success

Embraer owes much of its initial success to having realized that the main aircraft manufacturers were concentrating on larger planes and, implicitly, larger airports, thus abandoning a market niche that could be occupied by the Bandeirante. The regional aviation segment of civilian aviation was formally regulated in the 1970s by the Brazilian aeronautical authorities, creating a largely captive market for Embraer's planes. The company's attention was initially geared exclusively to the Brazilian market. Soon, though, it realized that the domestic market was too small. Exports were also important for reducing the company's exchange rate risk, considering that most of the parts used in manufacturing its planes were imported. With time, exports would supersede the domestic market as the main destination of Embraer's production, so the reasons for its success as an aircraft manufacturer to some extent overlap with those that explain its success as an exporter. The following six factors seem to have been crucial determinants of this success story:

1. *Strong emphasis on generating state-of-the-art technology with direct commercial use*. Embraer's design solution aimed at the lowest

possible aircraft weight per passenger, which led to fuel-saving equipment. The productive strategy has been based on three factors: reducing aircraft weight, achieving low manufacturing cost, and producing equipment with a high level of reliability. This has been facilitated by strong connections with the CTA and ITA, which helped the company master new technologies. Embraer was also able to "poach" most of its engineers from the CTA and ITA (Goldstein, 2002). Sequencing was also important: first, the creation of a high-quality university and technological center, in addition to research institutes that pursued and developed clearly targeted projects, and only later the creation of the company. Embraer's privatization was also part of this unplanned, but successful, sequencing.

Ownership of the technology used in manufacturing the planes was a critical determinant of Embraer's success as an exporter. This was a strategic decision. Very early on it was decided that licensing from a foreign producer should be avoided, so as to achieve independence in technology and marketing for exports. With its own technology and brand, Embraer was free to sell airplanes wherever it wished, as long as it was able to certify them with the local authorities. This allowed Embraer to export to markets as diverse as the Soviet Union, Israel, and the Middle East. In turn, this option introduced important technological uncertainties and coordination problems.

2. *Reliance on absorption of technology from other airplane and parts manufacturers.* As early as the 1970s, Goldstein (2002: 100) notes, Embraer relied crucially on "co-operation with foreign partners, negotiating co-production and licensing arrangements designed to achieve rapid market penetration without excessive technological dependence.… Besides technical competencies, all these partners provided Embraer with organizational know-how in serial production."[8]
3. *Early concern with avoiding excessive vertical integration.* Rather than attempting to produce the entire airplane, or being forced to rely on less efficient and more expensive domestic substitutes, Embraer turned to the world's most competitive parts manufacturers, with

[8] Goldstein (2002: 100) notes that Embraer also "used the threat of a steep increase in import duties to successfully arm-twist foreign producers of general aviation aircraft into accepting an agreement whereby they had to provide the kits to assemble the final product in Brazil."

which it built long-term ties, while stressing the company's competitive advantage in designing and assembling aircrafts. Thus, Goldstein (2002: 100) notes, "[f]or the most part, Embraer shied away from manufacturing high-value, high-technology components and concentrated instead on designing the aircraft, producing fuselages, and assembling the final product: Already in the 1970s Embraer concluded long-term purchase agreements with its major suppliers…. The two best-seller planes—the two-seat Tucano turboprop military trainer and the 19-seat non-pressurized, twin-engine turboprop Bandeirante—were of national design, although more than half of the latter's value consisted of imported parts."

This has allowed the firm to operate with suppliers that, in turn, produced at worldwide scale. Its partnerships with suppliers in the development of new projects seem to have been particularly important. These factors played a triple role: they guaranteed price competitiveness, reduced the cost and risk of new developments, and helped create a constituency against trade barriers in the supplier's country of origin. In particular, with suppliers sharing the costs and risks of development, they were similarly interested in selling the plane, for this would be the means through which they could ensure being paid.

4. *Ability to focus on the right market niches*. Embraer sought from its very beginning to occupy a niche in the market to service short, regional routes. The equipment it produces has been used mostly to operate in secondary air routes, notably those linking small- and medium-sized cities to the main airports. In the mid-1960s, Embraer identified its market niche based on the dictum, "fly to your preferred destination at the time you wish." Moreover, "the company correctly saw a niche for aircraft that could operate in the more difficult environment (harsh weather conditions, unprepared or unpaved airstrips, minimum ground support) of backward regions and countries and [that] were easier and cheaper to maintain. The Bandeirante joined the fleet of a number of commuter airlines in the United States, accounting by 1982 for a third of the market for 10–20 seat planes. The same logic underlay the production of less sophisticated military aircraft than those exported by advanced industrial countries" (Goldstein, 2002: 101).
5. *Solid logistical support in the main export markets, with the establishment of subsidiaries and commercial offices*. The first subsidiary,

Embraer Aircraft Corp. (EAC), was founded in 1979 to sell parts and provide after-sale support in North America. It supported marketing, commercial, and technical assistance activities in the commuter airline market in the United States and Canada. In 1981, EAC was followed by Embraer Aviation International (EAI), which performed the same functions in Europe, the Middle East, and Africa. In 1997, Embraer established a similar unit in Melbourne, and in 2000, in Beijing and Singapore. In 2001, the company created EAMS (Embraer Aircraft Maintenance Services) in Nashville, Tennessee. These units serve a fourfold purpose: they facilitate the sale of equipment, providing face-to-face sales pitches; they reduce the costs of servicing and repairing the company's equipment; they protect the company's reputation by guaranteeing reliable after-sale assistance; and they allow for extra revenues, as the market of airplane parts and services is very substantial.

6. *Appropriate export finance*. A program through Banco do Brasil, PROEX, (Programa de Financiamento às Exportações) was a critical element of competitiveness, as it provided finance terms comparable to those offered by foreign competitors. Later on, Embraer counted on loans from BNDES, especially after privatization.

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CHAPTER 10

Software Discovery in Uruguay: Public-Private Solutions to Coordination Failures

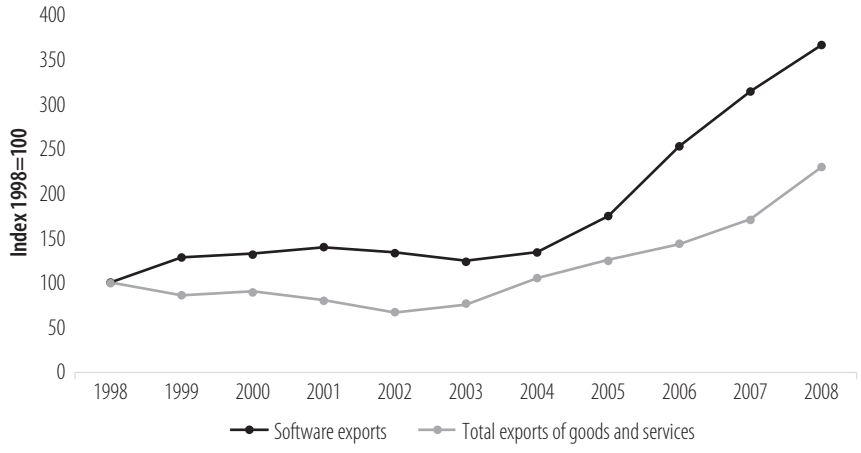
Michele Snoeck and Lucía Pittaluga[1]

Software exports are a novel diversification of Uruguayan exports that took place in the 1990s. Although some software firms appeared during the 1970s, the sector really emerged in the second half of the 1980s when personal computers (PCs) were introduced into the country, spurring the demand for programs and services related to information technology (IT). A new generation of entrepreneurs appeared, several of whom still head some of the most successful software firms. One of these is ARTech, the first firm to export on a sustained basis. Other local pioneers exist as well, but ARTech and its flagship product, GeneXus, are an excellent illustration of a first-mover strategy that included the promotion of a product-diffusion process by setting up what might be called a community of practice.

This chapter focuses on the key elements of this discovery. It checks the validity of the analysis through a review of the conditions that prevented a positive outcome in a counterfactual case—that of the electronics sector. Research carried out in the early 1990s (Snoeck, Sutz, and Vigorito, 1992) showed that

[1] This chapter is an updated version of the software discovery case included in Snoeck et al. (2009). The authors thank the rest of the team for their valuable comments on the current version.

FIGURE 10.1 | Uruguay's Software Exports and Total Exports, 1998–2008



Sources: Cámara Uruguaya de Tecnologías de la Información (CUTI); Banco Central del Uruguay (BCU).

both the software and electronics industries were developing in Uruguay and were contributing to the buildup of a knowledge-intensive sector. Commercial opportunities deriving from the rapid expansion of IT could be seized thanks to qualified human resources and a tradition of research in these fields at the public university. Both the software and electronics sectors had star products that were finding their way into foreign markets. However, difficulties of several types hindered further growth in electronics and the diffusion process was truncated.

Today, the software sector is made up of about 350 firms producing and selling products and services to 55 markets, with a total turnover approaching $500 million (Betarte, Cancela, and Moleri, 2008).[2] Exports grew from essentially nothing in 1989 to $104 million in 2005. During the following three years they doubled, reaching $219 million in 2008 (Separata Brecha-ANII, 2010). While the country's total exports grew at a high rate from 2005 to 2008, software exports performed even better (Figure 10.1). At the turn of the century, Uruguay briefly became the largest software-exporting country in Latin America. It still ranks first in the region in terms of per capita exports.

[2] Roughly half the firms are software developers, and also provide services related to the applications they develop. The rest perform different types of services and consultancies. Additionally, there are about 400 firms selling hardware and software, and some 1,600 independent consultants.

Though the share of software in the country's total exports of goods and services is modest (2.36 percent in 2008), the sector contributes to export diversification. Significantly, it is the first time in Uruguay's history that knowledge accumulation at the national level has generated significant exports that are not based on natural resources, are not ephemeral (because they have continued for a decade), and are not marginal to the economy—at least as judged by the share of software sales in gross domestic product (GDP) of some of the most successful, developing software-exporting countries.[3]

First Mover ARTech

ARTech Consultores S.R.L. was cofounded in 1988 by two Uruguayan computer engineers. One had headed the computer center of the Uruguayan social security institution; both had consulted abroad (in Brazil and the United States) in the then relatively new field of relational databases. Having realized that it was feasible to automate part of the database programming process, they decided to create a software tool that would enable consultants to develop their own applications more efficiently. After an unsuccessful attempt to sell the project to get funds to develop it, they faced the following options:

> Either we [could] abandon the project and continue with normal consultancy tasks or we [could] continue fighting for it. Since we thought our development was useful, we decided to create an enterprise to host our GeneXus project. Initially, it had quite minor objectives, consisting mainly of assisting in the design of a database, but then, as time passed, we ended up using it to generate applications (Valverde et al., 2006).

GeneXus was an integrated tool set for developing complex mission-critical applications with large databases. The first version was released at the end of 1989. A firm from northern Uruguay was the first client; a few more clients followed, including the Ministry of Defense and De Larroble y Asociados, a firm that would become a strategic partner of ARTech and a leader in banking

[3] In 2002, software sales/GDP amounted to 1.5 percent in Brazil, 1.1 percent in China, 2.5 percent in India, 3.7 percent in Israel, and 1.3 percent in Ireland (excluding multinationals); in 2008, software sales/GDP amounted to about 1 percent in Argentina, and to an estimated 0.7 percent in Uruguay (Arora and Gambardella, 2004: 36).

software in Uruguay. Abroad, Chile was the first destination of GeneXus, followed by Brazil, the "natural" market for ARTech's partners since they had been working extensively there. By 1991, ARTech had sold 350 copies of GeneXus, mostly in the Latin American market and through direct sales abroad. Foreign revenue represented roughly $250,000 (Snoeck, Sutz, and Vigorito, 1992), while other exporters were mainly exporting on an experimental basis.

In the past 20 years, ARTech has evolved from a small company founded by two inquisitive, creative computer engineers to a large-scale, prosperous business with worldwide distribution of its product. About 6,000 customers have purchased the product, with more than 50,000 licenses sold in 60 countries. ARTech does not reveal data on its turnover or its exports, but in 1997 it disclosed that GeneXus license sales amounted to $10 million (with 2,200 clients) and generated another $50 million by way of related services, including consultancies and development of turn-key systems.[4] Exports grew dramatically, representing 90 percent of total sales in 2007.

ARTech's capital is still entirely national and the founders maintain their positions as president and vice president of the company as well as of GeneXus Consulting, a sister firm created to provide consulting services.

The Main Uncertainties Faced and Solved by ARTech

The greatest uncertainties at the planning stage concerned the technological challenge and uncertainty about demand, which was potential but not explicit. Development expenses were unknown and treated as sunk costs. It turned out that the development of the first version of GeneXus required about 20 person-years and cost about $500,000 (Snoeck, Sutz, and Vigorito, 1992). Because of the lack of initial capital, this investment was indirectly financed by consultancies carried out by ARTech's professionals.

Once the product was developed and launched in the local market with a reasonable degree of success, uncertainty concerned, above all, foreign market penetration. ARTech's lack of specialized management and marketing skills in its early phase made it difficult to discover an effective export strategy. Furthermore, there were no official procedures for exporting highly intangible goods, such as software. As ARTech quickly discovered:

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[4] Nowadays, a license for the GeneXus development environment costs about $5,000 and an additional $2,000 for each generator. Annual maintenance fees (15 percent of the initial price) give customers the right to obtain updated versions (interview with one of ARTech's managers).

> So far we had exported only one package, for $15,000. We had to pack the program and fill in a form specifying how much it weighed, what color it was, etc., just as if it were about shoes. There [was] absolutely nothing specific for software…In addition, as a professional company, we could not export. It had to be done through a business firm because, according to the Banco de la República [the state bank in charge of foreign trade], a professional company cannot be an exporter (Snoeck, Sutz, and Vigorito, 1992: 260).

This problem vanished as the development and spread of the Internet enabled online downloading. However, more generally, some of the obstacles faced by ARTech—and the software sector in general—can be ascribed to differences between traditional industries and the software business. Laws and regulations in the country tend to be based on the former model, which can result in awkwardness in the case of software. For instance, the software industry typically works on a project basis and therefore requires flexible employment mechanisms. The Uruguayan Chamber of Information Technologies (Cámara Uruguaya de Tecnologías de la Información, or CUTI) tackled this difficulty only recently at the policy level.

In the early 1990s, ARTech's search for new ways of expanding its commercialization channels coincided with a change in IBM's commercial strategy: an opening to partners to expand its business. With the launch of its new AS400 platform, IBM needed a network of partners to develop applications, and ARTech became one of these. IBM's reputation and marketing channels facilitated the diffusion of GeneXus as a product easily used for business applications development with this new platform. Later, when Microsoft consolidated its position as dominant supplier in the PC world and PC servers became an alternative for business applications, ARTech developed a closer relationship with Microsoft.

ARTech opened offices in Chicago (1994), Mexico (2002), São Paulo (2003), Shanghai (2003), and Tokyo (2007), where ARTech participates in a joint venture with Japanese entrepreneurs for the distribution of its product. Overall, ARTech's distributor network now comprises 35 countries. Carefully thought-out commercial alliances are a basic part of the firm's strategy. At times, ARTech hired specialized consultancies to help choose a foreign partner, as was the case in Brazil. Results were sometimes slow to appear: ARTech worked for about four years with its distributor in China to acquire know-how on business negotiation in China (how to negotiate, deal and work with people, gain confidence, develop projects, and the like) before getting a very important contract

in 2005 to provide "GXHealth," a comprehensive administration system for the WantWant Hospital in the province of Hunan. Moving toward Asia also entailed moving to multi-language versions of the product.[5]

Summing up, the exporting learning curve included different, successive approaches to internationalization: direct sales abroad, taking advantage of IBM's development strategy, establishing a network of distributors and sales agents abroad, selling through the Internet, establishing a commercial joint venture, and opting for a multi-language product. As ARTech moved from regional to extra-regional markets (e.g., the United States and Asia), uncertainty was increasingly related to cultural factors and the firm had to dedicate substantial efforts to adapt in each case.

Another source of uncertainty concerned the extent to which profit-eroding diffusion could be avoided or postponed. The company had to address two related concerns: What should it do in terms of product upgrading? Which alliances should it pursue to generate and internalize network economies?

Product Strategy

The GeneXus discovery is a typical case of exploitation of a proprietary knowledge niche that was generated and maintained through intensive R&D in the area of relational databases, applications development, computer-aided software engineering (CASE), and artificial intelligence. The R&D team now includes 30 engineers, some of them part-time.[6] A clear, long-term product strategy was fixed at an early stage, even before technology had developed sufficiently at the global level to fully attain the strategic goals (Gonda and Jodal, 2006). For instance, in 1992, an innovation with high-level procedural language allowed for the automatic maintenance of the whole user system, with significant cost savings. In 2001, GeneXus was able to develop applications for all relevant platforms in the market. This also allowed software developers to reuse knowledge bases in different environments and has been a way to widen the network of GeneXus users. The 2005 version of GeneXus resulted in a fivefold increase in productivity, compared with manually programming in common languages. In 2008, another major leap in productivity occurred when GeneXus X was totally

[5] Radio interview with an ARTech partner, May 23, 2005. GeneXus: el software uruguayo que llegó a China para quedarse. Available at http://www.espectador.com/1v4_contenido.php?id=43084&sts=1.

[6] Eighty percent of the 110 employees were professionals with university degrees, as of 2006.

