

The Emergence of New Successful Export Activities in Argentina: Self-Discovery, Knowledge Niches, or Barriers to Riches?¹

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1. Introduction

This paper studies the determinants of new successful export activities in Argentina in the past 25 years, particularly in those sectors where there may have been important uncertainties that introduced information and coordination externalities and that made unclear the ex-ante profitability of the new export. The following questions guide the research contained herein:

Are new exports driven by the *self-discovery* of local costs of production and/or foreign demand? Or are they driven by the exploitation of proprietary knowledge (*knowledge niches*)? Or could it be that they are led by a combination of self-discovery and/or partially proprietary knowledge, together with the pioneer's ability to introduce barriers to the entry of newcomers (*barriers to riches* at the micro level)?⁶

It is very important to ascertain the extent to which there were uncertainties (regarding local costs of production, foreign demand, commercialization strategies, non-tariff barriers, and/or the ability to produce locally) and coordination externalities involved in the emergence of these new export activities, how they were resolved, and whether this resolution led to an information revelation process and the development of industry specific public goods that facilitated the growth of new export sectors. We believe that this is important for three reasons. First, insufficient investment due to information externalities may generate forgone Harberger triangles that are not visible. Second, because Hausmann, Hwang and Rodrik (2006) have found that bigger export sophistication is associated to higher growth, and in turn this sophistication is facilitated by a bigger experimentation in the development of new export activities. Third, because insufficient experimentation may lead to export concentration which in turn has a negative effect on growth (see De Ferranti et al, 2001).

⁶ Parente and Prescott (2000) argue that "Although countries have access to the same stock of knowledge, they do not all make equally efficient use of this knowledge because policies in some countries lead to barriers that effectively prevent firms from adopting more productive technologies and from changing to more efficient work practices." This argument may be extended at the micro level to the case where pioneer introduces market barriers to entry that prevent imitators from benefiting from the information revealed by the pioneer.

Economic environments where experimentation is not facilitated (either through targeted subsidies, carrots and sticks and/or direct government involvement, or through adequate export-facilitating policies and institutions) may lead to a predominant emergence of new exports in activities where the pioneer that invests in resolving the uncertainty or the coordination failure does so because she expects to capture a large enough share of the rents by blocking or postponing profit-eroding diffusion to some extent. This would possibly lead to sub-optimal investment in the new export sectors and to the lack of experimentation in other potentially profitable new activities where the pioneer does not have this ability to subdue diffusion.

Diffusion will be preferred instead when there exist agglomeration externalities in the new activities (technological spillovers, thick labor market externalities, the development of a network of specialized inputs, or the establishment of a reputation for the quality of the exports originating in the country). In such a setup, the pioneer may actually want to promote diffusion (at least to some extent). In this case, one should not look for information externalities as potential deterrents of discovery, but rather for coordination failures, credit constraints, and/or inadequate trade-facilitating policies, institutions and infrastructure.

In this vein, the main interest lies in analyzing to what extent these new export activities are the result of a process of self discovery of local production costs and/or foreign demand, with knowledge externalities that lead to a large diffusion of these activities, à la Hausmann and Rodrik (2003) (HR), or whether they result from other processes, such as the exploitation of proprietary knowledge, development of new markets with barriers to entry, à la Baumol et al (1986), or the existence of new large ex-ante profitability due to changes in world markets.

We also seek to shed light on the types of uncertainty that may be present in the process of investing in the development of a new export activity. As suggested by HR, the production of new goods, even in the presence of *a priori* comparative advantage, is subject to uncertainties regarding the local costs of production that requires sinking costs in experimenting to find these costs and the underlying profitability. Additionally, exporting new goods, especially when they are differentiated goods, may be subject to uncertainties regarding: a) foreign demand (idiosyncratic preferences, prices and points of saturation in foreign markets), b) the costs of quality upgrading to meet technical and

consumer requirements abroad, c) commercialization strategies and export product mix. Finally, two other types of uncertainty may emerge. First, an uncertainty regarding how binding non-tariff barriers actually are (you may have to sink capital in specific export developments and ship them abroad in order to test how binding the restriction is). Second, there may be a more basic type of uncertainty: finding out whether the good can be locally produced at all, which may demand an R&D effort.

This means that even with knowledge of local costs of production arising from a long experience of producing the good under import substitution, newly exporting firms/sectors may face ex-ante important uncertainty regarding the profitability of exporting.

We care about these different types of uncertainty because their resolutions will lead to different extents of information revelation, which will be transmitted through different channels and have different implications for the diffusion of new exports. For instance, when the uncertainty is related to commercialization, foreign demand and product mix, export knowledge may diffuse across borders. In this setup, a pioneer may block domestic diffusion, but not foreign diffusion, which could further reduce the scope for local diffusion of the new exports (as foreign diffusion lowers export prices). In the case of uncertainty regarding the ability to produce the good at all, its resolution via R&D will probably generate proprietary knowledge and no diffusion, unless researchers move from one firm to the other.

We also seek to inquire about the possible presence of coordination failures (simultaneous development of upstream and downstream activities, simultaneous investment in production and in the required infrastructure, etc.) that may affect negatively the emergence and diffusion of new export activities, and how these failures are overcome.

The ultimate goal is to shed light on whether there is sub-optimal investment in new export activities, either in discovery or in diffusion. We also intend to evaluate whether some activities are likelier to emerge for reasons such as prior knowledge that reduces uncertainty and that may tip the balance towards safer activities, leaving other potentially profitable and feasible new exports untapped.

The analysis will also distinguish between those factors that played a role in the emergence of the new export activity, and those that were important for its consolidation and sustainability.

Another key evaluation to be made is how efficient has been the emergence of new activities in the absence of government intervention: for instance, how fast and widespread has diffusion been when there were substantial knowledge externalities involved. Related to this, it will be important to analyze whether *laissez-faire* outcomes and government promotion of the diffusion of new activities may not also lead to an over-investment in new export activities. The policy analysis also includes an appraisal of the role played by trade-related policies, institutions and basic and technological infrastructure as facilitators or hurdles for the emergence of the new activities and the speed and extent of diffusion.

Finally, we also consider the role of previously accumulated capabilities (at the country, industry and firm levels) in facilitating the discovery and diffusion, and the new capabilities that the new exports are creating for jumping to more sophisticated exports later on.

We first describe and analyze the overall export background in which the new export activities have occurred.

Next we develop a theoretical framework for analyzing the emergence of new export activities. The starting point for the theoretical thinking is HR's model of local cost discovery, adapted to encompass the other types of uncertainties mentioned above, and to allow for the possibility of prior knowledge playing a role in the choice of new export activities. In order to understand the actual processes of emergence of these activities, we allow for competing (or at times complementary) explanations that arise from industrial organization models based on: a) brand development and sunk costs (contestable market models as in Baumol et al, 1986), b) technological or knowledge barriers to entry, c) R&D or foreign technology adoption with technological or R&D spillovers. This theoretical framework generates testable predictions regarding the determinants of emergence of new export activities and their diffusion, and describes the different inefficiencies that may arise in the emergence of new export activities.

Then we contrast the predictions arising from the theoretical framework with a case study analysis of the actual process of emergence of selected new exports in Argentina. The main tool for gathering the required information is the realization of interviews to pioneers, imitators, industry associations and public officials involved in public policies that affected the new exports. This information is supplemented by secondary information from websites, publications, and so on. We also use disaggregated secondary information on sectoral and firm level trade data from the Customs Office. A key tool for accepting or rejecting hypotheses is the counterfactual analysis, i.e., the analysis of sectors or firms that shared some common features with the new export activities, and yet failed to take-off. The comparison of the features that are not shared will help shed light on the key determinants of the emergence and diffusion of the new activities. Counterfactual analysis is also a useful tool for appraising why diffusion occurs in some cases and why it does not in others.

The choice of new export activities to analyze is based on the following considerations: a) negligible exports 25 years ago, b) fast export growth, c) reversal of revealed comparative disadvantage, d) current large volume and value of exports, e) degree of diffusion, f) relatively little intensity in the use of natural resources, g) preliminary appraisal of the degree of uncertainty involved in the discovery of these new activities. Based on these considerations we chose to study the following new export activities: blueberries, chocolate confections, and biotechnology applied to human health. Another two sectors (raspberries and strawberries) are analyzed as well, as counterfactuals for blueberries, albeit at a lesser depth.

We conclude by undertaking an analysis of the development and policy implications of the new export activities considered here.

Section 2 and the Statistical Appendix provide an empirical evaluation of the trading environment for new exports, and of their contributions to export growth. Section 3 presents the theoretical framework. Section 4 discusses the methodology for the empirical appraisal, via case study analysis, of the theoretical predictions regarding the determinants and impacts of the emergence of new export activities, and the choice of sectors to be studied. Sections 5 through 7 present the case studies, their lessons and their possible policy implications. Sections 8 and 9 respectively present the development and policy implications. Section 10 concludes.

2. Empirical evaluation of the trading environment for new exports, and of their contributions to export growth

The purpose of this section is to provide a background on the trading environment in which the emergence of new exports occurred, to appraise how widespread and how linked to revealed comparative advantage they were, and to evaluate their contributions to overall and export growths. The background statistical information and graphical and correlation analysis that support this appraisal is included in the Statistical Appendix.

2.1. Overall export behaviour

Our statistical analysis shows that Argentine exports largely stagnated during the 1980s, were very dynamic during the 1990s (until 1998), and grew below world trade since then. While technological exports increased their share in total exports during 1993-2004, this share is quite small. Regarding the structure of exports, during 1993-2004 there was a significant increase in the participation of natural-resource based exports, previously under-exploited, largely associated to privatizations and deregulation. The evolution of unit export prices suggests thus far that only a handful of manufacturing sectors showed improvements in the quality of exports. Finally, during this period Argentina showed a deepening of revealed comparative advantage in agricultural goods, mining and oil, and also a deepening in revealed comparative disadvantage in machinery and chemical products.

2.2. New exports

New exports between 1993 and 2004 represented a relatively small number of products. However, the new exports rapidly increased their shares in total exports. As a result, the emergence of new exports since the early 1990s have generated a dramatic structural change in Argentine external sales, as these new exports represent 20.9% of the total value exported during 2003-04 vis-à-vis 0.1% in 1993-94. These new Argentine exports grew significantly faster than their world counterparts, allowing them to increase nine times their participation in world trade.

The sectors with the largest presence of new exports (5% or more of the total number of exported goods within each sector) include activities directly linked to the exploitation of mining resources, industries that process agricultural resources, industrial manufactures that process natural resources, and motor vehicles (a relatively labor intensive activity that got an initial boost from Mercosur. On the other hand, there were very few or none newly exported products in “modern” activities such as Medical, Precision and Optical Instruments, Electronics, Electrical Machinery, and Computing Equipment. The concentration of new exports in activities linked to natural resources is consistent with the gain in participation of these sectors in total Argentine exports.

New exports contribute to more than 20% of sectoral export growth in most sectors, and to 60% or more in 5 out of 14 sectors. This means that new exports have been a driving force in most industries, even in those where there were relatively few newly exported products. Put differently, most sectors experienced substantial intrasectoral changes in the composition of their exports. However, there was a large and positive correlation between the percentage of new exports in each industry and the sectoral export growth.

The analysis of sectoral factor intensity reveals that the emergence of newly exported products has been more important in industries that are less labor-intensive. This finding is consistent with the fact new exports were relatively more important in natural resource processing activities, which tend to be more capital intensive. It could also reflect the fact that capital was relatively cheap vis-à-vis labor during the 1990s, favoring the capital-intensive activities.

Finally, comparative advantage has not been a key driver in the surge of new exports, as less than a third of new exports were in sectors with revealed comparative advantage (RCA) in 1993. However, a closer link between comparative advantage and new exports was observed in 2004, as 60% of new exports were then in sectors with RCA. This means that most new exports started in sectors with revealed comparative disadvantage but their sizable growth led their sectors to acquire a comparative advantage at the end of the period.

3. Theoretical framework

This section provides a theoretical framework for analyzing the case studies of emergence of new successful export activities.

Self-discovery

A good starting point for analyzing these phenomena is HR's model of self-discovery. In this model there is ex-ante uncertainty regarding local costs of production and firms must sink capital in experimentation to find the actual costs. Once these costs are revealed, they become public knowledge. In such a set-up, no firm will experiment in discovery unless it expects it can enjoy at least temporary monopoly profits (or government subsidies). Otherwise, fast imitation will quickly lead to zero profits making it unable to recoup the sunk costs of investment.⁷ If there are temporary "monopoly rights," there will be investment in discovery, and all the profitable new activities are exploited. Once the monopoly rights become void, free entry leads to specialization in the ex-post most profitable activity. In this framework, there is too little ex-ante investment and entrepreneurship (due to information externalities) and too much production diversification ex-post (due to temporary monopoly rights).

Coordination externalities

The resolution of coordination externalities may also matter for the discovery of new successful export-activities. This discovery often requires a simultaneous emergence of the different stages of the production and commercialization process (intermediate inputs, final good, etc.) and of required infrastructure, both traditional (transportation, logistics, etc.), sanitary and technological (testing, calibration and clinical analysis laboratories, etc.). Potentially profitable activities may fail to take-off because of failure to coordinate by the private sector and/or the lack of public investment (or promotion of private investment) in key stages of the production and commercialization chain or in industry specific public goods (like eradication of fruit plagues, irrigation, introduction of a regulatory framework, etc.). In this case we may observe an emergence of new export activities only when some of the required phases

⁷ The pioneer could still invest if she had a bigger ex-ante productivity (because of scale, prior production knowledge, etc.) that persists after the imitation.

of the production and commercialization processes and industry-specific infrastructure were already present and engaged in related activities.

The pioneer could be willing to overcome these coordination failures by herself, for instance through vertical integration, if the expected profits were large enough and she had enough resources to do so. However, this coordination failure is likely to affect the size of her initial investment. Additionally, the overcoming of coordination failures by the pioneer may at times introduce barriers to entry that hinder diffusion. On the other hand, there are instances where the pioneer may herself be “forced” to promote diffusion if she lacks the resources to attempt vertical integration (and there exist economies of scope and/or scale in the different stages). She will do so as long as the expected profits of specializing at specific stages of the production and commercialization process are large enough.

Another relevant possibility is that information and coordination externalities coexist. In this case it may occur that the pioneer, after some initial experimentation, discovers that the activity is not profitable for the maximum scale at which she can operate all the required stages through vertical integration (because of insufficient financial and managerial resources or optimal scale issues) and hence decides not to overcome the coordination failures by herself. This may prevent the emergence of new export activities that would be profitable at a large enough scale of operation.

Uncertainties that may be involved in the self-discovery process

We believe that the HR model must be extended to accommodate the following sources of uncertainty regarding the profitability of new export activities, especially when they involve differentiated goods:

- Foreign demand (idiosyncratic preferences, prices and saturation point in foreign markets).⁸
- Costs of quality upgrading to meet technical and consumer requirements abroad.⁹

⁸ Exporting involves important uncertainties regarding foreign demand, which are not revealed until exporting is actually attempted (see Vettas, 2000). These uncertainties may be related to finding the actual demand curve (slope and position) for your goods (especially when they are differentiated) and the ability to satisfy the idiosyncratic preferences of foreign consumers.

- Costs of logistics.
- Best commercialization strategies and export product mix.
- How binding non-tariff barriers actually are (you may have to sink capital in specific export developments and ship them abroad in order to test how binding the restriction is).¹⁰
- Finding out whether the good can be locally produced at all, that may demand an investment in R&D.

These uncertainties may be very important, even when there is an adequate knowledge of local costs of production arising from a long experience of producing the good under import substitution, which would be the case for most industrial sectors in a semi-industrialized country like Argentina.

Uncertainty about foreign demand and positive externalities from enhanced reputation or country brand name (demand shifting) can play a key role in semi-industrialized economies. It is important to clarify how these two features operate.

⁹ Complying with technical barriers to trade involves several incremental costs (new machinery and equipment, updating of production and managerial processes, replacement of inputs, etc.). There exists a vast literature regarding the impact of these costs on both the amount of exports and the ability to export at all (see Verhoogen, 2006; Maskus et al, 2004; Chen et al, 2004; Sánchez, Alzúa and Butler, 2005; Sánchez and Butler, 2005; and Popper et al, 2004, to name a few). While this literature treats these costs as certain, interviews and case studies conducted in Sánchez and Butler (2005) reveal that there exist sizable uncertainties in the costs of complying with foreign standards and technical regulations. More generally, the empirical literature of exports at firm level has shown that exporting involves several incremental costs, both fixed and variable, that affect the amount of exports and the ability to export at all (see for instance Roberts and Tybout, 1997; and Das, Roberts and Tybout, 2001). Any uncertainty in these costs will generate information externalities.

¹⁰ Even if there is no uncertainty regarding production costs, local producers may not know if they can export until one of them runs the risk of making shipments and learns whether they can circumvent the NTB. Once she does it and the experiment is successful, the bureaucratic feasibility of exporting becomes common knowledge to the rest of the local producers. The pioneer still has to make a risky investment which, if failed, could make her lose the value of the shipment and other exporting related costs. Sánchez and Butler analyze a case study of exports of treadmills to the EU, where there was a large uncertainty regarding the application of technical regulations referred to electro-magnetic interference and radio-frequency interference.

Demand uncertainty could involve learning about the right “price” (position and slope of demand curve) and commercialization strategies, and if it is profitable to serve this demand. Learning about the position of the demand curve can also entail learning about when the market is saturated. Vettas (2000) captures these features nicely. In his setup, the pioneer reveals information on the extent of foreign demand, allowing an update of the beliefs about the market saturation point, and subsequent entrants further enhance this knowledge. In Vettas’ setup there is another externality as well: the current price depends positively on past sales (until the market saturation point is reached), i.e., enhanced reputation (or another demand shifting effect) moves the demand curve to the right as exports grow.

Because of these two externalities, the competitive market equilibrium displays too little investment by the pioneer and too slow diffusion at the beginning. Diffusion then speeds up because of the demand shifting effect and eventually wanes as the revealed saturation point becomes near (S-shaped or convex pattern of diffusion). In this competitive market equilibrium the pioneer would export only if it is profitable to do so even with the small initial demand. On the other hand, a social planner or a monopolist would internalize these externalities and invest even if initial sales were unprofitable, as long as the demand shifting effect is large enough. What is more, they would want a very fast expansion of sales (concave pattern of diffusion).

An interesting question is why the pioneer does not do all the investment herself when there are demand externalities (in a competitive equilibrium). The answer would have to rely on issues such as access to financing, economies of scope, optimal scale and learning economies.

Conditions for the emergence of new successful export activities

The most important message of the HR model is that under uncertainty and information externalities firms invest in developing new export activities only when it is possible to capture sufficient monopoly rents. Hence in order to understand the actual process of emergence of successful new export activities we must depart from HR’s basic formulation, and allow the pioneer to capture monopoly rents through one, at least, of the following channels:

- Temporary monopoly rights, due to regulations or to the time it takes for the investments of imitators to mature (as in HR).
- Government subsidization of discovery (a corollary of HR).
- Learning economies that allow the pioneer to jump faster than imitators to new temporary monopolies in more sophisticated products on the technological ladder.
- Ex-ante productivity advantage of pioneer (from prior knowledge or scale in related activities) that will persist even after the new activity has been discovered to be profitable.
- The ability of the pioneer to become a monopolist in upstream, midstream or downstream activities in the new export sector.
- Proprietary knowledge (information externalities are not too big).
- Pioneer may introduce barriers to entry (brand development, sunk costs, scale economies, technological barriers).

These channels will have very different implications for diffusion. The first four may only delay it, the fifth may constrain it, and the last two may actually preclude it.

Activities that are more likely to emerge

The *choice* of new (ex-ante uncertain) exports to be developed may be *conditioned* by the pioneers' abilities to exploit one or more of the channels for capturing monopoly rents that are mentioned above.

For instance, prior knowledge and scale economies in vertically or horizontally related export activities may facilitate the adoption of barriers to entry in certain new exports that are thus preferred to others. Prior knowledge in related production or export activities may also facilitate the identification of sectors where learning economies and the possibility to climb the technological ladder are bigger. More generally, prior knowledge in related activities will tend to raise the expected profits of some new exports over the rest.¹¹

¹¹ Prior knowledge may reduce uncertainty regarding costs (of production and/or exporting), foreign demand and eventual agglomeration economies and abilities to coordinate, and/or reduce the expected costs or raise the expected price. Prior knowledge may arise from: a) learning from import substitution, b) having experience in the production/exports of this new good in other countries, d) having

An alternative scenario for the emergence of new export activities is the involvement of the government in the experimentation with these activities, possibly through a direct investment or joint ventures with private firms. In this case the pioneer would not care about monopoly profits and would want to generate a rapid diffusion. Additionally, the availability of prior knowledge that gives an edge to some potential new activities over the rest would lose relevance.

There are other possible scenarios that may underlie the emergence of new export activities. One such scenario could involve ex-ante uncertainty about local costs of production and profitability, but not about whether profits will be positive or not (because prices are too large relative to all possible local costs). In this case the pioneer's experimentation may reveal the *minimum minimorum* among cost minimizing production techniques. There would still be an information externality which introduces a value of waiting until the best production techniques are revealed. However, if the minimum expected profits are large enough, it may pay to start experimenting right away. This scenario raises the additional possibility that there may be more than one pioneer. This case is thus more related to technological or R&D spillovers than to HR's information externality associated to cost discovery. In this case, coordination failures in the simultaneous development of upstream and downstream activities, simultaneous investment in production and in the required basic and technological infrastructure, etc., may weigh more than uncertainty as a deterrent of the development of the new export sector.

Another possible scenario may involve agglomeration externalities from discovery and diffusion: technological spillovers, thick labor market externalities, development of a network of specialized inputs, or the establishment of a reputation for the quality of the exports originating in the country. In such a setup, the pioneer may actually want to promote diffusion (at least to some extent). In this case, one should not look for information externalities as potential deterrents of discovery, but rather for coordination failures, credit constraints, and/or inadequate trade-facilitating policies, institutions and infrastructure.

experience in the production/exports of related goods, e) association with foreign firms, customers or suppliers, f) public research.

The role of accumulated capabilities

A further issue to be considered is which activities are likelier to reveal themselves as profitable after being experimented upon by the pioneer (or the social planner). Hausmann and Klinger (2006) find that the countries' abilities to jump to more sophisticated exports is largely conditioned by what these countries were previously exporting and the associated accumulated capabilities (human capital, industry-specific public goods, production knowledge arising from import substitution, density of the occupied forest). In our framework, bigger cumulative capabilities would increase the expected profitability of some activities over others, making them a likelier target for experimentation and more natural candidates for success.

This finding also suggests that investing in the discovery of some activities that are in a denser part of the forest (i.e., which increase the probability of jumping later to more sophisticated exports) would have a bigger social payoff.

A related issue is whether the accumulation of capabilities for some new exports occurs at an economy, industry (like in the case of industry specific public goods) or firm (like in the case of tacit knowledge) levels, and which are the implications in each case for the discovery and diffusion of new goods. For instance, intra-firm accumulated capabilities could foster experimentation more (by yielding monopoly power based on proprietary knowledge) and on the other hand it could introduce permanent barriers to entry that hinder diffusion.

Uncertainties at the levels of the pioneer and of the industry

In HR's original formulation, all entrepreneurs face the same degree of uncertainty and the same ex-ante probability of success in discovering new activities. We considered above that pioneers differed from the rest in terms of their abilities to capture (at least temporary) monopoly profits in the absence of government intervention. We now add the possibility that the pioneer faces a smaller degree of uncertainty (along one or more dimensions of the discovery process) than the rest of the firms in the industry, thus increasing her expected profitability of the discovery vis-à-vis the rest of goods and entrepreneurs, which is what makes her be the first mover. This smaller degree of uncertainty may arise from a variety of sources: previous production or commercialization experience; international social, technological and/or commercial networks; accumulated human capital; etc.

In this setup, we care about both the uncertainty that the pioneer faced, which affects the size of her initial investment, and the uncertainty faced by the average producer/exporter, which determines the size of the information externality.

In the presence of an uneven distribution of prior knowledge regarding some of the dimensions required in the discovery process (production, commercialization, etc.) among the entrepreneurs in a given economy, some activities with better informed pioneers will be likelier to emerge in a market equilibrium.

In this same vein we must add that the coordination failures faced by the pioneer may also differ from those faced by the rest. For instance, a large firm is more likely to provide itself with the required industry-specific public goods and to vertically integrate (it may also have an easier time of developing specialized inputs suppliers with which it had a long term relationship in other related activities).

In this sense one could argue that, in the absence of government subsidization or provision of ISPG, sectors are more likely to be discovered whenever there is an individual with superior knowledge and/or there are large firms that resolve coordination failures by themselves. A corollary is that discoveries are likelier to occur when there are large firms in the sector.

Revealed information and the process of diffusion

The analysis made above focuses on when a pioneer is more likely to invest in the development of a new export activity, and also helps to shed light on when diffusion is more likely to occur. This is when:

- Knowledge externalities are large and the pioneer cannot introduce barriers to entry.
- Prior knowledge is more uniformly distributed among firms in a given sector.
- There exist agglomeration economies.
- There is some government promotion of diffusion.
- There is a bigger mass of existing firms with large productivity in related activities, access to better financing, good trade linkages and superior marketing experience/skills. Id est, the accumulation of capabilities occurred at an industry level.

- The pioneer has an incentive to promote diffusion at some stage of the production chain, in the expectation of capturing monopoly rents at other stages.
- It is easier to copy (no patents, information flows via suppliers of capital goods, thick labor market externalities).
- As in the case of the pioneer, the choice of new exports to imitate may be conditioned by the availability of prior knowledge.¹²

Additionally, the different types of uncertainty will lead to different extents of information revelation, which will be transmitted through different channels and have different implications for the diffusion of new exports. For instance, when the uncertainty is related to commercialization, foreign demand and product mix, export knowledge may diffuse across borders. In this setup, it could occur that a pioneer may be able to block domestic diffusion, but not foreign diffusion, which could further reduce the scope for local diffusion of the new exports (as foreign diffusion lowers export prices). In the case of uncertainty regarding the ability to produce the good at all, its resolution via R&D will probably generate proprietary knowledge and no diffusion, unless researchers move from one firm to the other.

Vettas (2000) suggests that subsidizing infant exporting industries may be optimal in the presence of demand revealing externalities. However, if there are cross border externalities (in the revelation of demand saturation), foreign competitors may enter the market, diminishing the case for subsidies to discover these activities. In any case, export promotion might then require some strategic subsidies to deter foreign

¹² The payoffs from imitation will depend not only on the costs or prices revealed by the pioneer, but also on the imitators' prior knowledge arising from previous experience in the production and/or exporting of related goods (either in upstream or downstream activities, or in horizontally differentiated goods in the same industry), which help reduce costs (or raise prices) relatively more in certain new activities. It is possible, and reasonable, to extend the theoretical framework to allow for the possibility that imitators face some uncertainties themselves regarding the costs of exporting. *Id est*, the discovery made by the pioneer reveals the industry-specific costs of exporting, but there may still remain idiosyncratic uncertainties that demand a sunk investment by imitators. In this framework, the uncertainty will be smaller the bigger is the prior knowledge of imitators and the less differentiated the new activity is. The presence of large idiosyncratic uncertainties may prevent an adequate diffusion from occurring. It would also make the decision to imitate contingent on how big diffusion is expected to be.

competitors from entering, and the welfare implications of such policies are not immediately obvious.

Welfare analysis

As it follows from the previous discussion, the inefficiencies that may be present in the actual process of emergence of new export activities will include those highlighted by HR (too little ex-ante investment, due to information externalities, and too much production diversification ex-post, due to temporary monopoly rights), but we must add other possible inefficiencies that generate sub-optimal investment in new exports and in their diffusion: a) biases in the choice of new exports towards activities that may not offer the highest social returns, but which may offer bigger possibilities of capturing rents by the pioneer (this is closely related to the second HR inefficiency), b) too little diffusion due to barriers to entry and to monopolistic behavior of the pioneer within the sectoral production and commercialization chain, c) too slow diffusion in the presence of demand revelation and demand shifting externalities, d) too much diffusion due to an excessive promotion of this activity by the government, or to wrong expectations regarding the foreign demand saturation point. To give an example of these other types of inefficiency, consider the case when the pioneer has the chance to become a monopolist in upstream and/or downstream activities. In this case she will have an incentive to promote diffusion only up to the monopolist optimum, which is likely to be smaller than the social optimum that a central planner would pick.

In addition to the inefficiencies arising from non-competitive behavior and from incomplete markets associated to information externalities, we must add other traditional sources of inefficiency that may hinder discovery and diffusion, such as: a) financing constraints, b) coordination failures, c) failures in the functioning of the national innovation system, that reduce the effectiveness of individual innovative efforts.

When appraising the social returns of the activities that are discovered we must include the following considerations: a) size and scalability of the new Harberger triangles, b) accumulated capabilities in the new activities and the types of new exports that they will later allow to develop, c) degree of diffusion and of intra- and inter-sectoral spillovers (technological, pecuniary and informational), d) rent shifting from foreign competitors.

Finally, we must also consider the role played by trade-related policies, infrastructure (both basic and technologic) and institutions in facilitating experimentation in new export activities and its subsequent diffusion.

4. Case study analysis of the emergence of new export activities in Argentina

This section seeks to shed light on the drivers and the extents of the emergence of new export activities by analyzing a number of case studies for Argentina. The main goal is to identify the commonalities and differences in these processes, so as to help characterize the nature of the emergence of these new activities in Argentina. We also seek to identify the main inefficiencies that may be present in these processes.

4.1. Criteria for sector selection

We selected three new export activities to be analyzed:

- Chocolate confections
- Biotechnology applied to human health (BHH)
- Blueberries

All these cases present the following characteristics that make them attractive for the present study: a) negligible exports 20 years ago in the case of chocolates, and 15 years ago in the other cases, b) very fast export growth, c) reversal of revealed comparative disadvantage in the case of chocolate confections, d) currently large volume and value of exports, e) large degree of diffusion in the case of blueberries, and little diffusion in the other two cases, f) relative little intensity in the use of natural resources in the case of biotechnology and chocolates, g) entirely new production activities in the cases of blueberries and biotechnology, h) preliminary appraisal of a relatively large degree of uncertainty involved in the discovery of costs and/or foreign demand for these new activities, i) they are located in the periphery of the densest part of the product space estimated by Hausmann and Klinger (2006), i.e., they are candidates to generate an accumulation of capabilities that allow Argentina to jump to modern (high productivity) trees in the forest. The three sectors meet all the statistical criteria used to define a new export in Section 2 and the Statistical Appendix.

The three cases offer very interesting insights on how pioneers deal with information and coordination externalities when there are no government policies or investments that facilitate discovery, i.e., how they manage to generate temporary or

permanent monopoly rents (through the introduction of barriers to entry, product-specific proprietary knowledge, technical features that prevent a quick diffusion).

In the case of chocolate confections there were several attractive features. The pioneer, and main exporter, has managed to become a global player in a world market that is dominated by large firms from rich countries. It is an interesting case of accumulation of capabilities at an intra-firm level (and also via the acquisition of other firms), of generation of information externalities regarding foreign demand and commercialization strategies, of demand shifting effects a la Vettas (2000), and of cross-border externalities, that offers very interesting implications regarding when the discovery of new exports should be subsidized, and when diffusion is socially optimal or not (in the case of chocolates there is the possibility that diffusion could be immiserizing). It is also a very interesting case because its monopoly position made the pioneer take socially optimal investments. This new export also helps shed light on the key role played by domestic firms over branches of MNCs in the risky development of new exports. Finally, it is a very appealing case because the sector lacked a natural comparative advantage (as it is intensive in the use of cocoa), and yet

Biotechnology applied to human health is also a very attractive case for several reasons. First, because Argentina managed to become an important exporter at an early stage of the world product cycle, ahead of all the countries with similar incomes and even ahead of many rich countries. Second, because the emergence of this sector was based on the exploitation of yet untapped accumulated research capabilities in life sciences, which had had no commercial use before, and was developed by national pharmaceutical laboratories that completely lacked experience in BHH. Third, the development of this sector involved two types of uncertainties. There was one generalized uncertainty regarding the suitability of local human capital for undertaking the required R&D to develop the new products, and a product-specific uncertainty that had to be resolved via R&D. Despite the relatively large information externality regarding the adequacy of local human capital, the pioneer managed to compensate it with the proprietary nature of the product-specific knowledge. Fourth, this new activity offers very important potential technological spillovers and large learning economies in R&D. Finally, BHH is representative of successes where timing is everything as a result of downward sloping demands and experimentation taking place in many different

countries. It is also an interesting case in which the pioneer has provided many public goods that have favored the newcomers, and where national firms were crucial for the development of the sector.