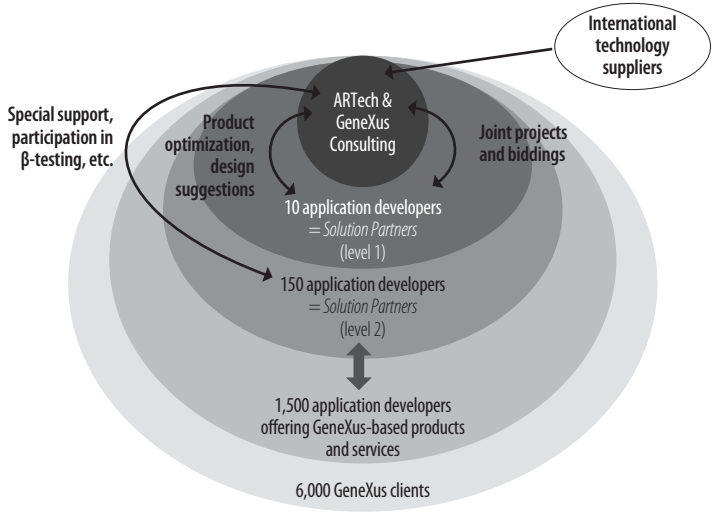
rewritten based on the current state of knowledge, instead of being built on the previous version. The early objective of general usability—to make the tool usable by anybody with a solid general background instead of only by professional developers—was finally achieved with this latest version.

ARTech's strategy aimed at anticipating upcoming coordination difficulties from two areas: rapid changes in computer sciences, and customers' reluctance to adapt to these changes because they do not perceive them as unavoidable. According to ARTech's partners, each of these areas entailed a period of profound crisis for the firm (Valverde et al., 2006).

Alliances to Benefit from Network Economies

Equally important as designing a good product is creating a network for it: finding firms that are willing to collaborate, building strategic alliances, knowing how to put the network to work, and managing it to internalize ensuing externalities. This was achieved through the development of the "GeneXus Community" (Figure 10.2). Since GeneXus is a tool for software developers (somewhat similar to a capital good in a traditional industry), developing close ties with those developers was of the utmost importance. The diffusion of GeneXus among end users needed the intermediate link of a strong user-producer relationship. The

FIGURE 10.2 | The GeneXus Community



Source: Based on interviews in 2006 with ARTech.

main instrument used to develop this relationship has been ARTech's Solution Partners Program, which actually promotes a community of practice.[7]

Solution Partners are developers of GeneXus-based solutions for their own clients, with whom ARTech establishes privileged information channels. The nature of the information flows defines the intensity of the links (levels 1 and 2 in Figure 10.2). When a developer of GeneXus-based applications (level 2) starts to deal with large clients, he or she is offered privileged treatment such as special prices and technical support, and participation in beta-testing (the second phase of software testing, in which a sample of the intended market tries out the product). In exchange, feedback information flows toward ARTech on aspects that could be improved, error detection, and the like. This is the way ARTech internalizes network externalities. There are about 150 Solution Partners, of which 100 are in Uruguay and the rest in other countries. All clients of Solution Partners must acquire a GeneXus license for program maintenance, thereby also becoming part of the GeneXus Community and increasing network economies.

With a distinguished group of nearly 10 Solution Partners, ARTech shares strategic knowledge (level 1): engineers of these firms work together with ARTech to increase complementary functions of the product based on their own experiences and needs.[8] Collaboration helps optimize the product:

> If a local firm—for example, a GeneXus user specialized in the development of distribution and logistics applications—has a problem in Malaysia with its beverage distribution system, we send a person, or work in Zonamerica [a technology free trade zone], to solve that precise problem. And this helps us to achieve GeneXus product optimization because it shows us a shortcoming. Despite our internal tests, with thousands of users unexpected events can appear; this is the market filter (interview with an ARTech manager).

ARTech also implicitly provides technological surveillance services to its partners because the partners are confident that ARTech will take care of any technological breakthrough or upgrading need. This means lower R&D

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[7] The concept of community of practice refers to the process of social learning that occurs when people who have a common interest in some subject or problem collaborate over an extended period to share ideas, find solutions, and build innovations.
[8] Firms closest to ARTech usually develop applications in market niches, including banking software, enterprise resource planning (ERP) solutions, distribution and logistics, and maintenance.

investment levels for small- and medium-sized partners. For ARTech, it necessitates meeting the challenge of maintaining a mainstream position at the world level in the future.

Other members of the GeneXus Community include the network of distributors and sales agents who sell the product in their countries and deliver complementary solutions and services, as well as a great number of software developers (about 1,000) who use GeneXus without being Solution Partners. Alliances have also been established with international technology providers that set the industry standard at the global level, such as IBM, Microsoft, Hewlett-Packard, and Oracle. In this case, ARTech operates as a solution partner for the latter.

The community meets regularly at the national, regional, and international levels to review and share the state of the art concerning GeneXus. ARTech also sponsors "collaborative projects" aimed at fostering integration and knowledge transfer within the community.[9] One important diffusion channel has been the inclusion of courses on GeneXus in the computer science curricula of the country's public and private universities. This is another way to enlarge the network and create positive feedback because it increases the dependency of potential software users on GeneXus. On the whole, the GeneXus Community is an open network where ARTech differentiates among different types of allies and maintains property rights for a key technological component of that network.

Thus, a product strategy and diffusion pattern was set up to avoid profit erosion. But was profit eroded by imitators? GeneXus never had a direct rival product in the domestic market. At the global level, competition derived less from other products offering the same integrated solutions[10] than from the barrier to entry for a small producer from an unknown country. The lack of imitation is also associated with the specific software segment in which ARTech operates: there are relatively few players in the software tools world.

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[9] An interesting feature is that university students with basic knowledge of GeneXus can propose and participate in collaborative projects, which gives them an opportunity to learn, meet the community members, and demonstrate their own skills and knowledge.

[10] The alternatives to using GeneXus include: developing a more traditional database system, which requires the use of several tools because no one provides an overall solution; or buying Microsoft's "Visual Studio Team System," an integrated development platform for building businesses' mission-critical applications. Although using a different technology, the latter aims at solving the same types of problems (interview with an ARTech manager).

First Mover Externalities

ARTech generated two important, positive *information externalities* for subsequent entrants into the software industry. First is the reputation that ARTech established for Uruguayan software goods and services in foreign markets, enhancing the country's image. Second, ARTech's experience had a demonstration and market revealing effect in the domestic market. In the context of a country with no risk-taking culture and with scarce entrepreneurship resources, ARTech showed that it was possible for Uruguay to export software and establish partnerships with the world's leading firms.

Knowledge spillovers were internalized, for example, through the agreement signed in 2004 between ARTech and the computer research center (InCo) of the public university, to collaborate in fields related to software development and education. Together, they implemented a testing center with the support of Microsoft. ARTech and private universities have also cooperated. Finally, the GeneXus Community has generated *network externalities*. This is a clear case of how private bargaining can internalize externalities, resulting in efficient solutions.

Public Support

In its early stages, the discovery did not benefit from any specific public support or incentives. However, the public sector was important to the extent that it adopted the product for some of its entities. In a later stage, ARTech benefited from important fiscal incentives granted to the software sector, as will be discussed below. It also established an office in a private, technological free trade zone in Montevideo (Zonamerica), where the legal regime provides total tax exemption.

Diffusion Process

It is now clear that ARTech played a first-mover role (as described in the 2003 model advanced by Ricardo Hausmann and Dani Rodrik) because it revealed to other potential investors the local cost structure and the profitability of a new activity at the country level. The basic logic of the self-discovery model indicates that once this information becomes known, imitation appears, and a new sector arises. However, in the current case there was no proper imitation of the pioneer's product. This is not an uncommon feature in the software tools segment. How, then, did an exporting software sector emerge and develop in Uruguay?

The discussion that follows considers three main issues: the availability of public goods; conditions that triggered exports and gave rise to different internationalization strategies; and the eventual replication of a community-of-practice model. Then, it turns toward some coordination failures and the way they were tackled. Lastly, it sums up the public response to the discovery.

Public Goods

Education and Research in IT-Related Fields

The dramatic growth of information and communications technologies (ICT) in the advanced industrial nations had two features that were of great importance for follower countries: the decoupling of hardware from software, and the pronounced human-capital intensity of software. This, together with rapid improvements in data communication (and communication more generally) and the steady increase of globalization, opened a window of opportunity for countries well below the technology frontier, but rich in human capital relative to the opportunities for that human capital (Arora et al., 2001). This great opportunity has been seized by the three "I's"—Ireland, India, and Israel—which all exhibited an "excess" supply of human capital in the 1980s and early 1990s and, specifically, an excess supply of engineers and technology graduates. Although this last condition does not hold in the Uruguayan case, the country fits the model insofar as it had a high share of university graduates compared with its level of technological development. There was no wide and diversified industrial base demanding these resources. The opportunity cost for professionals to work in the software industry was therefore not too significant and the window of opportunity for late-coming countries in IT could be seized.

The initial availability of very qualified human resources was the product of long-term investment in education and R&D in that particular field. In Uruguay, the only public university (Universidad de la República, or UdelaR) created graduate studies in computer science at its Engineering School in 1967, when it also set up a research-oriented Computer Institute (Instituto de Computación, or InCo) with the advice or collaboration of foreign researchers. After the dictatorship period (1973–84), UdelaR's Engineering School sent computer engineers to train abroad at the postgraduate level as a way to rebuild the computer center. Computer science was also included in the post-dictatorship Program for the Development of Basic Sciences (Programa de Desarrollo de las Ciencias Básicas, or PEDECIBA), which proved highly successful in bringing researchers and teachers back to Uruguay.

In the 1990s, the expansion of private universities—which was particularly noticeable in computer science—provided the additional human resources required for the growth of the software sector. The curricula of the computer sciences programs were pragmatic and market-oriented, aimed at facilitating the rapid incorporation of graduates into the software industry. In contrast, the sound theoretical base provided at the state university was crucial for developing the capacity for solving complex systems problems and generating technological innovations in a field where specific knowledge is particularly prone to become rapidly obsolete.

Education in ICT was thus the result of public and private efforts. Employment in the IT sector grew from around 800 at the beginning of the 1990s to 4,900 in 2004 (González and Pittaluga, 2007). It is now estimated to be close to 12,000 (Separata Brecha-ANII, 2010).

Telecommunications Infrastructure

In the past two decades, the state-owned telecommunications enterprise, ANTEL, developed a 100 percent digital telecommunications network covering the whole country, and an extended fiber-optic network for data transmission. Uruguay has a good relative position in Latin America in terms of ICT infrastructure, with some indicators comparing favorably with other emerging software nations.[11] However, the economic recession in the early 2000s affected ANTEL's revenue and investment, and the country also lost the opportunity to hook up to the fiber-optic loop for Latin America. It now has to connect to the Argentine hub, a more expensive alternative.

Quality of Life

This factor is important for attracting foreign direct investment and making the country attractive as a regional software hub, as well as for preventing the relocation of successful national firms in more vibrant business environments.[12] Some researchers have found that the type of talent sought by multinationals tends to reside in clusters typified by high quality of life standards:

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[11] See ICT indicators in www.itu.int.

[12] ARTech's partners and other successful entrepreneurs report having declined proposals to install their main offices in the United States, among other reasons, because of the quality of life in Uruguay.

that is, locations where there is quality of place, a deep labor market, and high levels of environmental quality (Florida, 2000, cited in Carmel, 2003). Environmental conditions are excellent in Uruguay, which is also a peaceful country with an educated population and no racial problems. The country ranks well in indexes of government stability, democracy, corruption level, and the like. On the downside, labor and other markets lack dynamism, and air connections are sometimes difficult, even for some Latin American destinations.

Legal and Regulatory Framework

Software products were implicitly copyright-protected by Uruguay's intellectual property law of 1937. An amendment in 2003 now takes software specifically into account, and the developer has the exclusive right to authorize the reproduction, distribution, transformation, and communication of programs he or she has authored.

No other laws or regulations were specifically directed toward the software industry during the export take-off period. It was only after exports began to grow rapidly that a series of fiscal benefits were established. In 1999, this industry was declared "of national interest," which provided it with some fiscal benefits, mainly exemption from the 1.5 percent capital tax and the 23 percent value-added tax (VAT) on capital goods. More significantly, in 2000, the sector was exempted from the then-30 percent industry and trade income tax and from VAT on exports of software and informatics services.[13] In 2010, exemption from the 25 percent income tax was limited to 50 percent of revenues from domestic sales.

Milestones and Comparative Advantage in the Development of Exports

Lower labor costs than those of the developed world are a basic advantage. But in international comparisons, Uruguay lies far from the cheap labor countries. Other factors must have combined to establish Uruguay's comparative advantage. Similarities in the trajectories of software firms in the early period of the discovery are revealing in this regard, besides illustrating some typical features of the sector's development.

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[13] Previously, only exported *goods* benefited from VAT exemptions. The decree extended the exemption to consulting services and licenses sold abroad.

Focusing on Niches and Customized Solutions

From the outset, the perception concerning software demand was that there were some market niches of no interest to large IT companies. Indeed, in some areas it was only possible to find either standard programs that would perform multiple, but not in-depth functions, or highly specialized but very expensive applications. Thus, demand existed for reasonably priced applications that would perform some functions better than the former programs but would disregard certain functions of the latter that were useless to the client.

Many of the emerging firms grew from links with other sectors that developed new demands and became a source of competence (through their knowledge and skills, their willingness to experiment, and their ability to engage in an active dialogue). Unattended needs were detected in both vertical and horizontal markets. To take advantage of these opportunities, firms developed a strong capacity for customized solutions, and the industry evolved from tailor-made programs or solutions (developed from scratch for a customer) to customized adaptations, integration, or implementation of existing, standard programs and tools to meet the specific needs of one or more customers; and products developed as open packages that support customized adaptation. Accumulated experience in attending to local specificities or conditions became a major condition for reaching foreign markets.

Generally speaking—as the pioneer case already showed—a final IT system applied in non-IT firms (end users) is the product of complex, nonlinear relationships between different types of agents. User-producer relations are a strong ingredient, based on formal or informal agreements. An end user can even become part of a solution that is then supplied to other customers, when the former is heavily involved in the building up of his system. At the same time, the search for network externalities and economies of scale stimulate producers to look for product-diffusion patterns that also enable complementary benefits for them, such as a greater capacity to upgrade products.

The Necessity to Export

Although software firms initially used the domestic market as a testing ground for their products and services, they rapidly had to look to foreign markets to achieve a better return on their investment and reap the benefits of their apprenticeship. The limitations of the domestic market, both in terms of size and sophistication, made it impossible to reach high business levels without exporting.

While Uruguayan exports were growing, countries such as Argentina, Brazil, and Chile were still focusing on their own, larger domestic markets and their exports were slower to develop. So, for some time, Uruguay benefited from a comparative advantage deriving from its insertion in regional markets before strong competition started from other larger Latin American nations. In 2002, Uruguay was exporting more than any other country in the region. Soon after, the financial crisis in Argentina drastically restricted its investment rate and imports, which in the field of software included 30 percent of Uruguay's exports. This had the effect of compelling Uruguayan firms to diversify their markets outside MERCOSUR, the Southern Common Market that includes Argentina, Brazil, Paraguay, and Uruguay as full members.

Sophisticated First Client

Many start-ups were spurred by a sophisticated first client (often referred to as a "godfather") that helped resolve uncertainties and reduce the cost of experimentation. In this sense, externalities were generated by clients taking the risk of hiring a local firm where there was no recognized national experience. Picking up the right first client was essential not only to having a technically proficient interlocutor, but also because it could mean a bridge toward markets where Uruguay lacked a reputation or a country image.

Low Initial Investment

Capital requirements are fairly low for developing software applications or services, as compared with other sectors of the economy, such as electronics. This fact, combined with few rewarding employment alternatives in this field (mainly the public sector or working abroad) in the early 1990s, spurred the creation of start-ups by graduates who "tried their luck."

Portfolio Diversification to Compensate for Lack of Capital

Venture capital has always been a scarce resource in Uruguay, even more so in the case of this "intangible" sector. So for many firms, the complementary sale of imported hardware was their "bread and butter," acting as a source of financing and insurance against failure in their new endeavor. Services related to their products also contributed substantially to their overall turnover. This tendency to engage simultaneously in different types of activities has persisted: firms maintain a diversified portfolio as protection against fluctuations.

Coordination Failures

A review of the sector's main features and early evolution reveals several coordination failures.

Limited Agglomeration Economies and Synergies

Has the growth of the software sector been related to benefits derived from the geographical concentration of the software firms? A 2004 survey of 97 firms in Montevideo sought to clarify this issue (Kesidou and Romijn, 2008). The study was based on theories of territoriality that identify the agglomeration of economic activity as a possible generator of benefits related to economies of scale, labor market concentration, and rapid diffusion of knowledge. Three mechanisms by which local knowledge spillovers—that is, unpaid-for knowledge flows—occur were analyzed: spin-off, labor mobility, and interaction. No significant results were obtained concerning spin-off, but the other two mechanisms—interaction and labor mobility—appeared to play a significant role in innovation and learning. The statistical results demonstrate that knowledge circulates among actors in the software sector, and that local knowledge spillovers are more important for innovation than other types of knowledge flow (market-based). The study concludes that the argument of local knowledge spillovers fostering innovation in high-tech clusters—as the argument found in theoretical and empirical works in developed countries—holds for the Uruguayan case.[14]

If local knowledge spillovers exist, this market failure could be restraining firms from assigning the required resources to develop endogenous efforts in a systematic way because they perceive they will not internalize all the social benefits of their investment. This limitation was somehow recognized in the 1990s, when several initiatives to foster joint activities were debated but did not materialize. It is only now—about two decades after the sector's birth—that complementary, collective actions are producing synergies in the sector, as will be discussed below.