The emergence of the blueberries export sector is also worth evaluating, as it is a case that fits very well the basic HR framework, although with some very interesting twists. The pioneer is an individual entrepreneur that faced an ex-ante uncertainty regarding the profitability of the new activity, that was however smaller than the one faced by the industry average. He invested because of the expectation of temporary monopoly position until the investments of the followers matured. However, he knew that newcomers would eventually enter and erode his profits, which made him undertake a sub-optimal investment. It is very interesting that the pioneer nevertheless tried to gain a permanent monopoly position by specializing in the nursery and commercialization stages and promoting limited diffusion at the production stage. However, due to his sub-optimal level of experimentation (and limited financial resources) he promoted diffusion before the best production technologies were learnt about, resulting in very poor initial productivity levels which were compensated by initially large prices. This poor technological transfer to farmers facilitated the entry of strong competitors at the nursery stage, which had started their research on plant cloning techniques at the same time that the pioneer started investing in production. The case is fascinating because the pioneer solved by himself coordination failures at several times, even though his profits would be eroded by the competition. It is also very interesting because it appears to be a case of overshooting in diffusion, as prices remained high for too long due to the poor productivity of the original plantations, sending the wrong signal about long-run profitability. Finally, the case is attractive because Argentina succeeded in a market with downward sloping demand despite entering late. This was due to the fact that it managed, due to geographical traits, to become a monopolist in an underserved off season market.

The three cases thus offer variety in terms of the information and coordination externalities involved, the way that the pioneers dealt with them, the degree of diffusion and its optimal level, the roles of previously accumulated capabilities, and the optimal policies to promote new exports. Availability of information and access to interviews was another used criterion for choosing these sectors.

4.2. Methodology for case study analysis

We start by using data from secondary sources (official trade statistics, websites, and publications) and from preliminary interviews to provide background information on the cases under study. This background information allows a preliminary identification of: a) pioneers and the dynamics of diffusion, b) uncertainties involved, c) possible information externalities, d) possible sources of inefficiency, e) possible market and coordination failures, f) contribution or interference of public policies. Then the proper case study analysis is undertaken.

4.3. Case study protocol and interviews

An appropriate case study protocol must be developed. First, the external validity will arise from the support given to protocol development by the theoretical framework proposed above. This theoretical framework facilitates the identification of appropriate case studies and of the variables to be included in the data collection.

Second, in order to ensure the operationalization of the procedures for data collection and recording, a standard questionnaire will be designed and employed in all the interviews in all the case studies. The questionnaire seeks to shed light on the next series of questions, which are based on the predictions of our theoretical framework and on the preliminary background information available:

- Which are the key drivers of discovery? Why was this sector targeted?
- Where there any uncertainties and/or coordination failures present?
- Why was the pioneer successful in finding a profitable new export activity?
- What type of information did it reveal?
- Why was the new export activity targeted for imitation?
- What determined the extent of diffusion?
- Which actual and potential inefficiencies are present in each case, and how important are they relative to each other?
- Was the emergence of new export activities helped or hurt by public policies?

Third, multiple sources of evidence must be used. We will conduct interviews with pioneers, imitators, business associations, and involved government agencies and officials. Interviewing multiple participants in each process of emergence of new exports will strengthen the robustness of the results. For the analysis of the process of diffusion we also have rich quantitative evidence from the Exporters' data base of the Customs Office.

4.4. “Hypothesis testing” and consistency analysis

We obviously cannot test hypotheses in an econometric sense. What we will do instead is to contrast the predictions of our theoretical framework with the responses obtained in the interviews to determine, based on qualitative criteria, which of the predictions more relevant. This is akin to analyzing the consistency of each of the case studies with the different specifications/extensions of our theoretical framework.

4.5. Counterfactual analysis

The counterfactual analysis involves the analysis of sectors that share some common features with the sectors that succeed in developing new export activities, and yet failed to take-off. The comparison of the features that are not shared will help shed light on the drivers and the key determinants of the success, or lack of, discovery and diffusion.

The choice of the counterfactual depends on the nature of discovery and diffusion in each case study. In the case of blueberries, where there is discovery and sizable diffusion of its export as a fresh fruit, the best counterfactual is the production and exports of raspberries, which share many market and technological characteristics with blueberries, where the discovery was attempted, but failed. We add strawberries to this counterfactual analysis both to blueberries and to raspberries because: a) strawberries can only be exported frozen, and not fresh (which is the really attractive market segment) like in the case of blueberries, b) frozen raspberries are not being exported (the contrary to strawberries). This stands in contrast with Chile, where all three activities have been successful.

In the case of chocolate confections, where there has been little diffusion, the counterfactual analysis will be based on a successful exporting sector that shares some similarities with it but have some important differences with chocolate confections, and where diffusion has been more widespread. This sector is sugar confections (an older export activity), that shares with chocolate some product attributes from the consumer's point of view and complementarities in commercialization, and differs in that there exists a natural comparative advantage for sugar confections (not for chocolates) and that product differentiation and brand barriers to entry are much less important in sugar confections.

In the case of biotechnology applied to human health, a good counterfactual is Brazil, which despite substantial government promotion effort has not been as successful in developing these exports. Brazil differs in terms of a much less significant previous presence and trajectory of national pharmaceutical laboratories (which are the ones that developed this sector in Argentina), i.e., in terms of the capabilities for BHH accumulated by national private firms and in terms of its initial endowment of life science researchers.

This counterfactual analysis will be done at a bigger depth for the fine fruits sector (with interviews to players in the counterfactual sectors). In the other two sectors we will focus mostly on primary information arising from the interviews to firms in this sector, and on secondary information from trade and production statistics.

5. Case study of chocolate confections

5.1. Background information

Even though Argentina has a long tradition in the production of chocolates and chocolate confections under import substitution, exports are a relatively new activity.

There are about 125 firms that manufacture chocolate products in Argentina. Production is moderately concentrated. Arcor is the leading producer of chocolate confections in Argentina, followed by Georgalos, another Argentine firm.¹³ Ferrero is the third producer and the largest exporter. Exports are more concentrated: Arcor and Ferrero represent 98% of Argentine external sales of these goods.

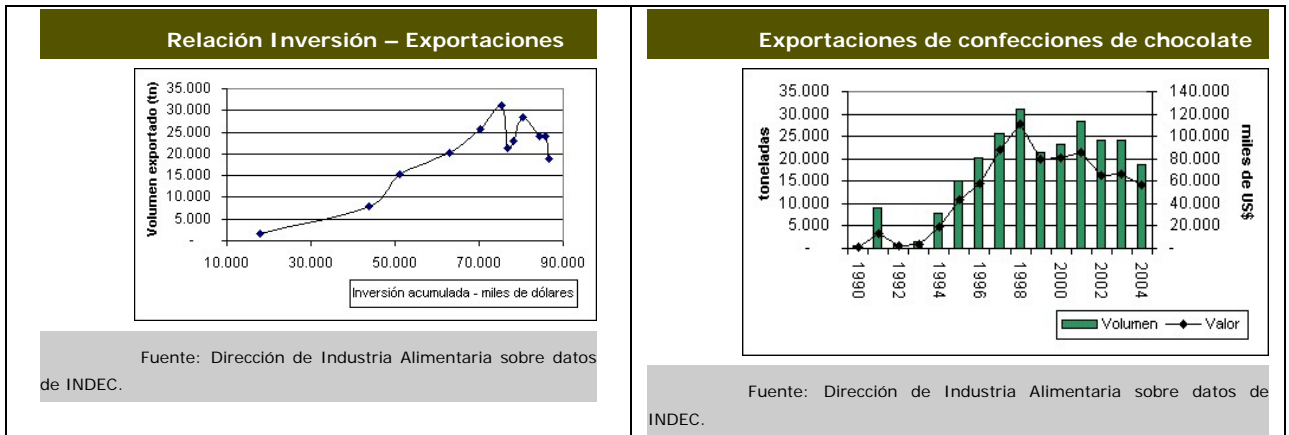
In the 1990s many multinational firms (Kraft-Suchard, Cadbury, Ferrero) located in Argentina, but most of them oriented their activities towards the domestic market, save for Ferrero, which was very export oriented almost from the onset. Most of the multinationals entered through the purchase of domestic firms. There were also important Chilean investments in the sector.¹⁴

Exports started in the early 80s, mostly in the form of non-differentiated products, and became significant in terms of volume and product differentiation only in the 1990s.¹⁵ This rapid export expansion involved sizable investment in production capacity, technological upgrading and market diversification.

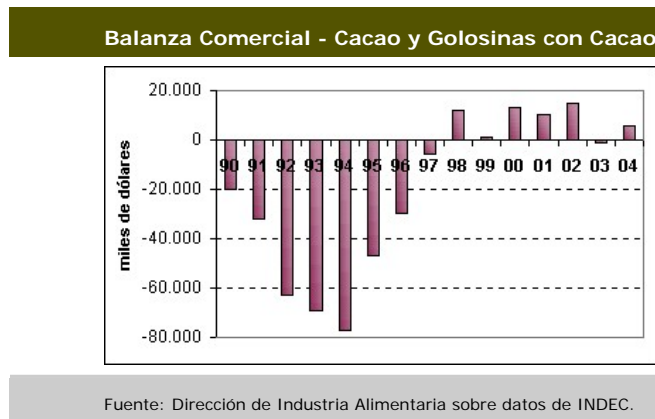
¹³ The latter is much less devoted to exports (it exports only 4% of its chocolate production, much less than Arcor, which exports more than 50% of its leading chocolate confections).

¹⁴ Costa purchased Chocolates Bariloche, and Ambrosoli purchased Bonafide, while Dos En Uno purchased an industrial plant for plastic products in the province of San Luis (to take advantage of an industrial promotion regime), which it reconverted to the production of chocolate confections.

¹⁵ It must be mentioned that this product category encompasses all goods that have a minimum cocoa content. The products under analysis are those under the code 180690 of the MCM (HS-2002) classification, being described as “Other chocolates and other food products that contain cocoa,” which includes products with a chocolate covering.



Exports grew very significantly between 1992 and 2005, from US\$ 9 millions to US\$ 72 million (according to national trade statistics from INDEC), led by an Argentine company, Arcor, and a multinational company, Ferrero. In comparison, the value of world trade of chocolate confections doubled between 1990 and 1998 (according to FAO data). Going further back in time, we observe that, according to COMTRADE data, these exports grew from US\$ 456 thousand in 1980 to US\$ 79.9 millions in 2000, switching from a significant revealed comparative disadvantage in 1980 to a strong revealed comparative advantage in 2000.



There are four large categories of products: chocolate tablets, chocolate confections, industrial chocolate, bakery and chocolate fudge. All of them are locally produced despite the comparative disadvantage arising from the lack of local availability of cocoa, by virtue of tariff protection (Mercosur has a 23% common

external tariff for these products) and the natural protection granted by logistics (mostly temperature management).¹⁶

Sustained export success was achieved only after the development of differentiated products that were adapted to local preferences in the different markets, together with competitive prices. Previous attempts to export non-differentiated products, such as chocolate tablets, had not been successful and/or sustainable due to the fact that these goods are cocoa-intensive commodities, dominated by world leaders (Kraft, Hershey's, Mars, Cadbury, Ferrero), which are usually vertically integrated (including the production of cocoa in African countries), have introduced brand barriers, dominate local preferences in different industrialized countries, and also frequently engage in dumping practices. Additionally, there is a world excess capacity for the production of these goods.¹⁷

¹⁶ Other inputs (milk, glucose, sugar) are relatively cheap in Argentina, but they are not important enough as to generate a natural comparative advantage.

¹⁷ Many Argentine firms started exporting mostly chocolate tablets, and some chocolate confections, to regional markets in the second half of the 1980s to take advantage of idle installed capacity (as a result of the domestic recession) and a temporary exchange rate advantage. An apparently key development was the possibility in the late 1970s, under the LAIA (Latin American Integration Area), to start importing cocoa from sources other than Brazil, such as Ecuador and Colombia. There was a problem with Brazil, in that this country was not a reliable supplier of cocoa, which generated unpredictability in production, a no-no for exporting. However, it was very quickly discovered that chocolate tablets are commodities, in the production of which Argentina has no comparative advantage.

Exportaciones de confecciones de chocolate (Ton. Y miles de US\$)										
Confecciones de cacao	2000		2001		2002		2003		2004	
	Ton	Miles de US\$	Ton	Miles de US\$	Ton	Miles de US\$	Ton	Miles de US\$	Ton	Miles de US\$
Chocolates sin rellenar	1610	4860	2680	6810	1220	2960	1740	3540	2259	4855
Bombones rellenos	5150	13700	6180	15950	5110	11890	5390	12240	7361	16287
Alimentos con cacao, excepto chocolate, bombones o figuras	3660	6680	2910	4760	320	580	480	1030	652	1383
Cobertura de chocolate	1660	3910	2210	4380	1750	3530	1970	4030	2055	4512
Chocolates rellenos	1080	3250	780	2310	750	1930	570	1510	609	1543
Preparaciones con cacao, en envases mayores a 2Kg	50	140	3090	4800	4390	6010	4000	6050	1925	3108
Caramelos con cacao	3270	5780	3920	6740	4270	7060	3440	5420	3756	5932
Confites y grageas	1090	2240	1170	2210	1400	2450	1150	2590	1752	4041
huevos no macizos	3770	36100	3440	32230	3360	26180	3580	25810	4128	33128
maní recubierto	320	660	550	1000	990	1780	970	2170	1052	2535
figuras macizas, excepto huevos	470	960	560	1120	12	30	260	800	65	220
bloques, tabletas o barras sin rellenar	2	10	0	0	5	10	150	300	328	669
Otros	758	2400	550	1680	403	1280	316	1123	548	1463
Total	22890	80690	28040	83990	23980	65690	24016	66613	26491	79676

Fte: INDEC

While export destinations were relatively concentrated in 1998 (44% to the UK, 38% to Brazil, 9% to Uruguay, and 4% to Chile), in 2004 these exports reached more than 100 countries, including Mexico (20%), Brazil (16%), Chile (15%), EEUU (7%) and Canada (7%).

The export/output ratio for the whole chocolate confection sector in Argentina is currently around 10%. However, in the case of specific products of the leading exporters this proportion can reach up to 70% and even more.

Today Argentina's exports of chocolate confections represent 1.2% of world exports of these goods (vis-à-vis a 0.39% participation of Argentina's exports in world trade in all goods). Argentina's production of these goods represents 1.4% of world production.

5.2. Analysis of the emergence of this export sector¹⁸

5.2.1. Who was the pioneer? Why did it target this new activity?

The pioneer for exporting chocolate confections (differentiated products) at a large scale and to multiple markets in the early 1990s is Arcor, a family-owned Argentine firm. This firm was also the first significant exporter among Latin American firms. It is not however the pioneer for production in Argentina.¹⁹

This firm was founded in 1951 and has been traditionally focused on the production and export of sugar confections (it currently is the world's largest producer and exporter of these goods).²⁰ Arcor is a global firm that has several plants abroad (Brazil, Chile, Peru, Mexico), as well as commercial offices in many countries. It exports to more than 100 countries, in many of which it has its own exclusive distributors. This international distribution system replicates its domestic nation-wide system of own distributors, which was established in the early 1980s.

Its two main chocolate confection exports are the Bon-O-Bon (BOB) and the Rocklets. The BOB is a chocolate bonbon that was developed in the early 1980s as an imitation of a product already developed by Garoto in Brazil.²¹ The Rocklets are candy

¹⁸ The analysis is based on interviews to Arcor executives (Guillermo Storni, Gerente de Negocios, División Chocolates; Marcelo Salcedo, Gerente de Investigación y Desarrollo, División Chocolates; Mariano Tamborini, Gerente de Exportaciones, División Golosinas), a former executive of Ferrero Argentina, Georgalos executives (Juan Miguel Georgalos, President), Cadbury Stani executives (Manuel González Campa, R&D Manager), Nestlé executives (written questionnaire to commercial department), and former government officials (Antonio Assefh, Undersecretary of Industry of Argentina, 1991-1996).

¹⁹ Aguila-Saint had been the major manufacturer of chocolate products in Argentina since the 1880s. This firm was acquired by Arcor in 1993. Other traditional manufacturers that preceded Arcor include Lerithier and Felfort.

²⁰ Argentina has a comparative advantage in the production of candies and sweets, which are intensive in the use of sugar, milk, and glucose, all of which are relatively abundant in this country. Arcor is additionally engaged in the production of exports of other goods such as jams, canned vegetables, cookies and cereal bars.

²¹ The BOB is a round wafer filled with peanut paste and double dipped in milk and dark chocolate.

coated chocolates, similar to Mars' M&Ms, and Nestlé's Smarties. The export/output ratios for these two goods exceed 60%.

The key reason for targeting these exports arose from the need and opportunity to exploit scale economies in the commercialization of sugar confections through its distributors abroad. Chocolate confections are natural complements of sweets and candies: they are sold in the same stores and they can be distributed by the same person/firm.²² This commercial complementarity was first exploited at the local level in the 1980s, and it was the main factor that motivated the production of differentiated chocolate confections by Arcor.²³

The *choice* of this new export activity was *facilitated* by the prior production knowledge, under import substitution, of both chocolate tablets and differentiated chocolate confections.²⁴ In this vein, it must be highlighted that the development of new chocolate products always had the ultimate goal of being saleable in both the domestic and foreign markets.²⁵

Another factor that emerges as facilitating the *choice* of chocolate confections by Arcor is its ability to overcome, and in turn introduce, barriers to entry through brand development, scale and learning economies, sunk costs, bargaining power with

²² This complementarity works well for a firm has its own distributors/salespersons. In the case of selling to independent importers (which deal with many exporters), the latter may give priority to some goods over the others, and the complementarity in commercialization disappears.

²³ The decision to start producing differentiated chocolate confections was based on the objective to gain market share in the 1980s in the market of the City of Buenos Aires, the richest in Argentina, where there is a bigger demand for quality, product differentiation and brands than in the rest of the country, where they were leaders in the candy markets. In Buenos Aires they had to compete with traditional manufacturers of chocolates, such as Aguila, Felfort and Bonafide, with well established brands. The first major non-differentiated product of Arcor was the BOB. This and other differentiated products, together with Arcor's innovations in distribution and commercialization, allowed it to become a major player in the market of the City of Buenos Aires.

²⁴ Arcor started producing chocolate tablets for the domestic market in the 1970s.

²⁵ For instance, while in the case of BOB it took a few years before it was exported at a significant scale, the Rocklets were exported to Paraguay even before they were sold in some regions of Argentina.

suppliers and clients, and technological barriers that are very important for being competitive exporters of these types of goods. Arcor's previous scale in the production, commercialization and exports of sugar confections certainly helped in this regard.²⁶

Hence commercial complementarity with sugar confections coupled with Arcor's network of own distributors (which introduce fixed costs and demand a constant flow of sales) was the ultimate reason for targeting chocolate confections.

It must also be highlighted that, albeit being a pioneer at the Argentine level, Arcor is an imitator at the world level. Its two most successful chocolate confections (the BOB and the Rocklets) are imitations of pre-existing products developed elsewhere. What Arcor does is to introduce some innovation to these products, particularly in terms of commercialization, distribution, and marketing.

5.2.2. Which were the main ex-ante uncertainties regarding the profitability of exports? How were they solved? What was discovered? Where were there any surprises?

Arcor's exports of differentiated products faced significant uncertainties on the demand side. It needed to invest time and resources to discover foreign demand, profitable export product mixes, prices and quality ranges where it could compete, best product presentation and sale strategy. It revealed considerable valuable information on this front, both to local and to foreign competitors.

²⁶ Arcor started both producing and exporting sugar confections (candies), where although there are important scale economies, there were not any big international or regional exporters that had introduced technological or scale barriers. Hence there was no need to differentiate products. Arcor took advantage of the comparative advantage from the local availability of sugar and milk and of Arcor's own production of flexible material for wrapping. These features were exploited to increase volume, exploit scale economies and become a world leader in terms of costs. For instance, in Brazil there are about 100 low scale producers which are not very competitive. There are very few big players (there is one in Germany and another one in the US, which was significantly weakened by Arcor's competition in that market). Product differentiation and brand development in sugar confections (with the Butter Toffee) was exploited later, but still it is not as big a barrier to entry for competitors as Arcor's scale, technological and sunk costs barriers in chocolates. Hence the prior trajectory in sugar confections gave it scale, technology and cost leadership, which facilitated the experimentation in discovering export profits for chocolate confections. If successful, they would only have to worry about brand barriers.

It did not face any significant uncertainty regarding costs of production and of complying with technical barriers to trade. There was not much uncertainty regarding NTBs either.

Production costs:

Arcor's previous experience in producing tablets for the domestic market, together with its knowledge in the technology for processing sugar, and its already well-learned cost and product development departments, helped reduce cost uncertainty significantly. They also got help from the suppliers of capital goods.²⁷ Arcor's large bargaining power with suppliers, its vertical integration in many upstream activities (arising from related activities in sweets and candies), its austerity, and its incorporation of the latest technologies also helped them control costs.²⁸

They also acquired further production know-how through the purchase of Aguila in 1993 (an Argentine firm that was a leader in quality and focus for chocolate products). They obtain additional production knowledge from contract manufacturing relationships with world leaders, whereby the latter transmit knowledge for the production a façon by Arcor.

Demand and commercialization strategies:

In order to be internationally competitive Argentine exporters of chocolate confections must offer differentiated goods that have a lower quality than the top world brands but higher quality than the rest and that has a lower price than the world leaders.

²⁷ Nevertheless, they still had to learn the use of the technologies for flour (for the wafers in the BOB) and of chocolates for differentiated products (the processes of coating and filling chocolate confections are technologically more complex than that of manufacturing tablets), and the technologies for temperature management as well. Products such as the BOB are not easy to replicate: a local producer in the province of Cordoba has tried to produce a similar product (the Oblibón), but has thus far failed, as the chocolate coating cracks very easily. This learning process took some time, but did not involve large uncertainty.

²⁸ The firm always had a clear view of costs, with an internal design of machines and equipment, on a very austere basis. It also benefited from long term contracts of suppliers of cardboard packaging, which ensured the supply of these inputs. A further cost cutting step was to install the latest technology (back in 1983-84), much more advanced and less labor-intensive than the major competitor in Brazil (Garoto). This helped reduce costs as long as they produced at a large scale.

To this end Arcor had to make investments to find which products worked in each market, and what the right price, size and packaging were. In some cases it even had to create the market for new exporting goods. In a word, Arcor had to learn the position and slope of the demand curves for its products.

Let us consider the case of the BOB as an example in this regard. The original product created by Garoto in Brazil was sold in boxes of assorted bonbons, together with other confections, and it targeted mostly the Brazilian market. Then Arcor came, which imitated and innovated upon the product.²⁹ It also made major commercial innovations that made it easier to sell in Latin America and the US. Arcor first sold it in a box of assorted bonbons. Then it discovered that it worked well if sold in a transparent plastic vase that contained only BOB. Finally it found out that it could be sold very well as an individual product in a large number of countries, which allowed it to become a massive product.³⁰ Individual sales were particularly useful for capturing Latin American markets, where sweets, candies and chocolate confections are sold in small drugstores, as in Argentina.

In the case of exports to the US (a large market for the BOB), part of the demand uncertainty was transferred to local players via contract manufacturing with local firms, and part of this uncertainty was resolved by the experimentation made by Arcor's own distributors and commercial representatives.³¹

It must also be highlighted that the BOB was a new product for world markets and Arcor had to create a market for it. To this end it followed several complementary strategies: a) the use of commercial persuasion by its distributors abroad, which already

²⁹ Arcor replaced the Brazilian filling of cashew nut paste (which is preferred only by Brazilians) by a peanut paste filling that is preferred in Latin America.

³⁰ Arcor currently manufactures 550 million units of BOB per year.

³¹ In the US these products are sold in boxes in supermarkets, both with Arcor's own brand (Whisper) and also through contract manufacturing. For instance, they have a large contract manufacturing contract with WalMart (which sells the BOB using the Sweet Enticement brand). They also had to adapt the filling and the packaging to local preferences (replace the filling with peanut butter, a salted material with a different consistency than peanut paste, which was a technological challenge, and the packaging with colours that were better adapted to local preferences).

had significant clout with local drugstores and supermarkets through the sales of sweets and candies, b) the diffusion in international fairs, c) the use of marketing whenever the product had some initial success.³²

Another key issue is finding the “right” price for individual chocolate confections that are sold in drugstores (or similar venues). This price bears a relation to what is considered pocket change in each country (e.g., US\$ 0.25 in the US), particularly because of the nature of the consumption of these goods (that provide quick gratification, and the purchase of which is usually linked to visual impact and to spending pocket change on them; or in the case of kids, to their limited budgets). Finding this right price entails some experimentation, and then determining if it is profitable or not.³³

In order to detect successful export products they had to undergo a trial and error process in different markets and market creation effort until they found the ones that worked.³⁴ This process became more efficient when they focused on a small set of products.³⁵

³² As it was done in South Korea, where they have done it to ensure customers’ fidelity; apparently the chocolate consumption patterns acquired during childhood are maintained throughout one’s life.

³³ In Argentina you have to sell the BOB either at AR\$ 1 or AR\$ 1.50. In South Korea the right price is 100 wons (US\$ 0.10), a very low price that is the pocket change in that country. It would be much more profitable to sell at 150 wons, but they cannot do so because it is not pocket change. Instead, in Australia they can sell it at US\$ 0.25, where it is pocket change, and there are no other chocolate confections sold at price (or sweets and candies in general).

³⁴ In the case of Rocklets, which were developed in 1995, there was already a world market for this product (it competes with M&M and Smarties), but a local market for candied chocolates had to be developed. Arcor did it through the use of its distribution network and its marketing activities. Additionally they had to install the brand in world markets through similar strategies, and it was very important to find the right price.

³⁵ In this process it was key the participation of the new management of the chocolate section that was incorporated via the acquisition of Aguila, which had long understood the importance of focus for success in the chocolate market. There was an internal confrontation in Arcor: distributors always pushed for obtaining shipments of assorted goods (which allowed for risk diversification), whereas the new chocolate management vied for focus. The latter finally prevailed in the mid-90s, after the success of

Regarding the selection of new products to experiment with, it usually arises from the following activities: a) participation in international fairs, which allows the detection of new products that are developed elsewhere (and upon which an innovative imitation can be performed) and exchanges with clients, b) exchanges with suppliers of capital goods, that suggest existing successful products that can be imitated, offering to convey the required equipment and production techniques, c) the market knowledge of Arcor's commercial representatives abroad.³⁶

There were also important uncertainties regarding the markets where products could be profitably sold.³⁷ Much of the market selection process (both for sugar and chocolate confections) is driven by the constant participation in the main international confectionary fair (ISM) in Köln, Germany, where Arcor has been present with its own exhibition space since the onset, 33 years ago.³⁸ Due to climate, size, purchasing power and relatively low trade barriers, there was always a bigger interest in the North American market (especially in the States of California and Florida), which presented some important commercial uncertainties.³⁹ Then they started to slowly open commercial offices in almost all of Latin America, which was closer in terms of

the exports of BOB and Rocklets. This does not mean that many other chocolate confections and chocolate products are not exported, albeit at a lesser scale. But the ideal thing for them is to have a few global products. Thus far only the Rocklets fall into this category.

³⁶ In the beginning, the decisions regarding products and markets were done solely by Arcor's local management in Argentina; currently they involve the participation of local managers and commercial representatives abroad.

³⁷ Arcor had to discover the prevailing commercialization system in each country (and if it suited Arcor's products), ability to deal local temperatures (chocolate consumption decreases with heat), local preferences, tariff and non-tariff barriers.

³⁸ This participation allows to contact international clients. The resulting process of market selection tends to be disorderly, based on the demands for samples and shipments from clients from any destination (South Korea, Central Asia, Africa, Oceania, etc.).

³⁹ The Miami office of Arcor was opened 15 years ago. The US are one of the main export markets for Arcor, and it is the most competitive market in the world. There they had a hard time finding the adequate distribution channel, as there are only 6 or 7 highly concentrated channels. In order to ensure a massive distribution in the US they finally signed contracts with Wal-Mart.

language, preferences, packaging and freight costs.⁴⁰ But they explored and exploited all sorts of markets, with their managers and directors spending substantial time in a large range of countries (Caribbean, Europe, Africa, Israel, etc.), following up on the contacts made in fairs, and reinforcing the initial sales.⁴¹

To sum up, Arcor resolved significant uncertainties regarding foreign demand and commercialization. As it follows from the evidence on finding the “right” price or on creating markets for new products, in some cases there was ex-ante uncertainty as to whether exports were profitable or not.⁴² In other cases the uncertainty applies to how big profits may be. In any of both cases, important information revelation was revealed, as attested by the attempts of some multinational firms located in Brazil and some Chinese firms to compete with imitations of the BOB in markets where Arcor is already a leader.

Exporting costs

The incidence of, and possible uncertainties with respect to, the costs of exporting (logistics, compliance with technical regulations in foreign markets, etc.) were relatively minimized thanks to Arcor’s scale of operations, and its long trajectory

⁴⁰ When it comes to foreign market cultivation, they first evaluate if exports to a given market are having some success, if the product is valued by consumers, if the “right price” is profitable, if the distribution channel is available, and if they have the financial backing to invest in marketing and distribution activities. Only then they decide whether they want to undertake this investment to jump to a higher sales level. This is the opposite to the multinationals (like Nestlé), that invest up-front US\$ 20-30 millions in publicity in markets like Argentina, before exporting the good and without knowing if it will be successful or not. Hence they have big successes and big failures. Arcor instead makes sure that the product will be successful first. They usually enter new markets with a bounded risk: they send small shipments of goods with low unit price, so that if the exports fail, the associated costs are low.

⁴¹ As overseas markets grew, a commercial office was opened in Barcelona, from where to take care of Europe, Israel and Africa. Over time they started hiring local salespeople in each market, with access to local networks and more knowledgeable about these markets, and with professional background in foreign trade operations.

⁴² According to Arcor, exports of chocolate confections are their most profitable line of business. On the other hands, the multinationals operating in Argentina aver that exporting chocolate confections can never be profitable, and that exports of sugar confections are cross-subsidizing this activity.

in export activities of sugar confections (they have their own accredited laboratories, etc.).

Surprises at the planning stage:

There were no significant surprises at the technological level. There were rather surprises at the demand discovery level. For instance, they had never imagined that bonbons such as the BOB could be sold as a unitary product. This was a truly unplanned for commercial innovation, that proved to be extremely important for market penetration and brand development. There were other commercial surprises regarding new products that worked well in unexpected markets and that failed in the markets they were originally designed for. This shows that developing differentiated chocolate confections is open to major surprises in terms of finding the combinations of products and markets that work fine.⁴³

5.2.3. Were there any coordination externalities? How were they solved?

Some of the required inputs were locally available as a result of their use in related food industries or because they could be directly sold in domestic and international markets (powdered milk, milk jelly, sugar, flour). Other inputs could be imported. However, the large macroeconomic disarrays during the 80s led to recurrent shortages of critical inputs (packaging, glucose, aluminium wrapping, etc.). Hence in order to be able to develop this new export activity (which requires a strong market cultivation effort) Arcor had to ensure a reliable access to these inputs. Vertical integration was critical to this end. It must be remarked that Arcor's size and internal resources facilitated this vertical integration. Local producers could have arisen for several of these inputs, but still they could not reliably supply the required inputs.