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[14] Other studies of the Uruguayan software sector, of a qualitative nature, emphasized the juxtaposition of firms, instead of firms' willingness to organize themselves into clusters to take advantage of mutual benefits. A study conducted in 2003 concluded that firms depended exclusively on their individual efforts to generate their competitive advantages (Magnone, 2003). According to another study, software firms were not prepared to combine efforts when there was a risk of real competition among them (Edelman, Regent, and Veiga, 2002).

Limited Linkages with Other Sectors

As mentioned, links with some particular sectors (e.g., the financial and distribution sectors) have been essential to the emergence of the software sector. However, until recently, similar ties did not develop with various other sectors, including the agricultural, livestock, agro-industrial, and energy sectors, though these sectors faced challenges that could not adequately be solved by importing ready-made products or systems. Three factors, among others, have delayed stronger integration of the software sector with the national economy. First, the size of the great majority of Uruguayan firms is limited, and small firms usually have no professionals to properly identify the benefits of investing in IT. Second, association—which could counteract this first factor—was uncommon. Third, government procurement in general has not been used as an instrument to foster the development of technology-intensive sectors in Uruguay.

Low Connectivity to Global Markets

Connectivity with the high-tech world is essential but full of obstacles for a developing country. Globalization compels investment in certification and networking. One of the problems experienced by small firms is the fixed cost of auditing compliance with industry standards. According to a survey carried out in 2002, of 38 innovative software firms, only nine had certified a product or service, and only five of them through a developed nation entity (UNDP, 2005). A more comprehensive survey conducted by CUTI in 2004 showed that 24 firms had an ISO-9001 or similar certification, and another 13 were working on it. Two firms in the survey were certified according to the Capability Maturity Model Integration (CMMI), the most demanding standard in this industry.

With regard to networking, the 2002 survey of 38 innovative firms revealed that the bulk of these firms (76 percent) participated in one or more networks—an instrument they considered of strategic importance. However, less than one-quarter of the firms were integrated into networks that included firms from developed countries, only 15 percent participated in MERCOSUR networks, and about 20 percent were integrated with networks in other Latin American countries. Considering that the survey concentrated on the most dynamic and exporting software firms, it seems that an extremely low share of the sector has invested in developing connectivity with the high-tech world. In addition, a vast majority did not have partners from developed countries helping them connect to global networks. It was only around the turn of the

century, as the software sector consolidated, that a few important foreign firms appeared—in particular, the Indian multinational Tata Consulting, in 2002.

Elasticity of Labor Supply

Several issues are at stake concerning the future supply of human capital for the software industry. In the past 20 years, an average of fewer than 300 students per year has graduated in informatics (CUTI, 2007), which is a very low figure if the software industry is to increase, or at least sustain, its current export growth rate.[15] An underlying coordination failure is expressed in the very high dropout rate in computer science students (public and private universities), as shown in Figure 10.3. Dropouts and delays in obtaining degrees are largely attributed to severe deficiencies in math education in secondary school, as well as to the early hiring of students by software firms, and vocational problems. Despite CUTI's campaign to promote the very diversified types of trained human resources that the industry requires and the different course and career options, youngsters often associate computer specialists or technicians with the image of an "asocial nerd" (Separata Brecha-ANII, 2010). At the same time, human capital with entrepreneurship and management skills—crucial for the expansion of the sector and its insertion in global value chains—is also a relatively scarce resource in the country.[16]

Solving Coordination Failures: Private Response with Public Support

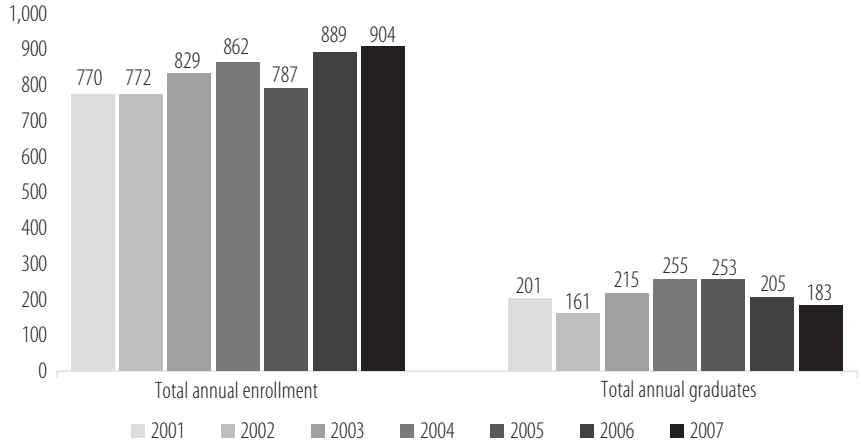
Since the mid-2000s, a striking fact has been the way some of the sector's coordination failures have been tackled through collective action. For example, eight firms of Grupo Integro (an economic interest group created in 2004 by 25 software firms) jointly negotiated their upgrading process with IBM to comply with the CMMI standard (level 3), and obtained a collective grant from the government's Technology Development Program (cofinanced by the

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[15] Tata Consulting opted for on-the-job training of non-IT graduates when it had to increase employment from 340 to 600 in 2005–06. Today, the firm trains human resources in ICT at the Knowledge Development Center, a joint venture between LATU, CUTI, and renowned ICT firms.

[16] It was only in 1988 that the private ORT University established the first business school in Uruguay. Since then, universities have increased their offerings in business-related fields. However, at UR's Engineering School, entrepreneurship and management still tend to be considered "second-rate" skills.

FIGURE 10.3 | Enrollment and Graduation of Students in Informatics Studies, 2001–07



Source: CUTI (2007).
Note: Data refer to engineering and undergraduate degrees. Technical levels are excluded.

Inter-American Development Bank [IDB]) to finance half the costs. In 2010, four of them obtained the certification. More generally, the practices of nearly 10 firms now meet the requirements of the CMMI model (mainly at level 3, which is apparently the highest level for which firms in Uruguay are currently eligible, given their size and the nature of the tasks they perform).

More significant collective actions started in 2006 when the software industry as a whole requested, through CUTI, that it be considered among the sectors to be included in a new government program aimed at developing the competitiveness of local clusters (PACC, cofinanced by the IDB). Within this framework, in 2007 the main sector's players collectively developed a strategic plan (PACC, 2007); a new one is currently being drafted with a view to 2020.

Public support was also provided to set up a software-testing center. In 2004, UdelaR's Engineering School and CUTI established a public-private consortium to this end, with the help of a grant from the European Union. CES (Centro de Ensayos de Software) provides specialized services and infrastructure to perform functional and platform testing with a view toward improving the sector's productivity and competitiveness. According to the head of InCo, one of the sector's challenges was to find ways to certify the quality of the products, offering greater security to (foreign) buyers and users:

> Uruguayan software is good, but one thing is to be good and quite another is to be able to demonstrate it. It was important therefore to establish processes allowing [products] improvement and to incorporate methodically tests that would permit their certification (Separata Brecha-ANII, 2010).

Since 2004, CES has carried out about 100 projects of independent testing, testing consultancy, and training. Fifty-six of these projects were performed for ICT firms, 24 for public enterprises, and the rest for private firms, mainly from the financial and services sectors. About 13 projects were developed with firms and universities from Argentina, Chile, Spain, and the United States. Colombia, Costa Rica, and Cuba are the next targets of CES's current internationalization program. As the head of InCo emphasizes:

> CES contributes to a sound country image because Uruguay takes a stand in the growing field of software testing. This type of undertaking means that the country is seen in the region as a referent in software. Though Brazil and Argentina surpass Uruguay's exports in number, we lead the sector with regard to certification and quality (Separata Brecha-ANII, 2010).

CES also favored a new type of academy-industry link; it stimulated human resources training in a new field, and it generated research lines that strengthened the software engineering group.

Last but not least, perhaps as a "boomerang" consequence of the reputation acquired by local software firms in the international arena, other sectors of the Uruguayan economy are now more prone to take advantage of the domestic capacities and competences in software. A notable example from the agribusiness sector is the participation, since 2003, of several Uruguayan software firms in the Program for Animal Products Traceability.[17] Cattle breeding is one of the most important economic activities in Uruguay, and the country has 30 years of experience in progressively setting up an integral—and now

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[17] In 2002, the Ministry of Agriculture (MGAP) opened an international public bid to contract a private operator for the design, implementation, and operation of the National Livestock Information System (SNIG) database, to be financed by a World Bank loan. The bid was awarded to—and successfully implemented by—a consortium composed of Sonda Uruguay S.A. (a subsidiary of a Chilean software firm), ARTech, and Ingenieros Consultores Asociados-ICA (IICA, 2009).

mandatory—traceability system (group and individual animal traceability, and beef traceability). The Uruguayan system, essential for maintaining or increasing access to high-value markets, is considered worldwide as a reference in the field of traceability, among others, because it is strongly ITC-based (Rodríguez Perdomo, 2009). This is a good example of how knowledge-based (software) firms—usually marginal exporters in developing countries—contribute indirectly to a country's main exports.

Summing up, association, clustering, and collective action have developed recently, while conditions for connectivity to global markets, as well as linkage with other sectors of the economy, have improved. Most of these initiatives were highly dependent on external financing, and CUTI played a determining role as representative of the software industry's interests.

Despite recent, conscious efforts to promote education in the different fields and levels required for the sector's growth,[18] both the business and the education sectors consider that the deficit in human resources is currently the main challenge facing the software sector. This is thus an unsolved coordination failure.

Public Response

In the early years of the software sector, software entrepreneurs' main request was no government interference with their businesses. On the one hand, they proudly distinguished themselves from the typical state-dependent entrepreneurs of the import-substitution industrialization of earlier decades. But underlying their request was the understanding that "a weak and inefficient bureaucratic structure works best when it attempts not to do too much" (Arora and Gambardella, 2004: 29).

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[18] For example, in addition to a promotional campaign among youngsters ("The Future Lies in You"), CUTI offers comprehensive information on IT education and employment, as well as a series of online courses, through an attractive Web-based program ("Just Click", http://www.haceclick.com.uy). In 2007, Tata Consulting and Laboratorio Tecnológico del Uruguay (LATU) created an IT training center, and four more prestigious local software firms are now active members. "ITC Path" is a joint project of a private university (ORT), CUTI, the Rotary Club, and the European Union that provides full scholarships to low-income young people to acquire a technical degree as Web programmers, object-oriented programmers, technicians in electronic informatics, or technicians in electro electronics. More generally, the initiative to retrain university graduates from different disciplines as software professionals has gained impetus.

At the turn of the century, the remarkable dynamism of Uruguayan software exports and, more generally, the need to foster the development of ICT in the country, led to several public debates on how to consolidate this area. Several initiatives were launched, with varying degrees of success. An early initiative, which did not prosper, consisted of the creation of a National Committee for the Information Society, with broader purposes than just fostering the software industry. More successfully, a set of important fiscal incentives was decreed, and the government has been backing programs funded by international organizations such as the Inter-American Development Bank and the European Commission, as mentioned. The software sector has also been the most effective sector in responding to calls from the Technology Development Program (Programa de Desarrollo Tecnológico, or PDT) and the more recent National Research and Innovation Agency (Agencia Nacional de Investigación e Innovación, or ANII), in terms of innovation and quality-improvement projects. In addition, Ingenio—an incubator for IT projects—was set up in 2002 as a joint undertaking of LATU (a public entity for the promotion of industrial technology) and ORT (a private university), with the initial support of the Multilateral Investment Fund. Ingenio provided different types of services to spur entrepreneurship, and several start-ups have developed as successful exporters. The incubator now extends services to other knowledge-intensive sectors, and has become part of *Programa Emprender*, a broader initiative to increase the number and quality of new undertakings in different dynamic fields.

Finally, macroeconomic monetary policies have affected the sector's competitiveness. Real exchange rate appreciation between 1990 and 1995 had a negative impact on all exporting sectors of the country, just as the 2003 devaluation of the local currency boosted export competitiveness outside the region.

In short, it would be a mistake to assume that the state played no role during the development phase of the IT industry (Rivero Illa, 2005). The state had a key role in the early creation of certain preconditions and public goods that made achievements in the software sector possible later on. In the current phase, public involvement is high, and the level of coordination with the private sector is relatively good.

Comparator Case: The Electronics Sector

Some segments of the electronics industry in Uruguay (automation/instrumentation, telecommunications, electronic inputs, and medical devices) started to develop in the 1970s, stimulated by the decreasing price of basic

components in the world market and by miniaturization, which widened the field for local design and production. Researchers at the public university's Electrical Engineering Institute (Instituto de Ingeniería Eléctrica, or IIE) set up some of the firms. They were looking for new ways to remain in the electronics sector after being banned from working at the university during the dictatorship period (1973–85). The sector showed some dynamism throughout the 1980s (there were 40 firms in 1989, mostly small, producing 45 types of products), mainly associated with the strong increase in imports of electronic capital goods (Snoeck, Sutz, and Vigorito, 1992). Integrating these goods into different economic activities required knowledge and skills in the electronics field to adapt to local needs, which created business opportunities.

The *potential* market for national electronics consisted of applying these recent technologies and goods to specific problems of other productive sectors—at a reasonable cost—thereby enhancing the productivity and export capacity of these sectors. However, Uruguay did not have a strong industrial sector, and most firms did not count on expertise to detect upgrading options through accessible electronic devices. *Real* market niches did not emerge abundantly as they had in software and/or were not fully exploited. These and other factors prevented the electronics sector from evolving by exploiting some local market niches and developing customization skills that would have helped them pursue successful internationalization strategies.[19]

The most decisive condition driving the initial development of the electronics sector in Uruguay was the availability of highly skilled human resources. The IIE has a long tradition and started dealing with modern electronic issues, such as digital techniques, in the mid-1960s. As in the case of software, the state takeover of the university in the 1970s had a severe, disruptive effect on research at the IIE, but its strong capacity was rebuilt after the dictatorship period. Difficulties in consolidating full-time research and teaching teams (mainly due to the very low salaries at the public university) led to the multiplication of agreements and contracts between the Engineering School and the private

[19] Interestingly enough, interviews with entrepreneurs show that three features identified in software discovery can be found in some electronics cases: the cost of the first experience was shared among different actors; an externality was generated by the client that decided to hire a local firm with no recognized national experience; and the local firm was propelled to foreign markets hand in hand with its first client. A good example of this was the automation of wool processes in Uruguay, described in Sutz (2000).

sector, providing extra revenue to researchers. This was a general feature of the Engineering School, including the IIE.

In the 1960s, linkages also developed between the Engineering School and public entities, mainly the state-owned telecommunications enterprise, ANTEL. The implementation of a telex system in the country by a local firm, in 1976, consolidated a relationship that was decisive for the initial development of the electronics sector.

Electronics exports amounted to around $35 million in 1998—slightly higher than the level 10 years later ($32 million in 2007) (Gabinete Productivo, 2009). In the intervening decade, exports experienced a strong contraction, especially from 1999 to 2004. MERCOSUR is the destination of half these exports. Currently, probably no more than 10 firms are developing their main production activity in the electronics field. Moreover, some electrical engineers migrated toward the software industry.

Overall, the apparent potential of an exporting electronics sector did not materialize, despite two first movers that are worth mentioning, one in the automation and instrumentation segment and the other in the medical instruments segment.

Automation and Instrumentation Segment

In 1973, three engineers created CONTROLES S.A, a firm that evolved from a workshop into a small factory, and then into a medium-sized firm (with around 40 employees, and turnover in excess of $1 million). CONTROLES designs, produces, and sells electronic equipment. It developed some niches in the domestic market, such as elevator controllers, industrial automation equipment, power converters, different types of scoreboards and alarm systems, and SCADA (Supervisory Control and Data Acquisition) systems.[20] Few of the other Uruguayan firms operating in the field of automation and instrumentation

[20] An important factor was the deconcentration and deverticalization process of the elevator controller market in the late 1980s, a market previously dominated by OTIS. This provided CONTROLES with a technical and commercial opportunity to specialize in this segment, taking advantage of the broad range of elevators in Uruguay and Argentina that needed remodeling to comply with stricter municipal norms. CONTROLES started exporting in the early 1990s, according to Customs Office data. Exports reached $0.4 million around 2000 and $0.3 million in 2005, but fell sharply during Argentina's crisis (2002–04). Export dependence on Argentina decreased from 79 to 18 percent from 2000 to 2005.

survived. The ones that did survive focus mainly on domestic niches, such as weighting systems.

When comparing the electronics segment with the software case, it appears that they faced very different market opportunities, which largely determined distinct trajectories. The software sector faced and seized different windows of opportunity, while the electronics segment did not.

A strong barrier to entry stemmed from a combination of the following factors:

Demand Must Be Large Enough to Justify Investment

Software firms can start from scratch with a very limited investment in physical capital. In contrast, the high fixed-cost structure of electronics operations is a major issue for small-scale firms.

The Production Process in Microelectronics Is Complex and Requires Several Stages and Inputs

Many of these inputs must be imported because the size of the domestic market and the rapid obsolescence of components make local production unprofitable (Pérez Acle, Oliver, and Silveira, 1997). Importing components has been plagued with difficulties (according to qualified interlocutors) that reflect, among other problems, a serious coordination failure around customs procedures.

Seed Capital and Working Capital Loans Were Practically Nonexistent in the Country

Since electronics tend to have larger initial capital needs, this sector is more sensitive to the lack of venture capital in comparison to software. There are several cases of failed start-ups in electronics (that often emerged as spin-offs from the university), mainly because the founder had to dedicate too much of his time to another, remunerated job.

Public Procurement Has Not Been Used to Promote Local Learning Processes

Because of their size and recurrence, public purchases could have been a way to support long-term projects in electronics, where continuity allows knowledge and capacity to develop and update in some specific fields.