Vertical integration in commercialization activities was also necessary, both in order to ensure larger profit margins (that allow to absorb macroeconomic shocks) and to learn about and cultivate foreign demand. Arcor had the scale to do so as well.

⁴³ For instance, they developed a product (a sort of "alfajor") that was a modified imitation of a product that is very popular in Japan and in South Korea and which is consumed as a snack during teatime. The surprise arose from the fact that the product could be successfully exported to Middle Eastern countries, where this type of products did not previously exist, instead of the Far East.

Vertical integration in production and commercialization is typical of the largest world exporters of these goods.

5.2.4. Why was the investment in new exports successful?

The endeavor was successful because Arcor managed to resolve significant uncertainties regarding foreign demand and commercialization strategies. We can distinguish between the specific actions and strategies that the pioneer took to resolve the uncertainty, and the characteristics of the pioneer that facilitated undertaking this risky investment.

Most of the actions and strategies undertaken were discussed in the previous section (trial and errors in finding out products that work, their right prices, the markets where these products can be sold; participation in international fairs to test customers' reactions, interact with them and other producer/exporters and to detect potential new products to be imitated and innovated upon; communications with suppliers and customers; commercial experimentation made by Arcor's own distributors and commercial representatives; market creation through commercial persuasion of Arcor's distributors and marketing efforts, etc.).

Among these strategies, we must highlight the role of product focus, which increases the probability of success in the experimentation, by concentrating their efforts in discovering the demand and commercialization strategies for a relatively small number of products.⁴⁴

Another strategy that was important is that of undertaking innovative imitations of products with large commercial potential at early stages of their product cycle. Arcor focused on introducing commercial (and some times technological) innovations to

⁴⁴ While focus on a few products was not a key factor in the beginning of the exports of chocolate confections, it has been very important for the take off of exports in the mid-90s and for brand installation of BOB and Rocklets. Previous to that, they experimented with several products in different markets, which revealed information about successful products (they have had a number of episodes of failed exports). There was a conflict between distributors, who wanted to as large a product portfolio as possible, and the chocolates managerial staff, who understood the importance of focus and market cultivation.

products that have been proven to work in some countries and/or some market segments, and on creating new markets (sometimes global) for them or discovering demand for these goods in other market (quality and price) segments.⁴⁵ This reduced a significant part of the commercial uncertainty and helped increase the chances of success.⁴⁶

Then we must consider the characteristics of the pioneer that *facilitated* this investment. Since the experimentation may involve certain losses (or at least the opportunity costs caused by the sales of other goods that are forgone) the firm must be able to finance/subsidize this endeavor. In this vein, Arcor was able to cross subsidize experimentation in chocolate confections with established profitable activities (sugar

⁴⁵ In the case of the BOB, they improved upon the original Brazilian product in terms of commercialization strategies, export focus, and adaptation to local preferences. In the case of Rocklets, they developed a product of good, but not premium, quality that could be sold cheaper than the M&M or the Smarties, thus capturing an important market segment. The Rocklets were developed in 1994 and very quickly became a major success in the domestic market, thanks in large part to the distribution network of Arcor, substituting M&M imports (Rocklets now have 85% of the Argentine market of candied chocolates, whereas M&M only has 5%). The price difference was also key: a 25g M&M package costs AR\$1, while a 20g Rocklets package is worth AR\$0.50. The persuasive activities of distributors at the retail level, together with marketing activities, do the rest. Marketing activities through major advertising are undertaken only when a product is relatively well sold in a given market. For instance, the BOB is sold very well as an individual product in confectionary shops (a combination of drugstore and school material shop, focused on children) in South Korea, where they ship 100 containers per year (12 tn per container). The combination of having found the “right price,” and of a similar retail system than in Argentina, allows these large sales. Now they want to move beyond pure price-based sales towards branding. To this end in 2006 they made a commercial selling the BOB brand that was especially made for South Korea. They want to develop customers’ fidelity towards the BOB. The development of fidelity to products and brands in the case of confectionary products occurs during school years, and that is the target of this product’s commercial.

⁴⁶ We must stress that in the opinion of Georgalos (which is the second largest producer but an almost negligible exporter) innovative imitation is not crucial, and that what matters is the development of products that target preferences in market segments (by age, income level, etc.) that have been revealed by other firms rather than imitating products, because of the risks of failure of imitations (either because of brand barriers or because of technical complexities). Since Georgalos (or any other firm that pursues this strategy) has not become a successful exporter, it cannot be established if this strategy would be able to overcome the commercial uncertainty involved in exporting these goods.

confections). The external economies from being able to export chocolate confections together with sugar confections (exploiting the already established distribution network in many markets) also helped, by reducing some of the certain costs of commercialization and by helping amortize the fixed costs involved in their trial and error process. Accumulated capabilities in the commercialization of sugar confections were a key factor. Indeed, Hausmann and Klinger (2006) product space analysis shows that these two goods are one next to the other.

Arcor's commitment to exporting, even if uncertain of the final profits, was also a major facilitating factor. This willingness to take risks sets it apart from local branches of multinational companies, which can only export already established products that offer a sure profitability (i.e., they cannot cultivate uncertain markets and/or invest in discovering demand), and from other local firms that are not willing or able to commit simultaneously to exporting and to investing in the required technology to meet foreign demand requirements.

Finally, all the traits of Arcor that helped reduce the costs of production (discussed in a previous section) also facilitated experimentation, by moving the probability distribution of profits to the right.

5.2.5. What was done to consolidate the new export success?

After shedding light on what uncertainties were resolved, and how, revealing that these goods could be profitably exported, we now focus on the actions taken by the pioneer to consolidate these new exports (i.e., its business strategy).

Two types of actions must be considered. First, those related to product attributes and choice of production technologies that affect the ability to sustain exports and to cultivate markets over time. Second, those related to preserving, and capturing, market shares from competitors that target the same market and product segments. These competitors could include imitators of Arcor at the local, regional or global level. These actions are not likely to generate any information externalities to potential imitators. They are rather likelier to block diffusion.

The ability to sustain exports and to cultivate markets over time is very important for chocolate confections. This helps to: a) build a reputation for reliability

among clients, b) install brand names, c) exploit learning economies in production (that allow for quality improvements and/or facilitate new developments), d) develop long-term relationships with suppliers of specialized inputs, e) be better prepared to comply with product and process norms and technical regulations, and to adapt products and packaging to local preferences. In the case of Arcor it also helps amortize the fixed costs associated to having its own network of commercial offices and distributors.

In the case of chocolate confections, this ability could be negatively affected if macroeconomic shocks (such as large exchange rate fluctuations) have a sizable negative impact on unit costs of production and on profitability, as it is not possible to pass through these cost changes to foreign consumers (exports of these differentiated products involve pricing-to-market).⁴⁷ This is because these goods compete with relatively close (horizontally or vertically differentiated) substitutes and even with sugar confections.⁴⁸

Most of the inputs for chocolate confections are tradable goods (cocoa, milk, sugar, fructose, dry nuts, etc.). Hence exchange rate devaluations only lower unit costs in dollar terms when labor costs have a large incidence in the final price.⁴⁹ If this were the case, real exchange rate appreciations would significantly hamper the ability to sustain exports over time. Macroeconomic fluctuations may also introduce large uncertainty regarding the availability of critical inputs. Hence one of the keys for persistent exports appears to be undertaking a set of actions that insulate export

⁴⁷ Arcor prices to market, sticks to these prices and lets the profit margin adjust to each market.

⁴⁸ Chocolate confections have large income elasticities. When there are large negative income shocks consumers replace higher end chocolates by cheap substitutes such as “fake” chocolates made of hydrogenated palm oil compounds (a replacement for cocoa), sugar confections and cereal bars (this explains the boom of this product in the Argentine market since 1998). An example is provided by Cadbury, which last year sold 8 thousand tons of Bazooka chewing gums vis-à-vis 2500 tons of chocolate in Argentina. They aver that the main targets are the children who face this type of budget constraint: “With AR\$1 they have to choose between one chocolate bar and ten chewing gums”.

⁴⁹ Arcor claims that currency devaluations have neutral and even negative effects on their international competitiveness, due to the relatively large incidence of imported and tradeable inputs (cocoa, some wrapping material, milk, sugar).

profitability from exchange rate and other macroeconomic fluctuations. In the case of Arcor this was done via:

The investment in the most advanced labor-saving technology, which sizably increased productivity, ensured quality, and reduced the vulnerability to exchange rate fluctuations.⁵⁰

The relatively large value added through product differentiation, quality development, marketing and branding, which helped reduce the incidence of labor costs in prices.⁵¹

Upstream and downstream vertical integration. This integration allows the pioneer to increase profit margins (as it must not share rents with suppliers of many key inputs, dealmakers, importers and foreign distributors) and to better absorb negative cost shocks.

Upstream vertical integration, which ensured access to critical domestic inputs even at times of large macroeconomic disarray.⁵²

⁵⁰ Arcor set top-of-the-line production facilities for chocolate confections, particularly the BOB, in 1982, and then new top-of-the-line production facilities and technologies in 1995. Both plants and production lines were the most advanced technology for Latin America at both times. They currently have to expand the production capacity for the BOB, to which end they will set up a new production line with the latest technology and send one of the old production lines to the new plant in Mexico.

⁵¹ Higher prices of chocolate confections through product differentiation and branding substantially helps reduce the incidence of labour costs: the average export price of chocolate products is US\$ 5 per kilo, while the average price of exports of sugar confections, where there is much less product differentiation and branding, is lower than US\$ 1 per kilo.

⁵² During the 80s there were recurrent shortages of critical inputs (packaging, glucose, aluminium wrapping, etc.). Vertical integration guaranteed the supply of these inputs. The vertical integration in glucose was a master stroke, as there was only one multinational supplier of this input, which exerted its monopoly power on local demanders of this input. Additionally, producing glucose by themselves allowed them a better integration in the production of its different goods (sugar confections, chocolates, etc.). They built the glucose plant secretly, as they had to continue purchasing this input from the multinational until their own plant started to operate. Arcor also highlighted the importance of its large bargaining power with suppliers of inputs, which allows them to transfer, at least a part of, profitability losses that may arise from macroeconomic shocks.

As a result of these business strategies, labor costs are a very minor share of costs and prices for Arcor, and reliable access to critical inputs is not a source of concern.⁵³ Among all these factors they consider that a true export success involves brand development and installation, and significant marketing activities, i.e., minimizing the random component of market penetration.

The ability to cultivate multiple (almost 100) markets (and to preserve them) is additionally affected by relatively large fixed costs of exporting, which tend to vary from market to market and very frequently over time. These fixed costs introduce sizable scale economies, which demand a large installed production capacity and that make exporting to different countries viable only if these exports are large enough.⁵⁴

In order to serve all these markets, they must adapt the products, flavors, sizes and/or packaging and labeling to local preferences, pocket change, norms and technical regulations. These adaptations involve a variety of fixed costs (adapting production lines, developing country-specific packaging and labeling, adapting flavors and product contents, certifying products, processes and suppliers).⁵⁵

⁵³ The counterfactual is the lackluster export performance of Georgalos, which exports chocolate confections mostly designed for the domestic market, mostly to neighbouring countries. This firm has an older, more labor-intensive technology that makes labor costs represent 12% of unit prices, which sizably reduces competitiveness. Due to this labor-intensity, Georgalos is very vulnerable to exchange rate fluctuations. For instance, 3 years ago they participated in 4 international fairs, but as labor costs measured in dollars grew steadily since then, this year they are participating in only one international fair.

⁵⁴ Arcor's strategy is to secure massive sales, first through low prices and unit sales, then through brand installation.

⁵⁵ Take for instance the technical regulations regarding labelling. Arcor hires translators for each market that must be knowledgeable not only in translation but also in the technical language of the food sector. It is very difficult and costly to find individuals that meet both requirements. Arcor has developed its network of translators, through contacts in the embassies and in Argentina. These translators are not Arcor's employees and often times do not make the required translations as fast as it is needed, especially when there are sudden changes in the norms for nutritional labelling, like in 2005. Labelling is key for Arcor, they cannot make any mistake. They must be updated on all the laws and regulations, which change very often, in every country of destination. For instance, Mexico changed all the laws and regulations in a two-year time span, and they had to adjust all the labelling and packaging. Then a change in Ecuador came up, which required new adjustments, and so on. The regulations and norms for ingredients and processes also vary from country to country, and over time with high frequency. For instance, the admitted contents and processes for milk chocolate are different in Argentina, Europe and the US. The adaptation of production lines to these different contents and processes entails non-negligible fixed costs. There are also important differences in regulations for designs of packaging. For instance, in some countries the inclusion of a fruit image in the packaging requires that the product has a relatively

All these actions and strategies not only help Arcor sustain exports over time and cultivate multiple markets, but also introduce barriers to entry to competitors in the form of brand barriers, sunk costs, scale economies and technological barriers.

A good example is Arcor's permanent attitude of re-investment of profits, investing in the latest technology, and focusing simultaneously on the domestic and foreign markets. Interviews with less successful Argentine exporters reveal that investing in top-of-the-line technology makes sense if you are thinking of exporting at large scale, and that they are often reluctant to do so because of being unsure as to whether they will succeed in exporting. Arcor appears to commit itself to exporting through the nature of its investments in production and technology.

The impact of these barriers on diffusion will be analyzed later on. Here we can advance that there have been several instances where Arcor has pursued some of these actions with the sole purpose of deterring entry in regional markets.

5.2.6. What impact (actual and potential) did the new exports have on the pioneer and on the sector (knowledge and other spillovers)?

The discovery may have impacts on this sector through different channels. First, it may generate knowledge externalities about the profitability of exporting. Second, it can produce public goods (reputation for Argentine exports, opening markets, investment in infrastructure, etc.). Third, it can lead to the development of specialized inputs network. Fourth, it may generate learning and demands certifications that are then passed on to input suppliers and other producers through the previous two channels. Other firms in the sector may or may not be able to benefit from these potential impacts for reasons that may be related directly to the pioneer's actions, to market imperfections and to the firms' current productivities/scales.

Information revelation:

As discussed in a previous section, Arcor did reveal important information, especially about demand (products and markets) and commercialization strategies that

high minimum content of fruit pulp, whereas in other countries only a negligible content of fruit essence is required. Foreign market characteristics and local preferences introduce additional differences in contents, packaging and sizes, which generate further differences in the fixed costs of exporting to each market.

work best. It also revealed the advantages of undertaking innovative imitation.⁵⁶ As it will be shown when analyzing diffusion, other local producers did not take advantage of this useful information. Instead there are foreign producers, some in South America and others in China, that have used this revealed information to try to compete (with only partial success) with Arcor in some of its products and markets.⁵⁷ This information about products and markets was transmitted through the active presence of the involved firms (especially the foreign ones) in international fairs and in export markets (especially Latin America).

Regarding technical information about production, product and quality development and so on, there appears not to have been much revelation.⁵⁸ Arcor usually designs its own production lines, so as to avoid the transmission of technological knowledge to others via suppliers of capital goods. There has not been a flow of technical personnel from Arcor to other firms either.⁵⁹ Nevertheless, even if it were revealed it would not be much of a knowledge externality, as much of this knowledge is available from suppliers of capital goods, clients and the access to technical training of European experts.⁶⁰ Once this basic knowledge is acquired, the subsequent productivity and quality improvements arise from idiosyncratic learning-by-doing.

⁵⁶ Let us recall, for instance, that it showed the (ex-ante uncertain) advantages of selling bonbons on a per unit basis, or that it created a regional and global market for the BOB.

⁵⁷ Another example is that it showed the preferences of Latin American countries for peanut paste filled bonbons, such as the BOB, which has prompted to Kraft-Lacta and Nestlé-Garoto to compete in this line of products in Latin America. The BOB has also been imitated by Oblita (another firm from the Province of Cordoba), which sells it at half the price in Argentina, but with limited success due to quality problems. Arcor also revealed the BOB to Chinese firms.