Because of its complexity, this industry would have required a great deal of coordination at different levels of the economy to prosper. This did not happen and partial attempts were truncated.[21]

Medical Electronics Segment

A very successful pioneer in this segment is Centro de Construcción de Cardioestimuladores (CCC), one of the seven largest pacemaker producers in the world.[22] Founded in 1969, CCC develops and manufactures real-time systems, including active, implantable medical devices such as cardiac stimulators, as well as other medical electronic devices. Just as ARTech offers a world-class product to develop complex mission-critical systems, CCC develops world-class safety-critical systems. About 30 years after its foundation, CCC's products and services exports suddenly boomed: they increased from less than $1 million in the late 1990s to between $2.9 million and $3.6 million per year in 2004–06, reaching $4.4 million in 2007, and an estimated $6 million in 2008 (according to a knowledgeable source at CCC). The firm exports to 20 developed and developing countries.

Production developed in the 1970s in the context of an import-substitution strategy. Previously, few implantations were performed in Uruguay because of the high costs of imported pacemakers, but the foundation of the Institute for Highly Specialized Medicine helped create a domestic market for pacemakers by covering implantation costs for anyone who lacked medical coverage. In the 1980s, when the electronic sophistication of pacemakers increased and exceeded CCC's capacity, the firm went into partnership with a U.S. company that provided the designs for CCC production. In the 1990s, when microcontrollers were introduced inside the pacemakers, a group of engineers providing services to CCC in programming and maintenance presented a project to the firm to develop pacemakers completely in Uruguay, from design to production. The project was approved and developed successfully. Since

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[21] For example, an early attempt to organize an effective Economic Interest Group among the existing firms failed; exporting electronics goods to MERCOSUR countries was slowed down due to extremely troublesome and time- consuming procedures; and the need to possess the right quality certifications to enter foreign markets implied not only very high costs for single firms, but also a series of testing that was not provided by LATU, the industrial technology institution (MIEM, 1999; interviews in Sutz, 1997).

[22] An extensive case study of CCC can be found in Darscht (2005).

1994, CCC has designed all pacemakers it produces; technology has been constantly updated, with a new generation of pacemakers appearing periodically.

Product upgrading was parallel to a no-less-demanding internationalization strategy that was directed not only toward selling pacemakers and related devices, but also toward finding R&D enterprises demanding engineering services. In 2007, according to a CCC manager, services represented 64 percent of exports; third-party manufacturing, 32 percent; and pacemakers, only 4 percent.

CCC developed close ties with the Engineering School. A Microelectronic Group was created in the early 1990s, at a time when future demand for local research in this field was highly uncertain. The Group consolidated and was hired in the mid-1990s by CCC to develop an application-specific integration circuit (ASIC) for a new generation of pacemakers. In the field of medicine, CCC opened up links with an Argentine research center.

Considering there are few players globally in pacemaker production, the nonappearance of a diffusion process following this discovery comes as no surprise. However, it is interesting to note that some exporting firms have emerged since 2000 in the field of biomedical devices and equipment.[23] This new activity—strongly based on a niche strategy in the medical sector—reveals certain positive changes in the local business and innovation environment. To some extent, these firms take advantage of externalities from CCC: a local demonstration effect and a reputation for Uruguayan exports in the medical devices market.

Conclusion

The existence of qualified human resources, the R&D tradition in computer science, and a good telecommunications infrastructure were essential public goods for taking advantage of market opportunities that emerged from the

[23] There are at least six such firms, according to a recent survey (PACPYMES, 2009). They participate in a life sciences cluster promoted by PACPYMES, a program of the Ministry of Industry. For example, BIOGENESIS, a small firm created in 2002, produces temperature sensors, intermediary cables, and other devices for hospital care. It now exports 92 percent of its sales to 20 countries, after obtaining international certifications (GMP and ISO). BIOLOGÍSTICA, also founded in 2002, focuses on innovative blood-collecting devices and syringes; its first device has been patented in the United States and Uruguay, after having been granted funds from the Technology Development Program (PDT) to test and certify the device (DICYT, 2006). MEDICAA—a firm created in 2003 that focuses on R&D in neuroscience and neuro-otology—develops products and services for the rehabilitation of patients with balance disorders.

rapid development of IT in the 1980s and 1990s. Firms seized these opportunities by following a niche strategy, focusing on one or a few target markets small enough to be ignored by the major industry players. In short, this discovery was essentially about identifying an activity (rather than a product) that the country could develop thanks to some preconditions and low capital requirements, and overcoming barriers to entry in foreign markets for a country known only for natural-resource-based exports.

The firm ARTech played a first-mover role, although some other pioneers with different products also paved the way for followers. ARTech's partners were savvy investors: they had worked as consultants in a more sophisticated context than the Uruguayan environment, and this helped them find a niche beyond the local market. They opted for a highly differentiated product, with a well-defined and "limited" scope that enabled high productivity. ARTech's trajectory shows an ability to assume large challenges based on a long-term vision of the development of IT and trends in globalization. The firm has exhibited several of the characteristics usually associated with a market leader: substantial domestic market share in its segment (software development tools); extensive distribution arrangements; leadership in developing a new business model and a new family of products; a position in the forefront of a new technology; and some market power in determining prices for its products.

ARTech resolved a series of uncertainties, and some of that information contributed to the diffusion process. Meanwhile, for the pioneer, monopoly rents limited profit erosion. Three types of knowledge goods were produced:

- *Proprietary knowledge.* ARTech regularly renewed its temporary monopoly by improving versions of its product; this operated as a barrier against imitative entry.
- *Club goods.* Such goods are not rivals, but are excludable through the development of the GeneXus Community.
- *Public goods.* ARTech established a reputation for Uruguayan goods and services in foreign markets, as well as a demonstration effect at home.

Knowledge spillovers occurred mainly through the pioneer's collaboration with public and private universities.

The diffusion process extended well beyond the first-mover pattern, since there are currently about 350 firms producing applications and services in distinct segments of the software industry. Coordination failures in the sector

persisted for a long time. Many of them were solved through public-private cooperation once the software industry was firmly established and its potential as a strong knowledge-intensive exporting sector recognized. On the one hand, software entrepreneurs increasingly backed up the IT Uruguayan chamber, CUTI. On the other hand, public involvement—virtually nonexistent for the discovery and early diffusion process—increased significantly, often in coordination with or in response to, requests from CUTI.

The emergence of the local electronics sector shows some similarities with the software discovery (skilled human resources, research capacity, potential market niches, and the like) and there were a few successful pioneers in certain market segments. However, the diffusion process was truncated. As a whole, this industry could not take advantage of some local niches and customization skills to implement successful internationalization strategies. There were barriers on both the demand and supply sides, as well as unsolved coordination problems.

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CHAPTER 11

Animal Vaccines in Uruguay: A Truncated Discovery Process

Lucía Pittaluga and Michele Snoeck

Animal vaccines have become a critical factor in the prevention of animal diseases because of their ability to boost immunity, thus improving animal growth efficiency, and to lower the rate of mortality. The global veterinary vaccines market is rapidly growing at a compound annual growth rate of more than 6 percent, and it is projected to reach $5.1 billion by 2012.[1]

Continuous product innovation is necessary to keep pace with changing disease patterns and with animals developing resistance to available antimicrobials. Varied farming conditions and changing animal husbandry methods are resulting in the emergence of new diseases or new variants of existing ones. Hence, one of the most significant drivers of value in the vaccines market has been the development and commercialization of biotechnology advances applied to animal health, particularly to vaccines (Wesley, 2005).

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[1] Europe is the leading market for veterinary vaccines (with almost 30 percent of the global market share in 2006) and is closely followed by North America. Because of high susceptibility to diseases and heavy demand, Asia-Pacific is the fastest-growing market (estimated to grow 7.7 percent from 2005 to 2012). Major vaccine producers, such as Bayer Health Care AG (Germany), Fort Dodge Animal Health (United States), Heska Corporation (United States), Intervet International BV (The Netherlands), Merial Animal Health Ltd. (United Kingdom), Venkateshwara Hatcheries (India), and Virbac S.A. (France), allot vast resources to initiate and develop new technologies in vaccine delivery and immunological potency (see http://www.highbeam.com/doc/1G1-181424582.html).

In the context of this dynamic global market for animal vaccines, a new, successful activity emerged in Uruguay: the export of bacterial vaccines. Between 1995 and 2009, these exports grew at a compound annual growth rate of 9.9 percent, faster than the 6 percent growth rate for the global animal vaccines market, but slower than the growth rate of the Brazilian market, which recorded a 13.2 percent increase in 2008 and even higher increases between 2005 and 2007,[2] and which is the main destination of Uruguayan exports. This last feature signals the emergence of a truncated discovery process, as discussed later in the chapter.

A Uruguayan Export Discovery: Bacterial Vaccines

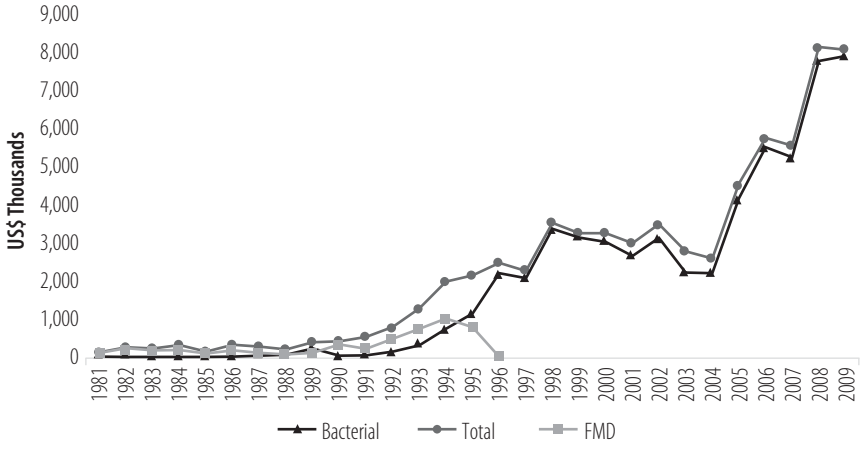
Uruguay's specific needs in animal health—namely to prevent foot-and-mouth disease (FMD)—served as an incentive to produce vaccines as early as the 1950s. The accumulation of local scientific and technical capacities in animal health and the presence in Uruguay of two of the largest multinationals in this field generated the conditions under which this demand for vaccines could be met. Some limited exports took place in the 1970s and 1980s, but as long as domestic demand existed for FMD vaccines, there were no real incentives to export. Indeed, in a country with 10 million head of cattle to be vaccinated regularly, FMD represented a huge and safe market, providing very high returns on capital. This is probably one of the few cases in which the size of the Uruguayan domestic market was not a limit on development.

In 1996, Uruguay was declared "free of FMD without vaccination" by the International Organization for Animal Health, a very important label in the global meat markets. To obtain this status, the government had decided two years earlier to discontinue vaccination. Simultaneously, handling the disease's live virus was prohibited for security reasons, which meant the end of FMD vaccine production in the country.

These events contributed to a turning point in the mid-1990s in the shaping of the current Uruguayan vaccine sector (Figure 11.1). On the one hand, multinationals lost interest in Uruguay with the disappearance of the domestic FMD market. On the other hand, projects to produce other animal vaccines took shape and led to an export discovery. Exports reached $7.9 million by

[2] Sindicato Nacional da Indústria de Produtos para Saúde Animal (SINDAN), Brazil. Available at http://www.sindan.org.br.

FIGURE 11.1 | Uruguay's Animal Vaccine Exports, 1981–2009



Source: Banco de la República Oriental del Uruguay (BROU) and Customs Office. Data for 2006–09 from URUNET, a private data service.
Note: Includes both finished animal vaccines (ready for export) and semi-finished animal vaccines (exported in bulk, and requiring packaging at the point of destination).

2009, mainly including bacterial vaccines.[3] These booming exports show how the country took advantage of technological, productive, and commercial capacities to respond to a negative demand shock (caused by the suspension of FMD vaccination) by seizing opportunities in a related field—albeit one with different technological features and markets.

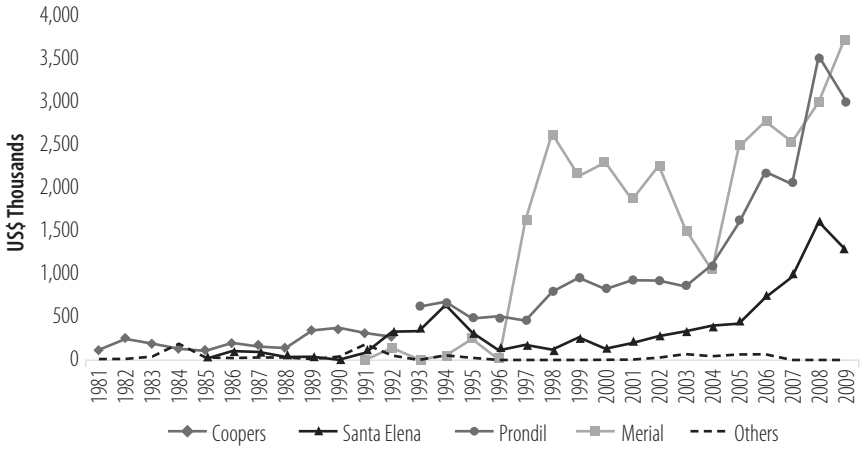
Only three firms in Uruguay have produced and exported bacterial vaccines since 1995: a branch of a multinational firm and two local companies (Figure 11.2). Laboratorios Santa Elena, one of the local firms, was created in 1957 by a small group of researchers at the public university's Veterinary School to produce animal health products, including vaccines. Its clients were veterinarians, cattle breeders, and traders from the countryside.[4] Although the firm developed its first export project in the mid-1980s, since 1995 it has exported bacterial vaccines (against anthrax and clostridial diseases) and viral vaccines (against rabies and eye diseases, among others) to Latin America and the Caribbean.

In 2006, Santa Elena invested in a former FMD laboratory with a view to recycling it and substantially increasing exports. Bacterial vaccines now account for the main share of Santa Elena's vaccine exports, which reached $720,000 in

[3] The recent world crises hampered the overall rate of growth in 2009, but business picked up again in 2010.

[4] Santa Elena's history is presented in Snoeck, Sutz, and Vigorito (1994).

FIGURE 11.2 | Uruguay's Animal Vaccine Exports by Firm, 1981–2009



Source: Banco de la República Oriental del Uruguay (BROU) and Customs Office. Data for 2006–09 from URUNET, a private data service.
Note: Includes both finished animal vaccines (ready for export) and semi-finished animal vaccines (exported in bulk, and requiring packaging at the point of destination).

2006 and $2.17 million in 2009.[5] In March 2010, the French multinational Virbac, a leading pharmaceutical animal health company ranked eighth in the world, acquired 30 percent of Santa Elena's share capital. This investment is Virbac's first step in Uruguay to developing livestock vaccines (essentially for bovine diseases). With this strategic partnership, Santa Elena expects to diversify its export markets through Virbac's international commercial network.

The second local firm is Laboratorio Prondil S.A. It was created in 1992 by a group of former employees of Coopers (now Intervet), the local subsidiary of the world leader in animal health multinationals that withdrew from the Uruguayan market in 1991. Prondil's capital is entirely national and independent of the multinational. The firm immediately targeted the global market, knowing that the national market on its own could not justify production. FMD vaccine production, the previous bulk of Coopers' production, was no longer an alternative. Initially, Prondil built on earlier marginal businesses of Coopers in South Africa and maintained some commercial relations with Coopers' head office. But the firm quickly developed new products to generate an independent business. It made the strategic decision to specialize in two lines of bacterial vaccines (clostridia and anthrax vaccines), on which it would focus

[5] The firm's annual turnover was $3.4 million in 2002 and $7.0 million in 2009. Vaccine exports represented 70 percent of its total exports in 2008 and 2009.

its technological and commercial efforts. Total vaccine exports reached $2.2 million in 2006 and nearly $3.0 million in 2009. Destinations include the Latin American and Caribbean region, as well as African markets.

The third producer is Merial-Uruguay (formerly Interifa). Atypically, this multinational subsidiary survived the wave of closures of most of the regional branches of multinationals in the 1990s. In 2006, its vaccine exports amounted to $2.8 million and reached $3.72 million in 2009. Latin America (mainly Brazil) is the most important market. The increasing external demand for the firm's vaccines led it to invest $2 million in 2006 to expand production capacity. The share of exports in the firm's turnover—about 50 percent in 2006—tends to increase year after year.

Summing up, Uruguay's new bacterial vaccine exports are a "discovery" because they represent a successful export activity that recently emerged and has experienced strong growth, going from basically zero to becoming significant for the country. The key reason for targeting these exports arose from the need and low opportunity cost to replace FMD vaccines when local production of these vaccines was prohibited. The choice of this new export activity was made easier by the prior technological, productive, and commercial knowledge about animal vaccines accumulated by the former FMD vaccine manufacturers. Uncertainties concerning local production costs were thus considerably reduced. As discussed in the next section, this heritage played an important role in the success of the new activity; however, it did not spare firms from facing other ex ante uncertainties regarding the profitability of exporting bacterial vaccines.

In more general terms, what the country discovered was the capacity to continue exploiting a comparative advantage indirectly related to its significant livestock sector. Indeed, the comparative advantage in FMD vaccine production was closely linked to Uruguay's competitive meat production, and the bacterial vaccine sector internalized the benefits from the learning trajectory of the meat sector.

The Pioneer Issue and Uncertainties to Be Resolved

According to Ricardo Hausmann, Dani Rodrik, and Andrés Rodríguez-Clare (2005: 12), the discovery process for new export activities requires a "pioneer investor who signals to other investors the profitability of these new activities." The case of animal vaccines in Uruguay is not a typical discovery of that kind because there was not a single firm that discovered the underlying cost structure of the new activity. Instead, three firms simultaneously discovered the profitability of producing bacterial vaccines for export. Merial-Uruguay,

Prondil, and Santa Elena began exporting vaccines at the same time—in 1995—and the products belonged to the same production line: namely, bacterial vaccines. However, the destination markets were somewhat different. The first two exported mainly to countries in Latin America and the Caribbean, and the third also to South Africa.

In this case, the pioneers were not savvy investors looking for broad opportunities, but rather prudent discoverers looking to exploit close, accessible opportunities. Discovery thus entailed low-cost activities, as firms jumped from one product to another with no need for a knowledge breakthrough at the firm level. However, even if bacterial vaccines were not new developments, their production and export involved a degree of uncertainty. What uncertainties were resolved in the discovery process? Did each firm accomplish the discovery separately? Or was it the result of synergy and collaboration between firms? To answer these questions, it is necessary to examine each firm's response to the negative demand shock associated with the eradication of FMD.

Until 1995, Merial-Uruguay focused on the domestic market, but things changed drastically with the ban on producing FMD vaccines in the country:

> When production had to be stopped, we experienced the same as any company that would lose its "battle horse": production had to be completely restructured since we had no product, neither biological nor chemical, with the same weight as the FMD vaccine. At that critical moment, we laid a wager on our professional background in biology and bacteriology. We had some experience in the production of bacterial vaccines, but it was still of a craft industry type. So we asked for financial and technological resources from Merial's headquarters to shift to the industrial production of bacterial vaccines (interview with Merial-Uruguay's manager, July 25, 2006).

Bacterial vaccine production was not totally new to the firm at that critical moment. An early manager of Merial-Uruguay, now deceased,[6] stressed the knowledge accumulated by the firm in that field since the 1980s:

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[6] Dr. Arturo Lezama was a veterinarian with a deep vocation for biology, who in the 1950s studied in the laboratories investigating the precursors of FMD vaccines, including Frenkel in the Netherlands and Mérieux in France. In 1962, he founded Interifa (a Merial subsidiary) in Uruguay. He developed FMD vaccines according to the French tradition. Dr. Lezama studied with Charles Mérieux, son and disciple of Marcel Mérieux, who in turn was the last of Louis Pasteur's close ring of 12 disciples.

> In the mid-1980s, we sent a vet of the firm [the current manager] to study biology at France. After his master's degree in biology at Lyon and at the Pasteur Institute, he prolonged his stay at Merial's laboratory in Toulouse, where he acquired know-how on anaerobic vaccine production (interview, September 20, 2006).

This was particularly relevant, considering that a long process of knowledge buildup is needed to deal with the risk involved in biological production:

> Biological training is a much more complicated issue than chemical or pharmaceutical training. Several years of specialized training after the basic university education are required before one can claim to be biologically trained. This is because of the high uncertainty associated with working with living beings (interview with Merial-Uruguay's current manager, July 25, 2006).

In short, the company received signals on bacterial vaccine profitability from the parent company, along with the physical and financial resources needed to restructure Merial-Uruguay. Also important was the accumulated local knowledge that enabled the new line of production to be implemented as soon as FMD vaccine production ceased.

In the case of Prondil, its director clearly referred to Coopers' legacy when asked about the initial strengths of the firm:

> In the first place, Prondil has a solid educational base, which derives from integrating professionals who had worked with Coopers, a highly renowned leading enterprise in animal vaccines. The British were pioneers in this field and Prondil succeeded in capitalizing on Coopers' legacy through its founders, who had been working for a long time with the multinational. In addition to the human resources strength, the inherited technology also was important in the first stage. Although some of Coopers' technology still remains in the laboratory, Prondil has gone much further and has developed many things that did not exist in Coopers' time. Local developments took place, some internally and others with the assistance of external resources, like some projects carried out with the Biotechnology Department [of the School of Medicine of the public university]. . . . On the commercial side, Prondil took advantage of having been closely related to Coopers' trajectory. This opened doors to some of Coopers' clients, who already

> knew people at Prondil because they were the same ones who carried out Coopers' businesses. These were the first steps, the most difficult ones (interview with Prondil's director, August 2006).

As in the case of Merial-Uruguay, bacterial vaccine production was not totally new to Prondil. A retired veterinarian and former technical manager of Coopers[7] pointed out that in the late 1950s, Coopers-Uruguay established a research team in technological developments in bacterial vaccines; however, in the 1960s, Coopers-Uruguay's main business was related to the FMD vaccine, which represented 70 percent of total sales. When Coopers closed its Uruguayan subsidiary, two junior members of the former bacterial research team participated in Prondil's creation and helped transfer the accumulated knowledge from one firm to another.

Hence, to a large extent, Prondil's discovery was based on signals it received from the multinational from which it was created. Coopers provided information on the profitability of the vaccine business. The new firm inherited the laboratory, tacit knowledge,[8] codified technology, and some clients. The main barrier to entry that Prondil initially faced in foreign markets was the lack of image and reputation. The formal registration of Prondil's vaccines in its destination markets was a very relevant factor, since it then served as a springboard for penetrating other markets.

Meanwhile, Santa Elena had invested in a brand-new laboratory for the large-scale manufacture of first-class FMD vaccines in the early 1990s, and it was on the verge of becoming a large exporter of these when production was banned. The firm found a way out of the ensuing crisis by focusing on bacterial and other vaccines that up until then had been marginal for the firm. Santa Elena thus received signals about the profitability of exporting bacterial vaccines from its own business, in a somewhat different way than the other two firms. The firm had previously developed these vaccines and produced them

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[7] Dr. Raúl Ángel Casas was a researcher who had been experimenting since 1946 in FMD vaccine development in the state-owned Laboratorios Rubino. He was hired in 1952 by Coopers-Uruguay to further develop this vaccine. He adopted Frenkel's FMD technology and developed the vaccine according to the English tradition. In 1954, the first FMD vaccine of this type was registered in Uruguay. During the next 15 years, Coopers' Uruguayan subsidiary became the multinational's main laboratory for testing the vaccine's performance (interview, November 10, 2006).

[8] Tacit knowledge (as opposed to codified or explicit knowledge) is knowledge that is difficult to transfer to another person verbally or in writing.

in small quantities. Uncertainty concerned commercial issues rather than technological or productive activities.

Thus, the three exporting firms simultaneously, but separately, found positive signals to invest in bacterial vaccines: Merial-Uruguay received them mainly from its parent company; Prondil, from the multinational from which it emerged; and Santa Elena, from its in-house and outside trials. This is not really surprising, because the information on commercial opportunities and technological features of bacterial vaccines was part of the industry's "common sense" at the time, according to a regional biotechnology consultant (interview, October 2006). Each firm counted on different assets to solve uncertainties related to concrete export possibilities: Merial-Uruguay was fully integrated in a global value chain as a subsidiary of a multinational; Prondil partially participated in one since its main market intermediary was the multinational Intervet (formerly Coopers); and Santa Elena had established connections through its recent market prospecting for FMD vaccines.

In conclusion, several factors combined precisely when veterinary vaccine firms lost their safe FMD domestic markets in the middle of the 1990s: commercial opportunities existed for bacterial vaccines and exporting costs were affordable because the targeted markets had relatively lax regulations at the time; there were local technological and productive capacities to seize these opportunities; and, last but not least, there were people in the local industry willing to continue "making their living" by producing vaccines in Uruguay. In terms of the Hausmann-Rodrik self-discovery model, these combined factors provided information that expected profits would be large enough to induce some pioneers to experiment right away. Apparently, the pioneer disregarded the possibility of waiting for an information externality from other experimenting firms.

Preconditions and Public Goods

Important preconditions existed for the development of the discovery, including the provision by the state of some critical public goods. Historically, Uruguay has been part of an internationally significant stockbreeding region. This spurred the local development of veterinarian products and services. In previous periods, the localization strategy pursued by multinationals led them to establish subsidiaries in this part of the world, to take advantage of the rapidly developing animal health market and the availability of human and other resources, like diagnosis services, national laboratories, and trained human resources. In the words of the son of a prominent veterinarian of that time:

> In animal health—in the field of biology and less so of chemistry—a world-level development focus arose in the Southern Cone in the 1950s. Looking at the history of Argentina, Uruguay, and southern Brazil, one can find in each case about seven to eight national laboratories that were created in the 1950s and 1960s, within the framework of the import-substitution strategy. Somehow, they were a kind of annex of the universities' Veterinary Departments. The technical experience of the teaching vets stimulated them to create private enterprises to develop products related to their teaching and research. Their education level was very good and there was very little difference between a national laboratory and a European or North American one. So firms like Bayer and Hoechst—typically with a chemical base but little biological knowledge—started their biological activities in the region, acquiring one of these national laboratories. Coopers Welcome was the only one of all the multinationals coming to this region that did not start by buying a local laboratory (interview with one of Santa Elena's partners, July 24, 2006).

Within this framework, the production of FMD vaccines proved to be a particularly profitable and highly secure business in the second half of the twentieth century, particularly in the River Plate Basin, one of the main cattle-raising regions in the world.

Once FMD was eradicated in Uruguay (in 1993), a natural course of events would have been to use the installed capacity to produce vaccines for countries still facing the disease. But the ban on handling the FMD virus in Uruguay made this impossible, and production was suspended. At that moment, it seemed that the local vaccine industry would be driven to extinction, but the firms undertook an unexpected path. What were the factors that triggered this new export phase? The first factor was the legacy of this period, in terms of learning economies in the field of animal vaccines. The second factor was the realization that banning FMD vaccine production could lead to the development of a new vaccine sector—this time geared toward exports.

Since the 1930s, Uruguay has been fighting FMD. State laboratories were established to experiment with new animal vaccines and regulations were created. In 1946, domestic private laboratories were authorized by the government to produce FMD vaccines, but it was only around 1954 that vaccines started being produced and registered. In 1967, regulations to start a national campaign against the disease were approved. In 1968, the campaign included the whole country and a governmental FMD institution (Dirección de Lucha

contra la Fiebre Aftosa, or DILFA) was created to control the quality of all FMD vaccine production.[9]

A relatively extensive scientific base of human resources dedicated to R&D was available for the development of this local industry at that time. The state laboratory, Laboratorios Rubino, and DILFA were in charge of transferring the researchers' technological developments to private firms. The Veterinary School of the public university (Universidad de la República, or UdelaR) was in charge of veterinary education but had very little intervention in R&D in this field.

The second factor, the development of new vaccine exports triggered by the ban on FMD vaccine production, was possible in Uruguay because there was a scientific, technological knowledge base working inside the firms, the state laboratories, and UdelaR. Uruguay still stands out not only for the quality of its scientists, but also for the quality of the technicians working in the laboratories. In the biotechnology sector (the current research field in vaccines), there is a critical mass of scientists who work mostly in laboratories at UdelaR.[10] That vaccine production costs are substantially lower in Uruguay than in more-developed countries is partially due to the comparatively lower salaries in Uruguay, especially for very qualified people.

Barriers to Entry in Global Markets

High barriers to entry characterize vaccine production because this activity entails high investments in R&D, production facilities, quality control, quality assurance, and product registration, as well as special arrangements (like partnerships) for selling and distribution. In addition, acquiring know-how is difficult, thus technology transfer often requires a strong, cooperative relationship between partners (e.g., joint ventures). These barriers, together with the limited world vaccines market (less than 2 percent of the pharmaceutical market), explain the relatively low number of vaccine producers in the world as compared to other classes of pharmaceuticals.[11]

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[9] This new institutional framework contributed to forcing several laboratories out of the market at the end of the 1960s. Of the 11 FMD vaccine producers in the country, only four survived; all of them were subsidiaries of foreign companies, and they would share the domestic market throughout the 1970s and 1980s.

[10] Recently, the private universities have also been delving into biotechnology.

[11] GAVI (Global Alliance for Vaccines and Immunization). Key Concepts: Economics of Vaccine Production. Understanding Vaccine Prices. Available at http://www.who.int/immunization_financing/options/en/briefcase_vacproduction.pdf.

The discussion that follows examines how Uruguay's pioneers have surmounted the various barriers to entry in global markets, including R&D, production know-how, scale economies, quality-control systems, upstream and downstream production, distribution economies, and vaccine registration in foreign countries.

The three Uruguayan firms mainly produce "traditional" vaccines by using available public knowledge.[12] But the process of mastering, adapting, and improving this public knowledge was not easy or smooth. It involved R&D and other knowledge-creating activities, distinct from the production process, which had different degrees of complexity depending on the "tacitness" of the adopted technology.[13]

The vaccine industry in Uruguay was, and still is, highly related to specific research carried out at UdelaR. Prondil and Santa Elena both have strong partnerships with local academic groups. The Biotechnology Department at the Instituto de Higiene (part of UdelaR's Medical School) is a very relevant actor, as well as the Biotechnology Department at the Polo Tecnológico de Pando (part of UdelaR's Chemistry School). In 2009, Merial-Uruguay signed a framework agreement with UdelaR's Veterinary School to implement programs and projects. The academic teams, although very limited in number, include scientists trained in some of the best academic institutions in developed countries. The teams maintain strong links with their academic partners in developed countries and therefore have access to state-of-the-art scientific equipment and methodologies. Thus, they provide the needed research infrastructure to local firms.

Since its inception, but more intensively since 1987, Santa Elena has worked very closely with local and regional academic institutions. It has signed research contracts with the public biological-research institute, Clemente Estable, mainly for molecular biology and genetic engineering projects. It has also carried out research projects with different departments of UdelaR, such as the Chemistry School, the Virology Department of the Sciences School, the Immunology

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[12] The international technological trend is toward more modern biotechnology, which until now has not been the main technology mastered by Uruguayan firms because of the high cost of entering and succeeding in the field.

[13] Tacitness is the degree to which some knowledge cannot be codified into blueprints that would allow it to be applied easily in the production process. As Nelson and Winter (1982: 73) point out, "The knowledge that underlies a skillful performance is in large measure tacit knowledge, in the sense that the performer is not fully aware of the details of the performance and finds it difficult or impossible to articulate a full account of those details."

Department of the Veterinary School, and the Biotechnology Department of the Medical School. In addition, Santa Elena has carried out research projects with Argentine and Brazilian universities. In September 2009, the recently created National Research and Innovation Agency (Agencia Nacional de Investigación e Innovación, or ANII) awarded Santa Elena financial assistance to develop five new vaccines and three new drugs for veterinarian use.[14]

According to Santa Elena's manager, the firm focuses on diseases affecting cattle and cattle breeding because these are of little interest to multinationals:

> We specialize in analyzing what the region needs. When the stockbreeders and the vets face a problem, they have no access to the R&D leaders of large companies so they go to the local laboratories, and the same happens in Argentina. The problems we face in the region have nothing to do with Europe or North America. We have a pastoral system, concentrated or extensive, but an outdoor system. The Europeans have a confinement system; their cattle practically do not eat grass and do not walk. So, diseases are totally different in the two systems. Our first task is to identify our problems….Then we identify the people at the university who can solve these problems, we support their R&D up to the point that they reach the development of an antigen. That is when Santa Elena takes over to develop the product at the industrial level….Industrial R&D at the laboratory never stops. The biggest investment is made inside the laboratory, and each time we get better results with lower costs, with faster and safer processes (interview with one of Santa Elena's partners, July 24, 2006).

Ever since its creation, Prondil has called on UdelaR's R&D capacity to solve some of its problems. For instance, in 1997, it requested assistance from the Veterinary School, then in 2001, from the Biotechnology Department of the Instituto de Higiene. Since 2004, it has relied on the Biotechnology Department of the Polo Tecnológico de Pando. This happens when the firm does not have the required expertise and/or equipment:

> Prondil has no intention of financing basic research. What it needs is to solve practical problems: to generate knowledge on how to solve problems that Prondil is already facing, like production problems, control

[14] See www.anii.org.uy.

> issues, better performance, or cost reduction needs. Researchers make an important contribution. They do not always find these issues very attractive, but they certainly are interested in establishing links with the industry, in part because it is a financing source for their laboratories and the critical mass that is needed in the sector. Prondil has developed a fruitful relationship with the Instituto de Higiene and, earlier, with the university's Veterinary Department….Sometimes the academic environment is somewhat slow, but the industrial sector has no room for dreaming. When we have a need, it is concrete, urgent and we have to solve it (interview with Prondil's director, July 26, 2006).

A good example of collaboration with the Instituto de Higiene was the development of a new cell culture. The industrial aspects were carried out by Prondil with equipment from the Institute, which in turn was in charge of applying all control techniques to the product. Another example is the ongoing collaboration with the Polo Tecnológico de Pando to optimize the production process of bacterial vaccines. Recently, the ANII approved financial assistance for Prondil to work in this line. This is the starting point to install a laboratory to develop new vaccines, a project in which the Polo Tecnológico de Pando will also be closely involved.

Because Merial-Uruguay's technology is provided by its parent company, connections with the national R&D environment are limited. Its closest ties have been with UdelaR's Veterinary School, which has an almost exclusively clinical orientation. This linkage has intensified since 2009 through implementation of the framework agreement mentioned earlier.

The patent system does not play a crucial role in impeding the diffusion process. Vaccines can be copied relatively easily if the required skills and knowledge exist, although the processes are not totally standardized since there are important issues related to the mix of the adjuvant and the pathogen agent to obtain the most effective vaccine. These issues are secrets of *production know-how*—important barriers to the entry of new firms.