⁵⁸ An example of the lack of transmission of technical knowledge is given by the lack of success of Oblibon, an imitation of the BOB for low-price segments of the local market, which has serious quality problems, as the chocolate coating cracks very easily. This occurs because Oblitas has not mastered the technology for double dipping with chocolate the peanut paste filled wafers.

⁵⁹ However Arcor benefited from the incorporation of technical personnel from Aguila when it acquired this firm.

⁶⁰ Georgalos usually brings its technical experts from Spain, Germany and Italy to train their production and product development staff. Additionally, producers usually receive knowledge transfers from multinational firms through contract manufacturing.

Arcor's learning and productivity improvement and its spill-overs:

Exports of chocolate confections brought forth significant productivity gains for Arcor, both in processes and products. The demands of certification of products and processes and of quality improvements from foreign customers (from the US, Europe, the Middle East) forced them to introduce significant improvements in products and processes in all of Arcor plants, leading to great productivity improvements. Additionally, all the new investments geared to expanding production capacity involved equipments with the latest technology, consistently with the foreign demand for quality.⁶¹ The demands of certifications and compliance with norms for contract manufacturing with big firms (WalMart, Nestlé in Brazil, and Brach in the US for sugar confections) are usually more stringent, as the latter face stringent demands of quality, in accordance to their brands and prestige in the market.⁶² As it will be discussed below, some of these productivity and quality gains spilled over to some of Arcor's suppliers of specialized inputs, but lack of export diffusion has allowed Arcor to capture most of these rents.

There were also some internal spillovers from successful chocolate confections to the development of new sugar confections within Arcor, which appear not to have spilled over to other producers/exporters of sweets and candies in Argentina.⁶³

⁶¹ Certifications (ISO 9001, HACCP and GMP) require improving production processes and logistics, making them more efficient. Plants started to operate in a more orderly fashion and the physical facilities were improved (sanitation, temperature management, security). And the new plants were set up anticipating the requirements to certify, based on what was learned from previous certifications, and aiming to rapidly certify the new plants, which led to install top-of-the-line plants.

⁶² Arcor does not use external consulting and training for the certifications, but rather relies on its own resources and previous experience, except for very specific certifications, that are new or strange to them. In the case of the ISO 9000 certification, which was the biggest (and one of the first certifications), and involved a massive revamping of their processes and helped them organize their work, Arcor did work with external auditors and consultants, as adequation to the norm involved a significant change in processes that demanded some time to reach. But once the requirements were learnt and implemented in one plant, Arcor was able to replicate them in all other plants, and to incorporate them to their common management systems.

⁶³ Inspired by the BOB, they have developed a bubble gum with juicy filling (produced under the Blow Up brand in Argentina and the Yahoo brand by Arcor-Brazil), which is an imitation of the Bubbalo (of Cadbury-Adams). Arcor innovated on the original product by adding candy coating that makes them crunchier without losing the interior freshness. They have also given them an oval shape (like

Development of specialized network of suppliers:

Arcor has a large degree of upstream vertical integration (sugar, glucose, fructose, corn, flour, cardboard for packaging), with the goal of ensuring a continuous supply of these inputs with adequate quality, and of controlling costs. But they rely on external suppliers for milk, milk jelly, cocoa, and aluminum and flexible wrappings.

The demands for Arcor's certifications by foreign customers have a cascade effect on Arcor's suppliers, as they have to accommodate their processes and products to the same quality standards that are demanded of Arcor, having to comply with the same norms and technical regulations. Arcor is deeply involved in the development of suppliers, demanding certifications and providing technical assistance to suppliers, taking advantage of the expertise obtained from auditors sent by clients from the US and Europe.⁶⁴ Arcor has a system of evaluating suppliers that is being continuously improved, as they provide assistance to suppliers and their customers increase their quality demands. There is thus an implicit long-term contract between Arcor and its suppliers. The latter benefit from Arcor's continuing auditing, consulting and technical assistance, and tend to work exclusively with Arcor.⁶⁵ Hence the quality improvements in this area do not spill over to other chocolate producers (lack of export diffusion does not contribute either).⁶⁶

a rugby ball) instead of the original one. The innovations were inspired by the BOB. This product, which is an export success for Arcor-Brazil, required three years of development, and they are still experimenting with new markets.

⁶⁴ The stringent quality demands demanded by Arcor (and indirectly by its clients) make it difficult sometimes to obtain suppliers in Argentina.

⁶⁵ Arcor keeps its suppliers updated on the latest developments in quality requirements and auditing. When they have to reject a shipment, they have a very fluid communication with the supplier, assisting it to correct the problems. They lower the grading of the supplier and penalize it, but they do not sever links, as it is difficult to find reliable suppliers. Arcor has an auditing plan, and a great number of people that are continuously travelling to audit suppliers.

⁶⁶ This point is well illustrated by the experience of Ferrero Argentina (the other largest exporter), which initially faced uncertainty regarding continuous and reliable access to some inputs of the required quality, like milk. In the case of milk they started purchasing it at the wrong price and with poor quality, and had to appeal to business contacts and negotiations with large local producers through their

Arcor's external suppliers are mostly in the area of powdered milk, where suppliers and products are continuously audited.⁶⁷ Arcor is currently focusing on the development and quality improvement of its suppliers of powdered milk and milk jelly. They are also devoting substantial effort to the development of suppliers of peanuts, where many suppliers already are very advanced in terms of certifications as several of them are exporting a lot.⁶⁸

Reputation:

The development of these new exports of good and reliable quality by the pioneer, and their persistence over time have helped build a good reputation for Argentine producers of chocolate confections as being able to reliably supply differentiated goods with an adequate combination of price and quality. In the past Argentine producers were viewed mostly as an alternate source of low prices for products with little differentiation. This is a public good generated by Arcor which has been taken advantage of by other Argentine exporters only to a very small extent.⁶⁹

4.1.1 Was it there diffusion of this export activity? What were the key drivers of this diffusion (or lack of)?

Extent of diffusion among firms located in Argentina

involvement in business associations. Through this channel they could negotiate the prices and quality of milk directly with the owners and CEOs of these companies. Georgalos has also stressed the importance of persistence of exports so as to develop long-term relations with suppliers, so that it pays for the latter investing in the development and production of specific ingredients. In fact, there appears to be an important idiosyncratic component in the relations with suppliers of specialized inputs.

⁶⁷ Then the cocoa suppliers ensue, which are also continuously audited (along with the product). They also audit the external supply of packaging (flexible materials and aluminium).

⁶⁸ There is one producer that supplies peanuts to Mars for the M&Ms; Arcor purchases peanuts of similar characteristics from it.

⁶⁹ According to Georgalos this reputation grew as Argentina started to develop products that were designed to meet the requirements of specific markets, with sustained production and exports (quality improvements and presence in the markets and fairs), and product differentiation was increased via marketing.

Code 180690

Descripción: Los demás chocolates y demás preparaciones alimenticias que contengan cacao.

Share (%)

Enterprises	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Arcor S.A.I.C.	78,15	75,47	77,78	49,39	49,74	35,39	28,90	34,54	42,75	40,20	39,42	37,58
Cadbury Stani SAIC.	0,00	0,13	1,38	1,29	0,70	3,07	0,82	1,76	1,34	1,18	1,75	1,52
Chocolates Bariloche S.A.I.C.	0,47	0,44	0,11	0,53	0,06	0,03	0,05	0,00	0,00	0,00	0,00	0,00
Estirenos S.A.	2,10	4,95	3,08	1,72	4,81	8,55	15,73	14,32	6,73	8,73	9,23	9,00
Ferrero Arg. S.A.	3,07	0,21	8,48	43,37	42,19	50,42	52,57	47,34	47,99	47,55	47,90	49,73
Georgalos Hnos.S.A.I.C.A.	1,81	1,96	0,97	1,25	0,91	0,96	0,79	0,02	0,04	0,18	0,14	0,24
Kraft Foods Arg. S.A.	0,80	0,00	0,00	0,00	0,00	0,27	0,11	0,13	0,01	0,12	0,11	0,07
La Delicia Felipe Fort S.A.I.C.Y F	0,08	0,00	0,36	0,45	0,22	0,19	0,13	0,16	0,22	1,20	0,35	0,16
Vealfe S.A.	9,61	12,55	2,91	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Nestlé Arg. S.A.	0,03	0,03	0,01	0,01	0,40	0,02	0,02	0,01	0,01	0,01	0,01	0,01
Total share	96,12	95,75	95,08	98,01	99,04	98,90	99,13	98,28	99,10	99,15	98,91	98,31

Total firms: 197

Selected firms: 10 largest exporters

There has been an almost nil diffusion of the discovery of exports of differentiated chocolate confections among Argentine firms (see Table above).⁷⁰ There emerged only one other major exporter, Ferrero Argentina, the local branch of Ferrero International (a global firm with headquarters in Italy).⁷¹ The other local branches of multinational firms are very minor exporters.⁷² As a result, Arcor (which owns Estirenos as well) and Ferrero represent 97% of all exports.

Exports in dollars

Enterprises	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Arcor S.A.I.C.	11227005	24658999	31735207	33123943	42648658	22441867	19585106	22694595	22531920	20499151	25621572	27347561
Cadbury Stani SAIC.	0	42395	563169	862107	603582	1944150	558925	1153437	706084	599978	1139030	1106199
Chocolates Bariloche S.A.I.C.	67204	144632	46126	358103	48911	21887	32843	0	0	0	0	0
Estirenos S.A.	302303	1618485	1254831	1150729	4125268	5422951	10661624	9412315	3546757	4450321	5998005	6551681
Ferrero Arg. S.A.	441203	69843	3458406	29087307	36173084	31978443	35634210	31111567	25293363	24248470	31127076	36187079
Georgalos Hnos.S.A.I.C.A.	259867	639006	397298	836246	776928	606374	535589	14398	20447	89821	89324	172956
Kraft Foods Arg. S.A.	114917	555	0	3177	2988	173411	77122	86130	7325	62185	71357	51361
La Delicia Felipe Fort S.A.I.C.Y F	10835	0	148158	300786	186417	122037	89692	104171	114991	612124	224585	115029
Vealfe S.A.	1381213	4100184	1188228	0	0	0	0	0	0	0	0	0
Nestlé Arg. S.A.	3902	10809	3442	7029	345195	15108	16184	9360	6118	5191	7802	7504
Total selected	13808449	31284908	38794865	65729427	84911032	62726229	67191294	64585973	52227006	50567240	64278752	71539370
Total exported	14365962	32673966	40800223	67062129	85737650	63421344	67779246	65713571	52703665	50998644	64988924	72772767

Production geared towards import substitution is more diffused among local firms, under the umbrella of Mercosur's common external tariff (23%) and the logistic

⁷⁰ The Argentine firms included among the top ten exporters are Georgalos and Felfort. Chocolates Bariloche was acquired in the early 1990s by the Chilean group Costa-Carozzi.

⁷¹ Estirenos, initially owned by the Chilean firm Dos En Uno (DEU), was already a significant exporter under 1997, when it was acquired by Arcor.

⁷² This group includes Cadbury-Stani and Kraft Foods. Nestlé does not produce chocolates in Argentina (Arcor manufactures some chocolate confections, the "Bananita Dolca" for them through contract manufacturing).

complications of chocolate exports.⁷³ These firms have been either unable or unwilling to take advantage from any knowledge spill-overs and public goods generated by Arcor.

Ferrero set up a new plant (greenfield investment) in 1996, which specialized in the production and exports of a chocolate eggs with toys inside (the Kinder Sorpresa) that was intended both for the local and the global markets from the onset. The other multinationals invested in Argentina mostly with import substitution in mind.⁷⁴

While there has not been a diffusion process in the form of local newcomers taking advantage of Arcor's revealed demand information, its development of specialized input producers network and its contribution to the enhanced reputation of Argentine exports of chocolate confections, it can be argued that diffusion occurred in the form of Arcor purchasing its potential competitors before they replicated its scale and strategies. For instance, Arcor acquired Aguila-Saint, the local leader in the production of chocolates and Dos-En-Uno, the Chilean leader.

Regional and global diffusion

Brazilian firms traditionally targeted mostly their large domestic market, where they sold chocolate tablets and bonbons in assorted boxes.⁷⁵ This did not change

⁷³ Geogalos is the second largest manufacturer of chocolate tablets, industrial chocolates, and chocolate confections in Argentina, and firms like Felfort are very important players in the local market.

⁷⁴ Cadbury set a top of the line production facility in 1995, that produced chocolates of the same quality as those produced in England, aimed mostly towards the domestic market (that had a large willingness and capacity to pay for high end chocolates at that time) and to intra-firm trade (what they call inter-company exports). The Chilean group Dos En Uno bought Estirenos, a plant for the manufacture of plastic products that benefited from an industrial promotion regime in the province of San Luis, and refurbished it for the production of chocolate confections. Its purchase of Estirenos reflected a wave of Chilean acquisitions (Costa bought Chocolates Bariloche, Ambrosoli bought Bonafide). They started producing some of the products they had developed in Chile (to benefit from industrial promotion), that were exported to Chile and from there re-exported to other Latin American countries. One of these products is the Nicolo (Hamlet in Argentina), a chocolate-like tablet made of hydrogenated palm oil (not of cocoa) that has cereals and almonds in it, and which continues to be successfully exported by Arcor to Latin America. Dos En Uno (and its Estirenos plant) was purchased by Arcor in 1997.

⁷⁵ Brazilian firms benefit from the local availability of cocoa, which however is not of prime quality (compared to the cocoa of African origin). They rarely specifically developed products thought for export markets.

initially after the big acquisitions by multinational firms (Kraft purchased Lacta; Nestlé also has a strong presence in Brazil, both with its own brand and with its purchase of Garoto). However, Kraft-Lacta and Nestlé-Garoto in Brazil are currently taking advantage of Arcor's insufficient production capacity for the BOB to supply part of the growing demand for this product in Latin America, using similar sales strategies (sold in units as individual products) and flavor adaptations as Arcor.⁷⁶ These firms are certainly trying to take advantage of Arcor's revealed information. The Chilean firm Dos En Uno, before being acquired by Arcor in 1997, also appears to have benefited from Arcor's revelations regarding best commercialization strategies.⁷⁷ Other regional producers are trying to compete with Arcor in Latin American markets with similar commercial strategies, but without success yet.⁷⁸ It must be stressed once more that Arcor was a pioneer in exporting to (and designing specific products for) Latin America at a large scale.

Chinese firms are currently trying to imitate the BOB, and to compete cost-wise. At the same time Arcor must compete in overseas markets with firms from countries like Turkey, that are becoming very competitive in producing and exporting

⁷⁶ Kraft-Lacta is exporting a product very similar to the BOB under the "Gallito" brand (a leader brand in Central America). Nestlé is exporting the Garoto original version of the BOB. In both cases they are replacing the Brazilian cashew nut paste filling by the peanut paste filling favored by Latin Americans.

⁷⁷ Dos En Uno was considered to be a small replica of Arcor, with a significant commitment to exporting, a strong presence in Latin American markets, somewhat similar commercialization strategies, and focus on a lower quality and price segment, although with brand development (like the Nicolo, a value-for-money product that was, and continues to be, highly successful in markets like Mexico). The acquisition of Dos En Uno arose from a commercial opportunity (it was put on sale by the Chileans), and involved a US\$ 100 million investment by Arcor.

⁷⁸ The Chilean group Costa-Carozzi is very committed to exporting: its overall exports (of which chocolates are still a minor fraction) represent 30-35% of its production, it exports to more than 30 countries, is involved in several horizontally related activities, and even has a commercial and distribution office in the US. They export a relatively narrow range of differentiated chocolate goods without much success thus far. According to Arcor they made a strategic mistake when they acquired Bonafide in Argentina. The Colombian Compañía General de Chocolates is also trying to compete in regional markets.

differentiated chocolate confections that are filled with hazelnut (Turkey generates 70% of the world production of this fruit), which suits well the European preferences, targeting quality and price segments that are similar to those of Arcor.

There thus appears to occur an interesting global export diffusion process from world leaders to Arcor (which performs innovative imitation upon their products), and a limited regional diffusion from Arcor to firms (either local or subsidiaries of multinationals) in neighboring countries, and basically no diffusion to Argentina (except for Ferrero, which did not benefit from any knowledge externality from Arcor, as explained below).