Concerning *quality control and assurance* as well as *scale economies*, two recent local investments are directed toward solving these fundamental issues. Through a $2 million investment, Santa Elena completely renovated its former FMD laboratory in 2006. The firm's objective was to improve the technology and quality of products and processes, and to produce in biosafe conditions compatible with the most recent biosafety regulations. Its production capacity was designed to respond to increasing biological demand. The new investment from the multinational Virbac is certainly a consequence of that. Meanwhile,

Merial-Uruguay is also seeking to increase scale economies (doubling its production capacity), update technology, and improve the quality system by investing $2 million in a new bacterial vaccine plant. The local director stresses that the parent company decided to locate this investment in Uruguay mainly because of the excellent clostridial vaccine performance attained by Merial-Uruguay.

Upstream links generate significant savings for the local firms. In the case of Prondil, for example, animal trials are outsourced to two veterinarians who are also cattle producers, and can therefore easily test new vaccines. In the case of Santa Elena, the firm is highly connected to different actors in the animal health sector: diagnosis firms, local veterinarians, and cattle and other animal breeders.

Another important upstream link relates to input supplies. Prondil established a user-producer association with its two providers of plastic bottles. Thus, while quality was inadequate initially, it was subsequently improved through an intense learning process. Another very relevant national input for Prondil production is horse meat, which is used to obtain the protein concentrates needed for antigen production. It is a tough process, and Prondil is the only vaccine producer to start the production chain from this early stage. But the firm found it rewarding in terms of quality and costs as compared to the alternative of importing the protein concentrates—and despite the fact that the firm is a price taker in the local horse meat market, which is entirely geared toward export.

A *downstream production barrier* to entry derives from transportation costs. Vaccines are usually transported by plane and must be surrounded by ice, which inflates the weight.[15] Long distances to developing regions—like Africa—mean high transportation costs, which can end up being higher than the FOB price. So large-scale shipments must compensate for these costs.

A major barrier to entering export markets relates to the *norms* in force in the importing countries. Different countries apply different norms for biological products, and in developed nations, these have become nontariff barriers. Prondil's director explained this issue as follows. The firm registers its vaccines according to U.S. standards; consequently, its vaccines meet these norms. But exporting to the United States or Europe also implies submitting the vaccines to very complex laboratory tests in order to demonstrate compliance. Performing all the required tests and trials to export to these markets would require a technical structure far superior to the existing one, which in

[15] Only on some occasions do volumes and other conditions make sea transportation possible.

turn would imply huge investments.[16] Instead, the firm can use its cost advantages to export to countries that cannot afford to pay the price of vaccines produced in developed countries. The firm's vaccines are registered with Prondil's trademark and these registrations are Prondil's main advantage: the firm owns the sanitary registrations of its products in its export markets (interview with Prondil's director, July 26, 2006).

Finally, the pioneers overcame *selling and distribution barriers* to enter export markets in different ways. Merial-Uruguay is fully integrated in a global value chain as a regional provider of a multinational; Prondil is still, in its main markets, closely linked to the multinational Intervet for selling and distribution; and Santa Elena has established regional joint ventures to sell and distribute its products.

In conclusion, the three pioneers have overcome several barriers to entry in global markets. But during this process, they were unable to resolve some coordination failures. As the next section shows, this prevented the emergence of other local exporters.

A Truncated Diffusion Process

As Hausmann, Rodrik, and Rodríguez-Clare (2005: 13) observe:

> [The] self-discovery process is rife with information externalities because the cost information discovered by an entrepreneur cannot be kept private. If the pioneer is profitable, this can be readily observable by others. Imitative entry then follows, the incumbent's rents are dissipated, and a new sector takes off. If, on the other hand, the pioneer firm goes bankrupt, the losses are borne in full by the entrepreneur. Hence, entrepreneurship of this kind is not a very rewarding economic activity: the losses are private while the gains are socialized. Consequently, markets under-provide entrepreneurship in new activities.

In this case, the three pioneers developed a profitable business, but this did not give rise to an imitation process by other firms. In other words, the

[16] Naturally, this does not imply that the firm does not comply with international control techniques, since it must meet the established standards to register its products locally and abroad.

animal vaccine export discovery did not give rise to a new sector. Why did these opportunities not diffuse? Answering this question requires understanding the channels through which the pioneers captured monopoly rents, because different channels have distinct implications for diffusion. The pioneers used two channels: firms internalized an ex ante productivity advantage acquired from prior bacterial and FMD vaccine production; and they introduced new barriers to entry.

When the three pioneers launched the bacterial vaccine discovery, they were already producing FMD vaccines with strong economies of scale, and they had already developed and internalized production secrets. They thus took as a starting point prior knowledge from vaccine production and sales, which they had accumulated on their own or inherited from a former firm. This accumulated knowledge gives rise to proprietary knowledge, which in turn precludes externalities from spilling over, unless researchers, technicians, or other qualified workers move from one firm to another or create a new company. In this case, no flows of skilled workers can be observed; therefore, one can presume that the first channel to capture monopoly rent by the incumbent firms is an important explanation for the absence of diffusion.

The three pioneers also surmounted several barriers to entry in global markets, which paved the way for imitation. But each firm developed its production environment in isolation from the others (including upstream and downstream arrangements, in addition to substantial investment in R&D, infrastructure, distribution, and the like). Moreover, no common interest was identified that would give rise to collective actions. Similarly, there was no effective institutional arrangement in the broader field of biotechnology.[17] In this way, coordination failures were not resolved and no collective goods were created. These factors constitute a second channel for pioneers to capture monopoly rents, and help explain why other animal vaccine companies did not appear in Uruguay.

Actually, the coordination failures that have restrained investment in activities crucial for the sector's expansion mainly involve the lack of agglomeration economies that arise from a thick labor market, the absence of a scientific and entrepreneurial infrastructure for emerging projects, and the lack of a network of specialized input providers.

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[17] For example, unlike local software firms in Uruguay, the various attempts of the business organization AUDEBIO (Asociación Uruguaya de Empresas de Biotecnología) to coordinate the resolution of common problems has been fruitless to date.

A regional consultant in biotechnology explained the absence of thick labor externalities in these simple terms: Uruguay does not have the required professionals to set up new vaccine plants (interview, October 17, 2006). The inadequacy of the university curricula to serve that purpose and the lack of certain specializations at the graduate or postgraduate level are part of the explanation. For example, biological engineers to scale up processes in a vaccine plant are not available. Clearly, a coordination failure has arisen because of the complementarities implied: creating a specialization might not be reasonable in the absence of firms demanding such human resources, but firms will not invest in fields where it is difficult to find specialized professionals.

Concerning the second coordination failure, the origins of the three pioneers acted as a constraint to diffusion. The firms emerged as "traditional" firms that were then compelled to restructure, as technological breakthroughs in biotechnology imposed new conditions to attain competitive advantages in the vaccine industry. In contrast, new vaccine businesses must be created from scratch as biotechnology firms, with a very different profile in terms of technology requirements and business model. These latter firms (mostly spin-offs and start-ups) have a very difficult start because Uruguay lacks an adequate scientific and entrepreneurial infrastructure for emerging biotechnological projects.

Finally, the lack of a network of specialized input providers was a very important factor in slowing down diffusion. As a biomedical exporter explained in an interview (December 13, 2006), "a biotechnological endeavor in Uruguay implies the generation of the entire chain of production and distribution." The limited volume of biotechnological exports explains the absence of such specialized providers, and indicates once again a problem of complementarities.

These coordination failures were not resolved despite the existence since 2006 of public subsidies for the creation of a Life Science Cluster.[18] Only one of the three pioneers participates in the cluster's activities, and it seems that club good solutions—needed for the expansion of the animal vaccine subsector—are not part of the proposals that the cluster has implemented.[19] Some observers believe that the Life Science Cluster is too broadly defined

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[18] Within the framework of PACPYMES (Programa de Apoyo a la Competitividad y Promoción de Exportaciones de la Pequeña y Mediana Empresa), a national program supporting competitiveness and export promotion of small- and medium-sized enterprises (http://www.pacpymes.gub.uy).

[19] A club good is excludable in that it is possible to prevent its consumption by entire groups of people, but it is also a non-rival good in that its consumption by one individual does not curb the consumption of another individual (Tiebout, 1956).

and integrates firms from diverse subsectors; consequently, the club solutions provided by the cluster are not acutely defined at a subsector level.

Summing up, the truncated diffusion process in the veterinary vaccine sector is explained by two main elements: the accumulated knowledge in the form of pioneers' "manufacturers' secrets" impeded information externalities from diffusing; and the pioneers were able to surmount barriers to entry in global markets without resolving the basic coordination failures of the industry. In other words, club goods were not created during the discovery process so as to facilitate the entry of new firms.

Thus, the profitable business developed by the three pioneers did not give rise to an imitation process by other firms. But the sector can expand by other channels, such as the internal growth of a pioneer or the establishment of a joint venture with a local or foreign investor. Today, it seems that both these channels are offering a starting point for the creation of an expanded animal vaccine sector in Uruguay in the near future. Indeed, the multinational Virbac's investment plans to install its global base for livestock vaccine manufacturing in Uruguay through a strategic partnership with Santa Elena are promising. Prondil's strategy to create a completely new line of vaccines in collaboration with the Biotechnology Department of the Polo Tecnológico de Pando also strongly suggests that exports will increase. Finally, Merial-Uruguay's bacterial vaccine exports grew at a compound annual growth rate of around 30 percent between 2005 and 2009, denoting a strong expansion process. Merial-Uruguay is the only pioneer that continued to augment its exports during the international crisis in 2009 (see Figure 11.2).

Comparator: New Biotechnology-Based Firms

The new Uruguayan biotechnology-based firms serve as a useful comparator to the animal vaccine firms because they have not been able to export, or do so only marginally, despite enjoying the same critical public goods as vaccine pioneers.

According to a survey conducted for the 2005 Uruguayan Human Development Report (UNDP, 2005), approximately 24 firms apply biotechnology to products and services of human and animal health, and to plant and animal genetic improvements. Exports are highly concentrated in nine firms (in addition to the three vaccine producers previously analyzed)[20]:

[20] The survey was conducted in 2003–04 and firms declared their exports until 2002.

three producers of *Rhizobium leguminosarum*;[21] two plant micro-propagation companies; two human vaccine laboratories; a molecular biology firm; and an exporter of animal genetic improvements. Exports of the first seven firms are relatively important, while the last two firms export only sporadically.

Consistent with the previous analysis, the major biotechnology exporters and the three animal vaccine firms underwent a restructuring process from a traditional business to a biotechnology-based one. However, the minor exporters started a modern biotechnology business from scratch and these are the ones having a hard time taking off.

Biotechnology start-ups face a great deal of difficulty establishing themselves. In addition to expensive facilities and laboratories, they need substantial connections with R&D, regulatory and legal knowledge—including a thorough understanding of intellectual property issues—financial expertise, and know-how to manage this particular kind of business. Access to human resources with all these qualifications may be beyond the means of such start-ups.

In the case of biotechnology companies in Uruguay, connecting with R&D does not seem to be the main problem. According to the 2005 survey (UNDP, 2005), the biotechnology sector in Uruguay is distinguished from other knowledge-intensive sectors in the country by well-established links between firms and research laboratories. Furthermore, research laboratories have a relatively strong commitment to work on biotechnology-based solutions for issues related to the productive sector.

The regulation of biotechnology-related issues and the legal protection of biotechnology products are one way of making modern biotechnology a business. Uruguayan government authorities are currently designing a regulatory system for modern biotechnology. To date, very few biotechnology-related patents have been registered with the National Office for Property Rights (Dirección Nacional de la Propiedad Industrial, or DNPI), and most of them are from nonresidents, a clear sign of how modern biotechnology is still not seen as a business opportunity by locals. Not a single lawyer in the country specializes in biotechnological issues—a strong limitation for emerging entrepreneurs.

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[21] *Rhizobium leguminosarum* is a species of gram-negative, aerobic bacteria that is found in soil. It causes the formation of root nodules on some types of field peas, lentils, kidney beans, and clover.

Another major problem lies in the management side of the business. There is little experience in managing biotechnology-based undertakings—an issue that is worsened when the start-up is created by scientists, as often occurs. In Uruguay, researcher-entrepreneurs who set up their own companies usually must learn on their own how to become and remain competitive because support for entrepreneurship is scarce. In this context, business and strategic management is either not considered as essential as technological matters or is neglected because of limited means to hire the required expertise. The learning path is very troublesome, and limited initial gains leave little room for trial and error.

A related issue concerns the lack of sound projects emerging from universities, with notable exceptions. Ideas are seldom developed into viable projects backed up by a business plan or a feasibility study. This comes as no surprise given the rather traditional university curricula as far as entrepreneurship is concerned. Subjects involving intellectual property rights and other legal matters are restricted to the law school, while entrepreneurial skills and knowledge are developed only in administration and business schools, with no such courses in the science or engineering schools. Fellowships to provide young researchers with work experience in industrial firms and laboratories are very new. The divide between science and business is thus still in force at the educational level.

At the world level, it is common for biotechnology entrepreneurs to emerge from a university, a research institution, or a company with which they have been working. In Uruguay, some critical mass of researchers in biotechnology exists, and many scientists work in applied research and on concrete development- related issues. But few of them start their own firms.

Finally, investors such as angels and venture capitalists have not yet appeared in the local biotechnology field, and public agencies have not provided seed capital. This seems to be part of the explanation for the very slow diffusion process. This factor deserves to be considered in a set of instruments to generate adequate incentives to create biotechnology firms.

In short, new biotechnology firms have not been able to export because they lack management tools and other entrepreneurial skills to enhance their global competitiveness—even if they share the local R&D infrastructure with vaccine pioneers and other traditional biotechnology exporters.

A possible explanation for the difficulty of new firms to start a modern biotechnology business from scratch is the low profitability at the beginning of this kind of enterprise. The evolution from a traditional business to a biotechnology-based one needs creating what Bisang et al. (2008) call the capacity to

develop complementary assets. These would allow pioneers to improve the low rent profits associated with biotechnology initially. Vaccine exports are an example of this, and so is the emergence in recent years of Uruguayan biopharmaceutical exports.[22]

Summary and Conclusions

Three firms in Uruguay have produced and exported bacterial vaccines since 1995: a branch of a multinational firm and two local companies. These exports are considered a "discovery" because they represent a successful export activity that recently emerged and experienced strong growth. The key reason for targeting bacterial vaccines for export arose from the need and low opportunity cost to replace FMD vaccines when local production of these vaccines was prohibited. The choice of this new export activity was facilitated by the technological, productive, and commercial knowledge of animal vaccines accumulated by the former FMD vaccine manufacturers. In other words, what the country discovered was the capacity to continue exploiting a comparative advantage indirectly related to the country's important livestock sector.

The three exporting firms simultaneously, but separately, found positive signals to invest in bacterial vaccines: Merial-Uruguay received them mainly from its parent company; Prondil, from the multinational from which it emerged; and Santa Elena, from its own in-house and external previous trials. Hence, the case is not a typical discovery as described by the Hausmann-Rodrik (2003) model, as there was no individual pioneering firm that discovered the underlying cost structure of the new activity. These three pioneers were not savvy investors looking for broad opportunities, but rather prudent discoverers looking to exploit close, accessible opportunities. Discovery thus entailed low-cost activities, as firms jumped from one product to another with no need for a knowledge breakthrough at the firm level. However, even if bacterial vaccines were not new developments, their production and export involved some degree of uncertainty.

Two factors are considered important "preconditions" for making the export discovery possible: the three firms had a common origin in biological

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[22] Clausen, a family-owned pharmaceutical firm that went from manufacturing traditional products to biotechnology-based ones, is now increasingly exporting its quality biopharmaceuticals. Celsius, another traditional pharmaceutical firm, is heading in the same direction.

production, and they inherited the country's institutional setup for FMD vaccine production. They also took advantage of three critical public goods: the scientific base; technological capacities; and basic education, which was generally of high quality. Global markets offered niche opportunities, but several barriers to entry had to be overcome. The three pioneers invested in R&D activities, quality-control systems, and production know-how and capacity. They developed upstream and downstream activities, and distribution links. They also obtained vaccine registration in foreign countries.

The bacterial vaccine export discovery was truncated in the diffusion phase. Again, this case differs from the typical Hausmann-Rodrik discovery model, because the development of the profitable bacterial vaccine business did not give rise to an imitation process by other firms. This was because the pioneers were able to keep cost information that they had discovered private through two channels: the firms transformed an ex ante productivity advantage acquired from prior bacterial and FMD vaccine production into a manufacturer's secret, thus preventing information externalities from diffusing; and the process by which the pioneers overcame barriers to entry in global markets did not require them to resolve basic coordination failures of the industry. In other words, club goods were not created during the discovery process so as to facilitate the entry to new firms.

The coordination failures that impeded investment in activities crucial for the sector's development mainly involved the lack of agglomeration economies that could have been generated by thick labor market externalities, the existence of a scientific and entrepreneurial infrastructure for emerging projects, and the development of a network of specialized input providers. But currently, the sector seems to be expanding through channels other than the creation of new firms, such as the internal growth of incumbent firms and foreign investment in the sector. The question remains whether expansion will be possible without resolving the basic coordination failures discussed here.

The modern biotechnology sector was used as a comparator for this discovery because it did not develop exports, or did so only marginally, despite enjoying the same local R&D infrastructure as traditional biotechnology exporters. A central question appears to be the capacity to develop complementary assets when starting a biotechnology business. Thus, preexisting firms that branch out into the biotechnology field have a better chance of surviving than the ones that start from scratch.