Determinants of extent of diffusion among locals

Given the lack of comparative advantage in chocolate tablets, Argentine firms that wish to export chocolate confections must focus on differentiated products. International markets for these products are teeming with sunk costs and technological, scale, capacity, and brand barriers, introduced both by international firms and by Arcor. Hence the lack of export diffusion among locals appear to reflect the fact that the knowledge externalities and public goods (reputation) provided by Arcor were not large enough vis-à-vis the barriers to entry that they face.

Arcor introduced several of these barriers in the 1980s, anticipating a possible diffusion. To give one example, Arcor executives explicitly stated: “In the 1980s it was recognized the need to generate differentiated products that involve an investment with scale and technology barriers. This led to the development of the BOB and the Butter Toffee (a filled candy), that could not be easily reproduced.” Arcor had also sunk a lot of capital in investment in the latest technology and in vertical integration during the 1980s. This was tremendously costly during crises such as the 1989 hyper-inflation. However they survived and when the 1990s arrived, they were 10-15 years ahead of their competition. They permanently re-invest profits, in order to maintain these barriers. Arcor’s distribution system is another important barrier.

This makes it extremely difficult for small local firms that lack a minimum scale to try to make use of Arcor's commercial spillovers.⁷⁹ They would have to deal simultaneously with brand, scale, sunk costs and technological barriers. Credit constraints do not help either.⁸⁰ Faced with such barriers, they prefer to focus on the domestic market, operate less modern technologies at a lower scale, and make marginal exports to neighboring countries (and some times to farther countries like South Africa and Mexico), not making any significant investment in products specifically developed for foreign markets.⁸¹ Some of them, like Georgalos and Felfort, are experimenting with niches not targeted by the sectoral leaders, like sugarless chocolates, items which are expensive to develop and to produce (because of the need to find palatable artificially sweetened chocolates and the high cost of artificial sweeteners), but do not face brand barriers.⁸²

Not only the barriers to entry mattered, but also the fact that only Arcor appeared to have accumulated capabilities for commercialization in international markets through its experience in the sugar confections industry (both products are very close in the product space of Hausmann and Klinger), and that these capabilities did not spill over to other firms. It is interesting to notice that there is a bigger diffusion of exports in the

⁷⁹ For instance, while Arcor has 300 people devoted to international commercialization *alone*, Georgalos, the second largest producer, has a total number of 600 employees.

⁸⁰ Arcor has traditionally re-invested profits on top-of-the-line technologies. Georgalos relied importantly on external financing, and had a financial crisis in 1995 (concurso de acreedores), when they had an outstanding debt of US\$ 53 millions and no further access to external financing. Since then they have applied their profits to reducing this debt to US\$ 5 millions (they also sold the Mantecol brand –a leading peanut paste based confection- to Cadbury). Until they have not paid back all this debt they will not be able to invest in technological upgrading of production.

⁸¹ Arcor executives highlight that other local producers also lack definition of what their core business is, which leads to a lack of focus (for instance, Felfort is drifting between coffee stores cum confectionary shops, sugarless chocolates, and differentiated chocolate confections). But this is consistent with the impact of the barriers to entry.

⁸² According to Arcor, other local firms could become non-negligible exporters, but it would be a protracted process. They would have to start with a narrow range of products and markets (so as to be able to cope with the fixed costs of exporting that differ by product and by market), and profit from learning economies and progressively acquire scale to jump to other products and markets.

sugar confection sector, but that Arcor was the only firm in this sector that was able to become a successful exporter of chocolate confections. This suggests that indeed the accumulated capabilities were intra-firm.

The case of lack of diffusion among multinationals operating in Argentina (except for Ferrero) is interesting, because they would not be as constrained by barriers to entry as local producers. Arcor argues that this is due to the fact that multinationals operating in Argentina and Latin America lack the commitment to exporting, especially to global markets. Interviews with executives from some of these companies revealed that local branches are at times constrained to export only products that are *currently* profitable, i.e., they cannot decide by themselves to invest in market cultivation. They also consider that it is very difficult to achieve cost competitiveness for exporting from Argentina, due to the lack of cocoa and the logistics difficulties. As such, they concentrate on import substitution and to intra-firm trade whenever they can be cost-competitive vis-à-vis other branches in different countries. The two biggest foreign investments in the chocolate sector were made by Cadbury and by Ferrero.

Cadbury entered Argentina through the purchase of Stani, a local manufacturer of chewing gum, and then decided to invest in a top-of-the-line technology for chocolates (with the same quality as in England) in 1995, both because that is their core business and because there was at the time a willingness and capacity to pay for expensive chocolate tablets in Argentina. However, they consider that they should have invested in less advanced and more versatile technology aimed at producing less expensive chocolates more suitable for the domestic and regional market. They currently export to Chile and Uruguay, and do some sporadic intra-firm exports.⁸³

Ferrero discovered the Argentine market through a distribution contract in 1993-94 with Terrabusi, a local producer of confectionary products, for the import of Ferrero products. Under this scheme Ferrero's sales jumped from US\$ 4 million to US\$ 70 million in a short period of time, which prompted them to set up a plant in 1996 to produce for the domestic and world markets. This plant specializes in the production of

⁸³ Georgalos has pointed out that Cadbury Argentina is now trying to increase its exports to Chile, but their perception is that they have targeted late this market (which is already dominated by Arcor and by Georgalos to a much lesser extent), which may reduce its chances of success.

Kinder Surprise (KS; a hollow chocolate egg with a surprise toy inside).⁸⁴ The decision of setting up this plant in Argentina rather than in Brazil was based on the favorable regulatory environment at the time, the local ability and willingness to pay for these high end chocolate confections, Mercosur's high common external tariff, and the need that Ferrero had to install another KS plant from which to serve global markets.⁸⁵ A key factor was their expectation to have access to the benefits of the "Ley de Especialización Industrial," which favored the specialization in the export of a narrow range of goods, by giving extra export drawbacks and allowing to import other products, in a certain proportion to the increase in exports, at very low tariffs (2%). Ferrero had the alternative to invest in a multi-product plant of smaller scale, oriented to the domestic market and Mercosur but chose not to do so in the expectation of having access to the benefits of the Ley de Especialización Industrial, which they finally could not obtain.⁸⁶ These investments made it the only other major exporter from Argentina, especially after the domestic market shrunk sizably after 1998. However, they consider that this is not a sustainable endeavor and that they should have aimed for a Mercosur-oriented investment.⁸⁷ It must be stressed that Ferrero's investment was not led at all by

⁸⁴ The amount spent on this greenfield investment reached US\$ 80 millions.

⁸⁵ The other plants of Ferrero for the production of KS are located in Germany, Belgium, Poland and Italy. It must be highlighted that Ferrero has another plant in Brazil that specializes in Ferrero Rocher (a hazelnut filled bonbon) for world markets and a plant in Venezuela that specializes in the production of Noggy (another confection) for world markets. The other plants of Ferrero for the production of KS are located in Germany, Belgium, Poland and Italy. It must be highlighted that Ferrero has another plant in Brazil that specializes in Ferrero Rocher (a hazelnut filled bonbon) for world markets and a plant in Venezuela that specializes in the production of Noggy (another confection) for world markets.

⁸⁶ Arcor lobbied against the granting of these benefits to Ferrero on the correct grounds that the latter did not have a previous production and export history in Argentina, and hence did not have *incremental* exports. They did so because they did not wish to have Ferrero competing in the local market with quality sugar confections imported at low tariffs.

⁸⁷ This endeavor may eventually come to an end, as the world product cycle for KS appears to be in the downward phase. As world demand shrinks (because of the displacement of KS by other competing products) Ferrero International could opt to shut down Ferrero Argentina before the European plants. Logistics, transportation and production costs currently do not favor Argentina over the other KS plants,

any knowledge externality generated by Arcor; it rather seems to reflect a strategic mistake. In turn Ferrero's exports did not generate any important knowledge externality to other producers/exporters in Argentina.⁸⁸

Determinants of the extent of regional diffusion:

As mentioned above, some Brazilian branches of multinationals are trying to imitate the BOB and to compete with this type of product in Latin American markets. This is different from the behavior of MNCs operating in Argentina, and appears to reflect their bigger scale economies and accumulated capabilities (from operating in the large Brazilian market), which make it easier to try to overcome the entry barriers imposed by Arcor. The local availability of cocoa probably helps as well. The knowledge externality generated by Arcor very likely made these exports profitable enough to be approved by their headquarters.

However, the evidence collected here suggests that these attempts have been made possible only because of Arcor's temporary capacity constraints, which relaxed one very important barrier to entry. Arcor's reaction is to make substantial new capacity

with which it competes as an exporter. They have already moved much of the managerial staff from Argentina to Ecuador.

⁸⁸ Ferrero did not experiment in foreign market discovery either. Ferrero Argentina exports to commercial representations of Ferrero International in different markets. The decision to serve a given market from Argentina is guided by issues such as costs of logistics and transportation, and bilateral trade preferences that the country may enjoy (like in Canada, that imposes a 20% tariff on these goods, that is reduced to 6% for imports originating in Argentina; something similar happens in China). Then the commercial representations in each market take care of marketing and commercialization. Ferrero Argentina must of course have competitive costs and prices vis-à-vis the plants in Europe. Ferrero Argentina "imports" the brands and reputation of Ferrero International. It appears that Ferrero actually revealed some product and market information to the pioneer. Arcor imitated the KS with a lower-price, lower-quality (actually made of hydrogenated palm oil instead of cocoa) hollow egg with surprises inside, called Toys. This product has not been very successful in the domestic market because of its lower quality (the toys, which are imported from China, do not compete with the excellent quality of Ferrero's), and it is being exported to markets where the KS is relatively expensive (Latin America and a bit to Russia). Arcor has to overcome the hurdle that it is complex to export relatively inexpensive hollow chocolate eggs, because of the large freight costs involved and the costs of refrigeration.

investments to defend this brand.⁸⁹ Another strategy used to block regional diffusion has been to target marketing to children through the purchase of international licenses for stickers of characters like Superman or Pokemon that are attached to the packaging.⁹⁰ Arcor does so because it considers that these firms cannot compete with it because they can commit only to exporting to regional markets, and lack Arcor's scale in order to be able to compete price- and cost-wise at a global level.⁹¹

Counterfactual analysis of lack of diffusion

A counterfactual comparison with the exports of sugar confections helps shed further light on the determinants of the lack of diffusion of chocolate confection exports. As mentioned above, Arcor first targeted sugar confections because Argentina had a natural comparative advantage for its production and because there were no significant brand barriers to entry, i.e., there was less need to differentiate products and to invest in demand discovery. Sugar and chocolate confections are horizontally related both through sharing similar consumer targets, commercialization venues and several inputs, which makes them natural complements (they are very close to each other in HK product space). However the latter compete in a market with more brand barriers and product differentiation, and Argentina does not enjoy a natural comparative advantage

⁸⁹ In response to Kraft-Lacta's attempt to compete against the BOB in Latin America, Arcor is investing US\$ 50 million in a new production line (top-of-the-line technology), which is a tremendous amount for a product with a low unit price. Arcor is set to fiercely defend the BOB brand, and to maintain its scale and cost leadership in the region, and to reverse their temporary loss of ground because of insufficient production capacity.

⁹⁰ Arcor exports chocolate tablets with some international license for stickers (Superman, Pokemon), which allows it to capture markets where no other firm has these licenses. In this case there is no need to differentiate the product (which is a commodity) or to install a brand, what differentiates it is the international license. Arcor's size grants them large bargaining power for the purchase of the license for many countries. There are markets where they compete with other large players in this type of products, like in Brazil where Nestlé has several licenses. But Central America was targeted only by Arcor, which is the leader in the export of licensed products.

⁹¹ The Chilean groups (Costa-Carozzi, Ambrosoli) that try to replicate Arcor's commercialization strategies also started with some minimum scale acquired in horizontally related activities, and are considered by Arcor to be potentially more threatening because of their commitment to exporting both to regional and global markets.

in their production. This is reflected in the fact that Arcor's average export price of chocolate products is US\$ 5 per kilo, while the average price of exports of sugar confections, where there is much less product differentiation and branding, is lower than US\$ 1 per kilo.

**Exports of sugar confections
Share (%)**

Enterprises	2004	2005	2006
ARCOR S.A.I.C.	75,5	73,0	68,1
ESTIRENOS S.A.	10,1	9,7	10,0
CANDY SOCIEDAD ANONIMA	0,1	2,5	5,9
CADBURY STANI SAIC.	3,3	4,7	5,5
ALICA SOCIEDAD ANONIMA	3,5	2,5	2,7
PRODUCTOS LIPO SOCIEDAD ANONIMA	2,9	2,6	2,4
BONAFIDE GOLOSINAS S.A.	1,6	1,4	1,6
LHERITIER ARGENTINA S.A.	1,1	1,0	1,1
CHOCOLATES LACASA ARGENTINA S.A.	0,3	0,4	0,5
FERRERO ARGENTINA S.A.	0,2	0,2	0,4
Total share	98,6	98,0	98,2

Total firms: 75

Selectionated firms: 10

Exports in dollars

Enterprises	2004	2005	2006
ARCOR S.A.I.C.	57.161.100	55.762.125	41.027.015
ESTIRENOS S.A.	7.668.845	7.405.368	6.034.985
CANDY SOCIEDAD ANONIMA	98.173	1.894.323	3.554.596
CADBURY STANI SAIC.	2.520.562	3.623.702	3.334.178
ALICA SOCIEDAD ANONIMA	2.684.694	1.876.838	1.597.769
PRODUCTOS LIPO SOCIEDAD ANONIMA	2.159.116	1.969.110	1.432.561
BONAFIDE GOLOSINAS S.A.	1.209.929	1.095.006	993.383
LHERITIER ARGENTINA S.A.	825.349	782.482	685.294
CHOCOLATES LACASA ARGENTINA S.A.	221.246	322.148	282.859
FERRERO ARGENTINA S.A.	139.666	178.355	244.585
Total selected	74.688.683	74.909.458	59.187.227
Total exported	75.739.983	76.402.290	60.246.607

In this vein it is worth highlighting that there is a bigger diffusion of exports of sugar confections. While Arcor represents 78% of all these foreign sales, there are six other firms (five domestic and one multinational firm) with exports that exceed US\$ 1 million and which represent 19.25% of these sales. In contrast there are only three firms that export more than US\$ 1 million in the chocolate confection sector, and two of them (which are multinationals) appear to be the result of wrong business decisions. In the case of alfajores, another horizontally related activity in which Argentina enjoys a

natural comparative advantage, we observe that Arcor represents only 39% of exports while the next four exporters account for 55% of these sales.

Alfajores

Exports in dollars

Enterprises	2005	2006
COMPANIA AMERICANA DE ALIMENTOS S.A.		1.248.605
KRAFT FOODS ARGENTINA S.A.	693.175	916.801
HAVANNA SA.	388.713	470.252
ARCOR S.A.I.C.	1.280.533	392.989
MAYCAR SOCIEDAD ANONIMA	192.269	119.107
NEW-CREAM SRL.	18.519	97.610
SUPERMERCADOS MAYORISTAS YAGUAR SA.	35.105	65.897
POSTRES BALCARCE S.A.	38.630	33.485
DIELO SOCIEDAD ANONIMA	27.001	18.515
CARREFOUR ARGENTINA SA.		12.600
Total selected	2.673.944	3.375.860
Total exported	3.252.417	4.249.027

Share (%)

Enterprises	2005	2006
COMPANIA AMERICANA DE ALIMENTOS S.A.	0,0	29,4
KRAFT FOODS ARGENTINA S.A.	21,3	21,6
HAVANNA SA.	12,0	11,1
ARCOR S.A.I.C.	39,4	9,2
MAYCAR SOCIEDAD ANONIMA	5,9	2,8
NEW-CREAM SRL.	0,6	2,3
SUPERMERCADOS MAYORISTAS YAGUAR SA.	1,1	1,6
POSTRES BALCARCE S.A.	1,2	0,8
DIELO SOCIEDAD ANONIMA	0,8	0,4
CARREFOUR ARGENTINA SA.	0,0	0,3
Total share	82,2	79,5

Total firms: 33

Selected firms: 10

A quick comparison of the export history of the sugar and chocolate confections sectors would suggest that the lack of natural comparative advantage and the existence of important brand barriers and product differentiation in the chocolate confection industry are what hurt diffusion the most.