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Regional consultant in biotechnology, October 17, 2006

CHAPTER 12

TV Formats in Argentina

Alejandro Artopoulos, Daniel Friel, and Juan Carlos Hallak

Exports of television programs have increased dramatically with the advent of formats. The format itself is nothing more than the idea, main structure, and salient features of a program. Formats are programs made either by stripping existing series of their local cultural content or by directly developing story lines without specific cultural references, thus creating a flexible product that can be adapted to the idiosyncrasies of different markets. They are licensed to broadcasters, which adapt the format with content specific to the local culture. When making this kind of adaptation, the company producing the format often sells not only production services but consulting services. The sales of such services often prove more profitable than the sale of the format itself. The nature of formats enables companies that make them to sell their products to a wide variety of countries.

Before formats were developed—in the early 1990s—world trade in this industry was dominated by canned programs. This product is literally put in a can and shipped to the buyer. Once a program is canned, it can be changed only by dubbing in the target country's language or by adding subtitles. These activities are generally done in the country to which the product is shipped.

It was only after the television (TV) industry was deregulated and privatized throughout the world, in the 1990s, that the market for formats started to grow substantially (Moran, 1998). The move from canned programs to formats originated in the United Kingdom, brought about by the Broadcasting Act of 1990. This act required public broadcasters, such as the British Broadcasting Corporation (BBC), to source at least 25 percent of their programming from

independent producers (Barnatt, Starkey, and Tempest, 2000). Along with a worldwide deregulation of television broadcasting, this requirement prompted a shift in the production of TV programs. Vertically integrated companies that operated in protected national markets with their own full-time technical, creative, and production staff were replaced by independent companies that contracted many services and produced locally adaptable formats for international markets (Waisbord, 2004). Whereas global trade in TV programming up to that time had been dominated by canned programs from the United States, the advent of formats allowed European companies to emerge as world leaders in TV format exports.

One of the first independent companies to emerge as a result of the Broadcasting Act was Planet 24, a company owned by Bob Geldof. In 1994, this company created a format called *Survivor*. Although *Survivor* was not successful initially, it became a resounding hit when Strix Television, a Swedish television company, bought and renamed it *Expedition Robinson*. This format was the first highly rated, profitable reality show on broadcast television. Along with ABC's game show *Who Wants to Be a Millionaire?*, it sparked a format-based, reality-TV revolution. Broadcasters began to replace sitcoms and conventional drama series with reality shows (Moran and Malbon, 2006). The world leader in format creation today is Endemol, a Dutch company formed in 1994. It currently has offices in 23 countries.

The Television Industry in Argentina

Argentina has a long tradition of producing movies. During the first half of the twentieth century, Argentina was a successful exporter of films. Most of this country's exports went to Spain and Latin America. Despite this early success, exports disappeared almost completely after the 1940s. The experience with film did not spill over to the TV industry. Argentina had only a small share of Latin American "soap opera" exports during the 1980s, far less than that of Mexico and Brazil. Argentina's exports were carried out by the broadcast networks and oriented toward nontraditional markets such as Russia, as the conventional wisdom in the industry was that Latin American viewers did not find the Argentine Spanish accent appealing.

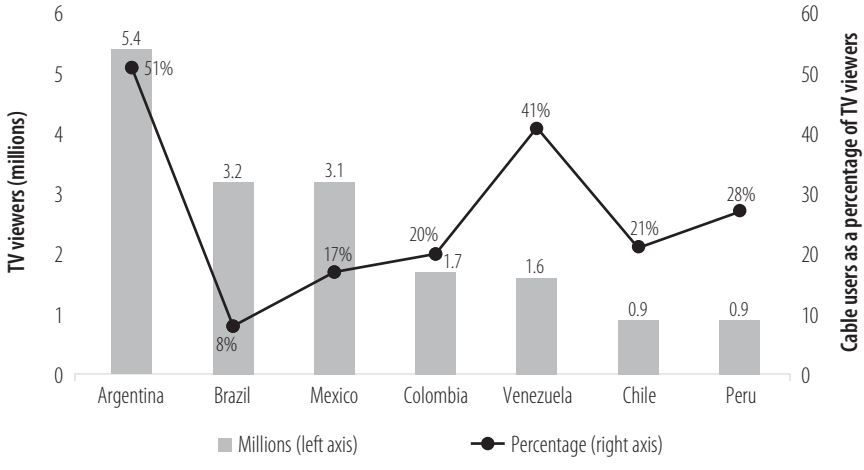
In the 1990s, the television industry in Argentina was privatized, leading to greater outsourcing and the growth of independent production companies. Although many of these new firms originally produced programs for the domestic market, they quickly started to develop products for export. They initially exported canned programs, but later moved on to exporting

formats. Argentina became one of the first developing countries to export this product.

Argentina's TV format sector has been successful in exporting a variety of different types of programs to a wide array of regions. Its exports range from programs for young Hispanics in the United States to lovers of fiction in Russia. Two of the most successful formats in the export market were *Montecristo* and *Rebelde Way (Rebel's Way)*. The former was sold to Chile, Colombia, Italy, Mexico, Portugal, Spain, and Russia, while the latter was sold to Asian and European countries. In 2009, *Lalola* was one of the three best-selling formats in the world, along with *Deal or No Deal* and *Hole in the Wall*.

The TV industry in Argentina currently consists of independent domestic companies, foreign-owned production companies, regional cable broadcasters, national broadcasters, and cable companies. Approximately 300 Argentine firms are active in this industry, employing 24,506 workers directly. Argentina was one of the first countries in Latin America to introduce cable television. As shown in Figure 12.1, by 2001, Argentina still had the greatest number of cable TV viewers in Latin America. It outstripped even Brazil, a country whose population is five times that of Argentina. The size of the domestic market for cable TV programs has helped companies in Argentina reach the scale necessary to produce programs for audiences beyond Latin America.

FIGURE 12.1 | Cable TV Viewers in Latin America, 2001



Source: Morgan Stanley.

Although a few firms specialize exclusively in either TV programs or commercials, many companies in this sector produce both. These companies often produce movies as well.[1] Most of the firms that produce formats are small- and medium-sized enterprises.[2] The long history of audiovisual production and the country's high-quality educational institutions provide Argentine firms in this sector with a large pool of qualified technicians, managers, and creative personnel. While some of these companies perform all of the functions related to producing a format, the majority tend to specialize in either the production of inputs or the adaptation of formats. All these companies tend to export their services through larger, sometimes international, companies. Promofilm and Cuatro Cabezas, the original export leaders in this sector, have merged with larger, international companies.

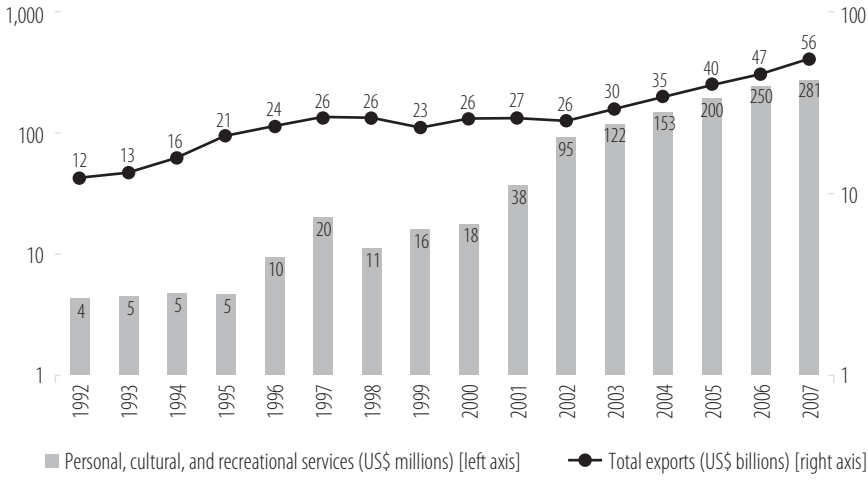
Argentine TV exports span the entire range of related services, from selling format rights to consulting and production services. Depending on the services involved, the current price of purchasing one hour of TV content from an Argentine producer can range from $500 to $100,000. The price varies depending on whether the firm sells only the format or also the consulting and production services needed to develop and make the program. Between 2006 and 2008, companies in Argentina exported 59 different versions of 26 original formats. During that period, local versions of Argentine formats were made in 15 different countries. The most successful format was *El legado* (*The Legacy*), a quiz show. By 2008, production of this format totaled 965 episodes in three countries. Of that number, 585 episodes were produced in Italy, followed by 210 in Portugal, and 170 in France. During the same year, 882 episodes of *Montecristo* (another format made in Argentina), were produced abroad, followed by 800 episodes of *12 Corazones* (*12 Hearts*) (FRAPA, 2009).

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[1] Out of 1,384 commercials filmed in Argentina in 2005, 712 were made for the domestic market and 672 were exported. Although no official statistics exist for these exports, Eddie Flehner, CEO of Flehner Films (Argentina's largest production company by film-hours), estimates that exports of TV formats in 2005 ranged between $70 million and $100 million. In the case of movies—although the Argentine film industry has achieved international recognition with foreign-language Oscar winners *La historia oficial (The Official Story)* (1985) and *El secreto de sus ojos (The Secret in Their Eyes)* (2010), and four nominations for the same category with *La tregua (The Truce)* (1974), *Camila* (1984), *Tango* (1998), and *El hijo de la novia (Son of the Bride)* (2001)—film exports have not achieved a substantial volume.

[2] See 2006 data on SICA (Sindicato de la Industria Cinematográfica Argentina). Available at www.sicacine.com.ar/estadisticas_ambossectores.php.

FIGURE 12.2 | Exports of Personal, Cultural, and Recreational Services, Argentina, 1992–2007



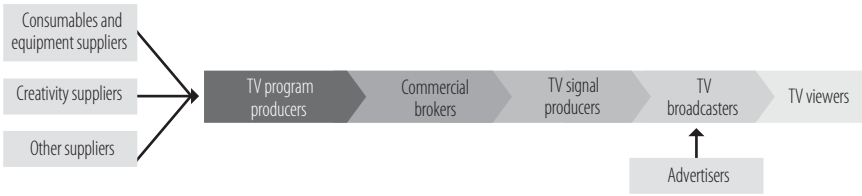
Source: National Institute of Statistics and Census (INDEC), Argentina.

Official statistics for TV format exports are difficult to obtain because these products are not processed through customs. Consequently, one can only estimate their real value. Exports of personal, cultural, and recreation services—the general category into which television formats fall—increased from $4 million in 1992 to $281 million in 2007 (Figure 12.2). Although exports of all television content in Argentina totaled $63,740,627 in 2005, it is difficult to ascertain what percentage of this figure applies to TV formats. More importantly, this figure underrepresents the actual value of exports in this sector, since it doesn't reflect the revenues (generated from consulting services employed to adapt the programs to local markets) that make up a substantial portion of those exports. Statistics for these services are lumped together with overall statistics on consulting services, and are impossible to break down. Nevertheless, according to the Format Recognition and Protection Association (FRAPA), Argentina is the fourth-largest exporter of formats in the world, right behind the United Kingdom, the United States, and the Netherlands. Other top exporters are Canada, Japan, Germany, France, Italy, Spain, Australia, Denmark, Norway, and Sweden.

The Value Chain of the Television Program Industry

Each television program is a unique project requiring a distinct assemblage of skills and capabilities. Many of the individuals employed in the various stages

FIGURE 12.3 | The Value Chain of Television Programs, Argentina



Source: Authors' compilation.

of the value chain are freelance contractors. The firm that develops the program generally acts as the broker in coordinating all other activities in the chain. Figure 12.3 depicts the value chain of the production of television programs in Argentina.

The Functions Required to Make a TV Program

Suppliers of Creativity

Suppliers of creative content include scriptwriters, directors, casting specialists, actors, costume designers, tailors, post-production editors, theatrical designers, and hairdressers. They are usually freelance workers whose services are purchased by a program's producer. Suppliers of this content are critical to the success of the television program because they tailor the product to the preferences of the target market and provide the distinctive qualities that can make a program appealing to viewers. The number of creativity suppliers in a television industry is indicative of its maturity. Argentina has a large population of TV scriptwriters, organized under the Argentine Scriptwriters Society (Sociedad General de Autores de la Argentina), as well as specialized Web sites and interest groups that organize and lobby for the community, and train new authors and writers.

Consumables and Equipment Suppliers

Consumables and equipment suppliers include the owners of film sets and studios, firms that rent equipment, and suppliers of film consumables such as tapes and optical discs. These suppliers are less critical than creativity suppliers in terms of the characteristics of the final product, but in some cases they establish long-term working relationships with producers.

Other Suppliers

Making television programs requires support services from catering companies, secretaries, and suppliers of general hardware needed on a set. The vast majority of these employees are hired on a temporary basis for an individual program.

TV Program Producers

Television producers are responsible for the final product. The challenge of a television producer is coordinating the activities of the value chain in a context in which each final product is radically different from the previous ones. Locations, costumes, and even climatic conditions must be tailored to suit a particular script. Nevertheless, television producers tend to work with the same suppliers over time. They build such relationships because it enables them to produce new products quickly. The network of suppliers managed by producers can be considered a latent organization, as the suppliers that are used are relatively stable over time—despite the fact that the actual tasks they have to perform can vary dramatically according to the project (Barnatt, Starkey, and Tempest, 2000).

TV Signal Distributors and TV Broadcasters

Before the appearance of cable television, content production and the broadcasting functions were integrated in the same firm. Since the advent of cable television, these functions have come to be performed by separate companies. Content producers tend to make a variety of products for specific television channels. Cable signal producers package television channels together from different sources and market them as packages to the final consumer. Nevertheless, some television signal producers are still involved in broadcasting. This is the case with "traditional" television networks such as ABC in the United States and Grupo Clarín's ARTEAR in Argentina.

Trend toward Integration of the Value Chain

The value chain for television programs has swung from integration to disintegration and, in recent years, back to integration—albeit under a different form. Traditional integration involved television channels that produced television programs and broadcast content. Television channels owned studios.

All human resources that were utilized worked as employees. These integrated organizations were replaced by a set of specialized firms, each working in one part of the value chain. Since 2000, a number of companies have started to integrate some functions back into their own hierarchies. Some television channels in Argentina have once again started producing television programs. For example, Telefé created Telefé Contenidos as a way to become involved in the actual design of programs again. For the same reason, Canal 13 (Channel 13) acquired a share of two Argentine firms that produce formats: Ideas del Sur and Pol-ka.

The Challenge of Making Television Formats

The production of television formats implies a change not only in the characteristics of end products experienced by viewers but also in the nature of the process leading to the final product. To develop formats, producers must create television content with a strong plot structure that can be adapted to other cultures. Although some formats are first made only in this generic form, others are designed as traditional programs that can be stripped of specific cultural content. Programs designed in the traditional fashion cannot be stripped of such content, as the essence of their plots tends to be culturally specific.

To export formats, companies must understand the expectations of audiences and program managers in different countries. At the same time, a format must be general enough to work in as many different countries as possible. To ensure that a format meets these requirements, companies must define a core story that is general enough to be adapted to other cultures, while characters are flexible enough to be adapted to different contexts.

Desperate Housewives was a failure in Argentina largely because this country lacks the typical suburban upper-middle-class housewife on which this series is based. In stark contrast, *Montecristo* has been successful across the globe because it has a very clear plot that has neither culturally specific characters nor culturally specific plot components. The historical setting is intentionally undefined. The hero of this format is betrayed by his friends, accused of being a spy, and imprisoned. During his imprisonment, a fellow dying prisoner bequeaths him a hidden treasure. He takes possession of the treasure, returns under another name, and spends years plotting his successful revenge against his former friends. That this format deals with universal themes such as death, hope, justice, vengeance, mercy, and forgiveness makes it applicable to different cultural contexts. Although firms that produce formats exclusively do not have to be directly concerned with understanding other cultures,

such knowledge is necessary if they want to tap into the lucrative business of helping their buyers adapt them.

Companies that make formats also must identify general target audiences and the genre of the format they seek to make. With regards to the general audience, formats for children differ greatly from those for adults. Some of the universal themes apply for both these audiences, and some do not. For example, *Survivor* and *Big Brother* are targeted at young people, while *Who Wants to Be a Millionaire?* is designed to appeal to older audiences. There are two genres, nonfiction and fiction. The former includes news programs, talk shows, reality shows, documentary reality shows, and game shows, while the latter includes dramas, special features, and situation comedies (sitcoms). Nonfiction programs are more common because they have less culturally specific content. Hence, it is not surprising that nonfiction products dominate the TV format market. Key examples are *Survivor, Who Wants to Be a Millionaire?*, *American Idol*, and *Big Brother*. Production companies tend to specialize in specific genres that usually correspond to the one in which they started their business. Although firms that export canned programs do not have to change them in this way, their potential audiences are more limited, as television producers across the world are increasingly looking for programs that can be adapted to the particularities of their culture.

The production of format-based television programs is divided into two distinct parts: the creation of the format and its production for a specific country. The former involves all the creative activities in designing the plot and the universal themes to be covered, while the latter encompasses not only producing the actual program but adding critical cultural elements specific to the market to which the format is sold. Companies will generally try to produce a format for the local market before stripping it of its local content and selling it abroad. Typically, some consultants specialized in the target market are utilized to adapt a format to a particular foreign audience effectively, as the information needed to make such adaptations is tacit by nature. These consultants generally work for production companies rather than for companies that design formats. Nevertheless, the purchaser of a format customarily also contracts its maker to help him or her understand the intricacies of the plot.

Program managers that purchase formats seek sellers that offer a wide variety of services so that they can reduce the uncertainty surrounding the possible success of the program. Hence, consistent exporters ensure that they can offer a wide variety of consulting services related to the adaptation of formats to local cultures. To sell such services, companies that design formats must have a creative team that understands values and ideas that transcend

national boundaries. These teams must also possess intimate knowledge of different cultures. Such consultants customarily have international experience and know how to find and decipher information about the cultural characteristics of different countries. If a company that makes formats does not have a significant number of talented employees in this area, the consulting services it can provide are limited and therefore its potential profits tend to be lower. The actual production of a format-based program is organized by an executive producer, who is customarily contracted by the buyer. This executive producer is in charge of coordinating services ranging from casting and location activities to catering and hairdressing. The executive producer can choose to do things within his or her own organization or outsource these services.

Makers of formats in Argentina export their products in three different ways. They sell them directly to potential clients through their own sales offices, work with international brokers, or merge with an international company. Cuatro Cabezas followed the last option by merging with Eyeworks, while CMG works with international brokers. Many of the new generation of companies that produce formats have chosen to follow the first option of conducting their own sales abroad. These companies tend to be owned and managed by former production managers who previously worked for established exporters. Nevertheless, the ability of Argentine firms to export is complicated by the fact that companies from western Europe, the United States, Australia, and New Zealand are already well established in international markets. Consequently, smaller firms prefer either to merge with larger ones or form alliances with them as a means of gaining access to important markets. International production companies that have opened branches in Argentina—such as Endemol, Dori Media, Eyeworks, and Telefé Contenidos—have the particular advantage of being able to leverage their existing international commercialization channels to sell their formats developed in Argentina. Telefé also acts as a broker for smaller Argentine format producers.

The Pioneer

Horacio Levin is the export pioneer of the Argentine TV industry. He was the first to understand the export potential of formats by selling television content and related services to foreign markets. The company he founded, Promofilm, developed this potential. Levin's business initially began as an advertising company that produced television commercials for the domestic market. Shortly after founding his company, Levin started to sell imported cartoons and animated films as a way to promote his business of making commercials

for the toy industry. Although Cuatro Cabezas was technically the first company to export a format from Argentina, Levin was the critical link for this sale. He was the broker that facilitated the contact and subsequent purchase of Cuatro Cabezas' format, *CQC (Caiga quien caiga) (Whoever May Fall)*, by a Spanish company in 1996. One year later, Promofilm was the first Argentine company to export a format within Latin America. He sold his format, *Causa común (Common Cause)*, to a Venezuelan company.

Levin was the first to understand the potential of globalization for the television industry after it was privatized in Argentina in the early 1990s. As he explained in an interview, "We were far away from the world….In those days, nobody (in the TV industry) took notice of what was going on in the world."[3] His experience as an importer of television programs was crucial. By witnessing the growing importance of trade in TV formats, he realized that most Argentine programs were not well designed, as they relied primarily on celebrities and impromptu comedy. Hence, he sought to develop programs that had a well-defined structure and did not rely on the charisma of celebrities or that type of comedy. In doing so, he adapted new features of programs from the United States. One of Promofilm's first programs was an "advertainment," an entertainment program funded by a single sponsor. He later introduced the talk show genre to Argentina by creating a show called *Causa comú*n, to which he added an Argentine twist by focusing on social issues. Shortly after its launch in 1993, it became a hit in Argentina, establishing Levin as an important producer in this field.

Levin was conscious of the need to keep in touch with developments in the international television market. Consequently, he made it a practice to travel to international trade fairs. He traveled twice a year to Cannes, France, and twice a year to the United States to attend important international trade fairs. This practice was unheard of for Argentine producers at the time, but Levin thought it was the only way to be up-to-date on new developments in the industry. Initially, he built on the contacts that he had established at these fairs as an importer of television programs. Slowly, he began adapting formats to the Argentine market. The majority of television companies in Argentina were reluctant to buy these programs, as they still did not fully understand their potential. Nevertheless, Levin overcame the resistance of some of these companies, such as Channel 13, by agreeing to shoulder the vast majority of their initial costs.

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[3] Authors' translation of Horacio Levin's statement: "estábamos mucho más lejos del mundo aquí (…) en aquella época nadie le importaba lo que pasaba afuera."

Although his initial advances were tentative, Levin gradually built his reputation by selling more programs to other television channels. One of these was *Sorpresa y media (A Surprise and a Half)*. Levin excerpted a Spanish program and added new elements that made it more attractive to an Argentine audience. Despite being aired on Sunday nights—a time slot that was largely neglected in Argentina at the time—the show received high ratings. Shortly thereafter, this time slot became more coveted by television channels in Argentina. The success of this program enabled Levin to gain further production experience, enlarge his staff, and buy more equipment. Nevertheless, he was not satisfied with being successful only in the domestic market. He used his flagship format, *Sorpresa y media*, to enter the Colombian and Venezuelan markets, rapidly taking advantage of the opportunities created by privatization and deregulation of the television industry in those countries.

Levin developed a close relationship with the owners of Globomedia, an independent Spanish production company. Levin met the owners of this company when they visited Buenos Aires in an attempt to sell a format for a game show. They started working together in 1995 by sharing production strategies, logistics, and formats, thereby enabling both companies to expand in Latin America. Levin's knowledge of the world market for TV programs convinced him that associating with a Spanish firm would provide him with more credibility to strike business deals with European companies. The two companies merged in 2000.

The first format developed by Promofilm-Globomedia was *Sorpresa y media*. The company adapted this format to Latin America, making its first sale to Venezuela in 1997. The format was later sold throughout Latin America. The sale of *Sorpresa y media* to Venezuela taught this new company that shows for other Latin American countries would have to be less melodramatic and more upbeat than the programs that originally aired only in Argentina.

Promofilm-Globomedia was also one of the first companies to adapt the Swedish version of *Expedition Robinson* to Latin America and Spain. This deal was quite risky, as it was the first reality show ever to be aired in Argentina or Spain. (Six months later, CBS bought the rights to produce the show in the United States, where it was aired as *Survivor*.) This was Promofilm-Globomedia's first venture into the game/reality show business. The program's production involved a crew of more than 100 people, including producers, scriptwriters, camera and sound technicians, and art directors. Production was done on-location in Panama, requiring the firm to overcome many logistical challenges involved in setting up production in this country. Despite these challenges, the program was an overwhelming success that taught Promofilm-Globomedia

that it would not have to limit its activities to Latin America. Moreover, it enabled the firm to increase its number of employees and enhance the skills of its existing workforce.

Promofilm-Globomedia's ability to successfully adapt *Survivor* to the Argentine and Spanish markets garnered international credibility for the firm. Strix Television, owner of the original rights to this format, was so pleased with the success of *Survivor* that it recommended Promofilm-Globomedia produce *Survivor* for other countries. This recommendation translated into contracts to produce 17 different versions of the program from 2000 to 2003. It aired in a number of different countries, including Chile, Colombia, Hungary, Italy, Spain, Russia, the United Kingdom, and Venezuela.

Promofilm-Globomedia used talk shows and reality shows as an experiment platform for creating formats for foreign markets. It adapted these shows to the particularities of the cultures in Chile, Colombia, Ecuador, Mexico, and the Hispanic market in the United States. This experience put the company in contact with television networks in various countries, including RCTV and Venevisión in Venezuela, Caracol and RCN in Colombia, Azteca in Mexico, and Telemundo in the United States. Until 2000, the company had produced a format for the Argentine market before exporting it. That year, it created and produced *Protagonistas de novela (Soap Opera Stars)* exclusively for Telemundo in the United States. Although Promofilm-Globomedia never made a version of this program for Argentina, it did export this format to Greece and five other Latin American countries.

Since its experience with *Protagonistas de novela*, Promofilm-Globomedia has continued to export formats without pretesting the format in its home market. In 2004, it produced *El conquistador del fin del mundo (The Conqueror of the End of the World)*, a journey through the Argentine Patagonia featuring teams from five countries competing in different games. The show was produced and broadcast simultaneously on five Latin American and Hispanic U.S. networks: Gamavisión (Ecuador), SBT (Brazil), Telemundo (United States), TV Azteca (Mexico), and UCTV (Chile). The show was also adapted for Basque TV. Leveraging its earlier experience with the "advertainment" genre, the company also created and produced formats for documentary/reality programs such as *Lo dejo en tus manos (I'll Leave It in Your Hands)*, a home renovation program sponsored by Loews, and *Mi primer hogar (My First Home)*, a similar program underwritten by Home Depot. These programs were made exclusively for Telemundo. In 2004, Promofilm-Globomedia purchased the format for *Temptation Island*, a game/reality show owned by Fox. It adapted this show to markets in Brazil, Hungary, and the United States.

In 2005, Promofilm-Globomedia was bought out by Grupo Árbol, a Spanish media conglomerate that has a 40 percent share in the Mexican cable channel, Televisa. Under Grupo Árbol's management, the company is currently producing over 3,500 hours of programming per year for broadcast and cable networks around the world. Nevertheless, most of its business is done for a new network in Spain called La Sexta. Horacio Levin decided to leave his executive post at Promofilm-Globomedia in 2004 when it became clear that Grupo Árbol would focus its television division on the broadcast side of the business. This shift in strategy explains why Promofilm-Globomedia is no longer one of the leading firms in the format sector in Argentina. Meanwhile, Dori Media, Cuatro Cabezas, Telefé, and Endemol have come to replace it as the leading exporters of television formats from Argentina.

Diffusion

The success of *Sorpresa y media* and the sale of production services to countries such as the United States established Promofilm-Globomedia as the industry leader. Although this company currently lags behind Telefé, Eyeworks, Cuatro Cabezas, and Dori Media, Horacio Levin did not fear the diffusion of his knowledge about how to take advantage of TV formats at the time his export business was incipient. As discussed below, he actually promoted the diffusion of TV formats as an export platform in the sector.

In 2001, the Dutch company Endemol followed Globomedia's strategy by acquiring a 65 percent stake in P&P, an Argentine format producer. This strategy was also followed by other leading firms in this sector. In 2007, Dori Media bought 50 percent of Central Park Productions and Eyeworks bought Cuatro Cabezas. By buying local format producers, these international companies were able to tap into the quality of formats produced in Argentina and resolve the problems associated with the difficulty of marketing them abroad. ARTEAR, a domestic company that runs Channel 13 in Argentina, followed a similar strategy in 2003 by purchasing Pol-ka and Ideas del Sur. Such a strategy was not necessary for Telefé, a Spanish company in Argentina that already had a format division (Telefé Contenidos). Nevertheless, the other companies mentioned above were following Levin's lead, as Levin was the first to initiate these types of mergers.

The domestic and international success of Cuatro Cabezas' format, *CQC (Caiga quien caiga)*, convinced Eyeworks to buy this company. *CQC* is a comedy-based, weekly news roundup program anchored by a famous trio of Argentine celebrities who discuss current events in Argentina by using doses of irony

and posing as street reporters that ask uncomfortable questions of politicians and celebrities. Some former anchors of this program have moved on to star in other programs that were developed into successful formats and later exported. Nevertheless, the international success of this program, as mentioned above, was actually made possible by Horacio Levin, who facilitated the sale of this format to a TV station in Spain in 1996.

Cuatro Cabezas would eventually reestablish ownership of the *CQC* format, enabling the firm to export it to Chile, France, Israel, and Italy. Before this firm was purchased by Eyeworks, it had already established offices in Spain, employing 100 people. Cuatro Cabezas' success with *CQC* enabled it to export formats such as *El rayo (The Lightning Bolt)*, *Puntodoc (Dot Doc)*, *Super M, Algo habrán hecho (They Must Have Done Something)*, *La liga (The League)*, *E-24 (24-Hour Emergency)*, and *Nos pierde la fama (We're Missing Fame)*. All these programs were first tested on the domestic market. Its success with such operations also made it possible for Cuatro Cabezas to produce programs for HBO *(Sexo urbano) (Sex in the City)*, TNT *(Proyecto 48) (48 Hours)*, The History Channel *(Historia secreta de las ciudades) (Secret Story of the Cities)*, and Discovery Travel and Living Channel *(Ciudades y copas) (Cities and Glasses)* and *(Casas) (Houses)*.

The growth in format exports from Argentina enabled Telefé, a Spanish company that owns a television station in Argentina, to split its production business into two divisions. Telefé Contenidos is in charge of production services and format creation, while Telefé Internacional handles international commercialization. Like other exporters in this sector, Telefé started out by importing and adapting formats, focusing primarily on reality shows and sitcoms. Telefé Contenidos produced domestic versions of *Big Brother* in 2001 and 2002, and *The Nanny* in 2004. In 2006, the company started airing a second version of a U.S. sitcom, *Married with Children*.

Following the success of adapting international formats to Argentina's domestic markets, Telefé Contenidos started creating its own formats and selling them abroad. Three of the most famous are *El deseo (Desire)*, *Resistiré (I Will Resist)*, and *Montecristo*. It also acts as an international broker for small, independent producers such as Ideas del Sur. Telefé has helped this company sell programs such as *Los Roldán (The Roldáns)*, *Disputas (Disputes)*, *Tumberos (Jails)*, and *Sol negro (Black Sun)*. It has also been involved in brokering sales of formats by RGB, Central Park Productions, and ARTEAR.

Notwithstanding, Horacio Levin was instrumental in helping Telefé develop its format capabilities. Telefé learned how to adapt formats to other markets when Promofilm leased from it studio space to film *El frijolito (Little Kidney Bean)*, a Mexican-style soap opera aired on Telemundo for the Hispanic market

in the United States. From this experience, Telefé Contenidos learned how to add cultural components to a format. This program was set in Mexico, even though it was filmed in Argentina and aired in the United States.

Although ARTEAR—the company that owns Channel 13 in Argentina—got a later start, it followed a path similar to that of Telefé. Until 2003, ARTEAR cultivated relationships with independent production companies such as Promofilm, Pol-ka, and Cuatro Cabezas. This policy changed when the network hired Adrián Suar as its general manager. Suar was the founder and CEO of Pol-ka, the formerly independent production company. Under his leadership, ARTEAR took over Pol-ka and Ideas del Sur. In 2004, ARTEAR produced the mini-series *Epitafios (Epitaphs)* for HBO. It also produced the *Desperate Housewives* format for Argentina and six other Latin American countries. In January 2009, ARTEAR—Telefé's main rival—established a new department for international program sales (FRAPA, 2009).

Endemol was the Dutch company that developed the *Big Brother* format. One year before merging with P&P in Argentina, Endemol was sold to Telefónica, a large Spanish telecommunications and media company that also owns Telefé. By acquiring P&P, Endemol has been able to widen its scope of programs to include fiction, documentaries, news, and children's programs. The company exported 700 hours of TV programming in 2005, including formats such as *Cuestión de peso (A Matter of Weight)* to Italy and Spain, and *El último pasajero (The Last Passenger)* to Chile, Indonesia, Turkey, and Vietnam.

Another important player in the industry is Dori Media Group (DMG). DMG is an Israeli company specialized in the production and distribution of soap operas; it started its activity in Argentina in the late 1990s. Its first success with an Argentine product came with the distribution of *Rebelde Way*—a soap opera produced by the local company, Cris Morena Group—which became an international hit and was sold in more than 50 countries. DMG currently owns a catalogue of approximately 4,500 hours of television consisting of soap operas and dramas produced in Argentina. Some of its most successful products are *Champs 12* (sold in 19 countries), *Amanda O* (sold in 23 countries), and *Lalola* (sold in 70 countries).

To a large extent, the diffusion of TV formats occurs when former managers leave leading companies and start their own businesses, or when existing companies appropriate workers from other firms. For example, the former production managers of Cuatro Cabezas went on to form Tandem Productions, while the former managers of Pramer formed Nativa Productions. Paradoxically, Levin was also a leader in this mode of diffusion. Production companies such as Teleset in Colombia and Magnolia in Italy hired entire groups

of technical staff from Promofilm during coproductions. Televisa, the largest TV broadcaster in Mexico, also recruited an entire group of scriptwriters from Promofilm.

Conclusion

The emergence of TV program exports shares critical features with the emergence of other exports in Argentina studied by the authors (Artopoulos, Friel, and Hallak, 2011a, 2011b). One of these features is the case of a pioneer—Horacio Levin—who spurs export emergence in the TV industry based on a knowledge advantage of the foreign market. Like Levin, the export pioneer of the motorboats industry (Luis López Blanco) and of the wine industry (Nicolás Catena Zapata) also understand foreign markets well. Furthermore, for all three pioneers, this understanding was based on their *embeddedness* (Granovetter, 1985; Uzzi, 1997) in the business communities of the industries abroad. By socializing with foreign members of those communities, they accessed critical tacit knowledge about foreign markets that would otherwise be difficult to obtain. The knowledge they acquired allowed them to build a vision of how to conduct business to achieve a stable presence in foreign markets. The pioneers' embeddedness in foreign business communities precedes, and is independent of, their decision to export. In particular, Levin, as well as López Blanco, achieve this embeddedness through their previous activities as importers.

While foreign embeddedness is crucial for the export pioneer, it is not necessary for followers. Key components of the pioneers' knowledge advantage are of a very general nature, as they are associated with the fact that demand patterns and business practices differ widely between developing and developed countries.[4] The pioneers' understanding of those differences is manifested in some of their actions, like their choice of target markets, product characteristics, type of employees they hire, or type of technology they incorporate. Those actions are visible and hence the object of diffusion. Most importantly, the export pioneers show that establishing a consistent presence in foreign markets is possible and profitable. They also demonstrate that in order to compete successfully in international markets as well as in domestic ones, different ways of conducting business are required.

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[4] Those differences are analyzed in detail in Artopoulos, Friel, and Hallak (2011b).

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