5.2.7. Roles of previously accumulated capabilities, industry specific public goods and public policies

The discovery of chocolate confections was built upon the capabilities accumulated in the production and commercialization of chocolate tablets and

confections for the local market under import substitution and the capabilities accumulated in the commercialization of sugar confections.

Arcor benefited strongly from the capabilities for the production of chocolate tablets and confections accumulated by Aguila-Saint, the previous leader in the domestic market, when it acquired this firm (which had been producing these goods since the 1880s) in the early 1990s. Aguila-Saint's acquisition also brought forth an understanding of the importance of focus for market cultivation, which proved to be very important for the export success of Arcor. The pioneer also took advantage of its own accumulated capabilities in the commercialization of sugar confections, and from the cost advantages granted by its scale in this last product and the associated bargaining power with suppliers, many of which were shared with chocolate confections (milk, milk jelly, flour).

Looking at HK's product space we can observe that the probability of exporting chocolate confections is also positively associated to the exports of products where Argentina has a natural comparative advantage, such as margarine, bakery products, cheese and curd and oil seeds, and in which Argentina had accumulated production and export capabilities.

It is interesting to notice that all the accumulated capabilities coalesced into a single firm (both through Arcor's own accumulated capabilities and through the acquisition of other firms). This is consistent with a world market structure where there one or at most two major producers and exporters per country (Mars and Hershey's in the US, Ferrero in Italy, Lindt in Switzerland, Cadbury in Germany, etc.), and where branding, scale and sunk costs are barriers to entry to most markets.

Some of the industry-specific public goods (food safety agency, basic logistics for food industry, skilled personnel) were already in place because of Argentina's tradition in the production and export of related foodstuffs. Other industry-specific public goods (laboratories, access to reliable packaging supply) were internally provided by Arcor, which fully internalized the benefits of having access to them.

There was no significant government intervention behind the emergence of this new export activity. Industrial promotion regimes influenced the location of some production plants, but were not necessary for their success. Arcor avers that one

distinctive feature of Argentina is that it does not grant special support for international competition to large global firms like them, quite the opposite to what Brazil does.

5.3. Welfare analysis

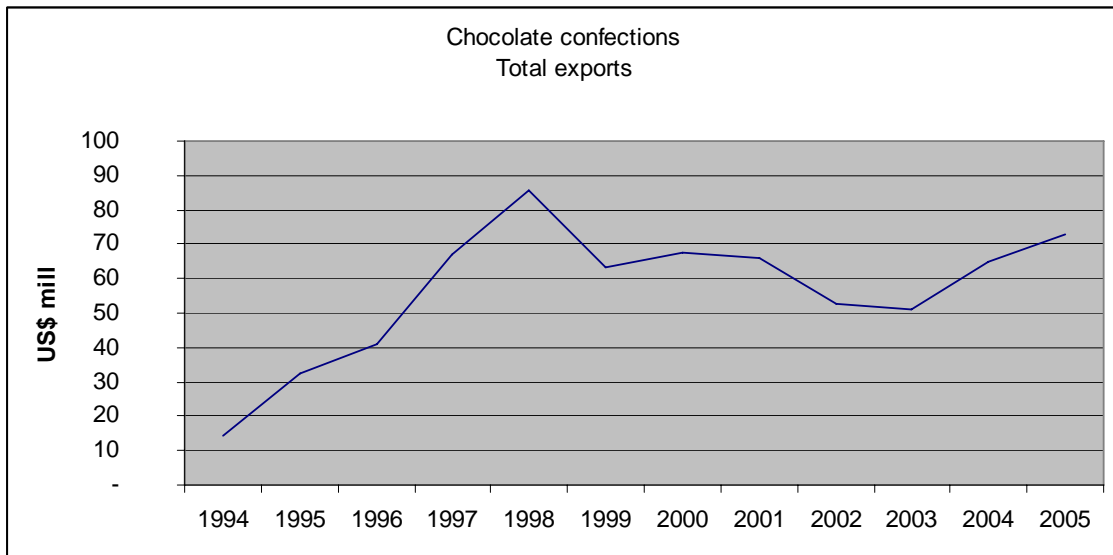
In this case there does not appear that ex-ante investment in discovery was too small due to information externalities. This was due to Arcor's ability to introduce barriers to entry, which helped it capture the discovery rents.

It is hard to argue that too little diffusion is inefficient in this case. First because these are differentiated products with downward sloping demands, and it is not clear if Argentine newcomers that sank capital in brand development, etc., would be stealing profits from foreign competitors or from Arcor. The fact that Arcor's future export growth appears to be tied to the opening of new markets rather than expanding sales in its current markets (stealing demand from foreign competitors) suggests that diffusion could even be "immiserizing," by duplicating sunk costs and splitting demand among more Argentine exporters.⁹² To this we must add that export expansion does not appear to generate technological spillovers and other spillovers in the form of the development of specialized input markets. In this vein, Arcor's could be introducing "barriers to poors" rather than "barriers to riches."

This case study fits nicely into Vettas (2000) framework for analyzing discovery and diffusion of new exports when there are information revelation about demand and demand shifting effects. In this case the pioneer reveals information on the extent of foreign demand, allowing an update of the beliefs about the saturation point, and its subsequent export increases further enhance this knowledge. Additionally, because of enhanced reputation (helped by marketing efforts), the demand curve moves to the right as exports grow (up to the market saturation point). Because of these two externalities, the competitive market equilibrium would display too little investment by the pioneer and too slow export growth at the beginning, and the pioneer would export only if it were profitable to do so even with the small initial demand. On the other hand, a social

⁹² Newcomers would probably steal some demand from Arcor and some demand from foreign competitors, while probably leading to bigger sunk costs and investment in excess capacity as barrier to entry.

planner or a monopolist would internalize these externalities and invest even if initial sales are unprofitable, as long as the demand shifting effect is large enough. What is more, they would want a very fast expansion of sales.



This clearly fits the case of chocolate confections in Argentina. Arcor acted as a monopolist, speeding up export growth at the beginning (to take advantage of reputation effects), and then slowing down as it learned that the saturation points became near. Indeed Arcor claims that their markets are currently saturated and that the only way for their exports to grow is by opening new markets or by developing new export products.

This is also a case where the pioneer appears to face a smaller demand uncertainty (because of its commercialization capabilities accumulated in sugar confections) and a bigger ability to overcome coordination failures by itself. These traits make initial sales more profitable in expected terms (and less uncertain) than for other local competitors, prompting it to make big investments. As a result there would potentially be large information and coordination externalities, which fail to materialize because of the introduction of barriers to entry.

It is interesting to notice that in this case monopoly substitutes for the need to subsidize infant export industries to fully exploit the information and demand shifting externalities in competitive market equilibrium, as proposed by Vettas. However two qualifications must be made. First, demand information externalities have a cross-border nature in the case of chocolate confections, in which case it is not clear that one would want to subsidize this activity in competitive market equilibrium. Second, a

monopolist such as Arcor can deal with these cross-border externalities by introducing brand and technology barriers to entry. Subsidization to small firms in a competitive equilibrium would probably require the introduction of strategic trade policies to deter the entry of foreign competitors, making uncertain the final welfare effect.

Arcor's choice of new exports to target was driven by the scale and prior knowledge attained in the sugar confection industry, which both lowered the costs of experimentation and also offered bigger possibilities of capturing rents by the pioneer. The little technological spillovers, development of open-to-all network of specialized inputs suppliers, etc., could suggest that this may not have been an activity with a large social return. However there are several arguments that counter this assertion. First, the presence of a monopolist led to an optimal path of investment and export growth in the presence of demand information and demand shifting externalities and allowed to offset the cross-border externalities. Second, this monopoly power in the new export has allowed an important profit-shifting from foreign competitors. Third, this new activity is allowing the accumulation of capabilities for jumping to more sophisticated products both within this industry and in other areas. Arcor's learning-by-doing and learning-by-exporting are allowing it to focus now on R&D to develop original products (instead of just doing innovative imitation) with which to target markets usually served by rich country firms. Additionally, HK's product space shows that the exports of chocolate confections appear in the periphery of the densest part of this space. Accumulation of capabilities in the exports of chocolate confections appears as favorable for jumping to the exports of goods such as "paper and paperboard, corrugated, creped, crinkled, etc.," "articles for the conveyance of packing of goods," "articles of paper pulp, paper, paperboard, cellular wadding," "aluminum and aluminum alloys, worked," "reservoirs, tanks, vats and similar containers," "casks, drums, boxes of iron/steel for packing goods," and "structures and parts of structures, iron/steel plates." Most of these neighboring goods can be described as related directly or indirectly to packing, which is naturally related to chocolate confections and to sugar confections. Some of these goods are already being exported from Argentina (mostly those in the aluminum industry). What is interesting is the possibility that the combination of exports of sugar and chocolate confections together with the accumulated capabilities in the production of

aluminum and paper products may lead to the production and exports of more elaborated wrapping and packing material for these types of goods.

The fact that the accumulation of capabilities occurs within a firm responds to the industrial organization of this product's world markets, and should not demean its contribution to economic development. Hence we should not be concerned about the fact that there was no diffusion in this particular new industry. We should be more concerned about the possibility that most new successful export activities in Argentina are discovered only when the pioneer can introduce barriers to entry, because of inadequate public policies, investments and institutions.

5.4. Conclusions for chocolate confections

In these conclusions we stylize the case study by evaluating how it fits into our theoretical framework. Thus far we conclude that these new exports were targeted because of:

Accumulated capabilities in the sugar confections exports, especially in the area of commercialization, and in other related foodstuff exports.

Strong complementarity with sugar confections in the area of commercialization.

Ex-ante productivity advantages of the pioneer (from prior knowledge or scale in related activities) that will persist even after the new activity has been discovered to be profitable.

The pioneer's ability, arising from scale and prior knowledge in horizontally related activities, to introduce barriers to entry (product differentiation, brand development, sunk costs, scale economies, technological barriers).

There were sizable uncertainties regarding foreign demand and commercialization strategies that the pioneer solved via a market experimentation process that was facilitated by its scale and prior knowledge in sugar confections. Key among the strategies that allowed for a successful discovery were the practice of innovative imitation (by focusing on products that are already established in some market they eliminate one source of uncertainty) and their focus on experimenting with a narrow set of goods.

Other local firms could not benefit from these knowledge externalities due to the barriers to entry introduced by the pioneer and other international players, and to the uneven distribution of prior knowledge and scale in horizontally related activities among firms in this sector. These barriers have been less binding for competing firms in neighboring countries, which have tried to take advantage of Arcor's revealed information.

A comparison with the sugar confections sector, where there has been bigger diffusion, suggests that the biggest hurdles to diffusion for chocolate confections are the lack of a natural comparative advantage and the presence of product differentiation and significant brand and technology barriers. Our welfare analysis suggests that this lack of diffusion is not necessarily inefficient, and that it may actually be efficiency enhancing.

A final important conclusion is that this case study reveals the importance a given country of entering early into new differentiated product markets where there are important barriers to entry. Once Arcor entered and developed its own markets and protected them with brand and technology barriers, it became very difficult for other regional competitors to challenge it. Had Arcor tried to enter later, it is possible that some other Latin American firm could have already captured these markets. In such scenario, the success of the new export would have been more difficult in spite of the accumulated capabilities in related exports.

6. Case study of biotechnology applied to human health (BHH)

6.1. Background information

BHH in the world

Biotechnological advances in human health have been revolutionary. While in 1995 there were only 15 biotechnological drugs in the world markets that number has grown to 80 nowadays. Some examples are human insulin, hepatitis B vaccine, EPO, G-CSF, and human growth hormone, among others.⁹³

This technology allows obtaining big quantities of therapeutic proteins that in the past could only be extracted in small amounts. The process to obtain the proteins includes fermentation, extraction, purification and formulation. In human health care, biotechnology products include diagnostic tests, antibiotics, therapies and vaccines.⁹⁴

The importance of biotechnology in the pharmaceutical sector is becoming very significant: 7 out of 50 of the main pharmaceutical products sold in the world were biotechnological in 2003. The combined sales of these 7 products reached US\$ 15 billion, more than 10% of total sales (US\$129 billion) of the 50 main medicines.⁹⁵

⁹³ Biotechnology is a collection of technologies that entail the use of cellular and bimolecular processes to solve problems or make useful products. To these ends it takes advantage of the fact that the DNA information manual of one cell can be read and implemented by cells from other living things and the genetic instructions to make a certain protein are understood by many different types of cells.

⁹⁴ Biotechnology-based diagnostic tools allow for quicker and more accurate tests. Tuberculosis, AIDS and many other infectious illnesses can be diagnosed in a few hours using these types of techniques instead of several days or weeks using traditional methods. Biotechnology also makes possible improved versions of today's therapeutic regimes by reducing side effects, in cases of cancer or other illnesses. Besides, it allows treatments that would not be possible without these new techniques. Therapeutics include using natural products, replacing missing proteins, using genes to treat diseases (gene therapy), cell transplants, stimulating the immune system, suppressing the immune system, xenotransplantation, using biopolymers as medical devices and regenerative medicine (tissue engineering).

⁹⁵ Besides, more than 370 medicines and biotechnological vaccines are actually going through the stage of clinic tests. They are aiming to fight more than 200 illnesses such as different kinds of cancer, Alzheimer, AIDS, arthritis, among others.

The main hurdles for participating in BHH targeted to rich country markets via the development of original new products are the high research, development and commercialization costs, which on average represent around US\$ 800 million per new product. Furthermore, the R&D success rates for innovative projects are normally less than one in a thousand

Although an important part of the research in rich countries is done by small new biotechnological labs, the discoveries end up being adopted by big corporations (by license agreements), because these new firms cannot face the high costs that these developments entail.

In biotechnology there is no possibility of copying. Even if the product already exists and it is not protected by patents in certain markets, the laboratory that wants to produce it has to develop it completely from scratch through costly R&D (the only known thing is the final product to which they should arrive). However, the success rate for this kind of developments is much higher than for innovative BHH products: about one third of the bio-generic projects succeed if the right research team is assembled.

BHH in Argentina

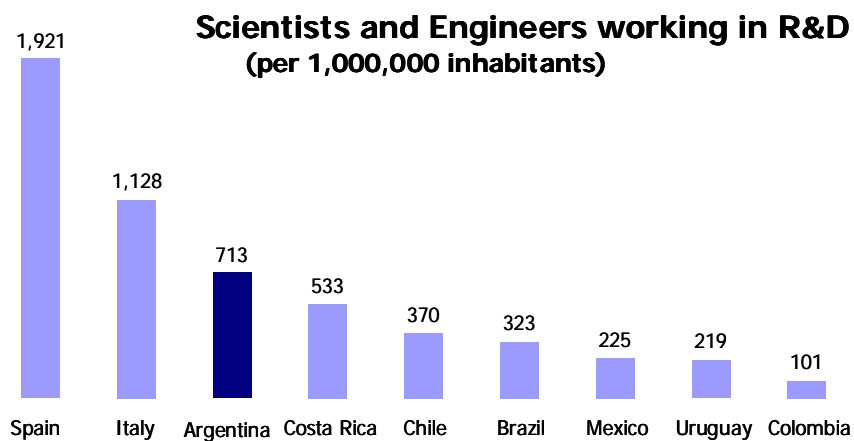
The application of biotechnology to human health in Argentina is focused in two big areas: biopharmaceuticals and diagnostic reactivities. The main biopharmaceuticals produced in Argentina are human erythropoietin, human interferons, G-CSF and growth hormones.⁹⁶ These products are sold both domestically and abroad. Diagnostic reactivities are sold mostly in the domestic market.⁹⁷

As this work aims to analyze the segments of BHH that are exported from Argentina, we will focus on biopharmaceuticals. This segment started to be targeted by

⁹⁶ Biopharmaceuticals include different types of antibiotics, the interferons alpha, beta, gamma and r, the erythropoietin, the human insulin, the G-CSF (granulocyte colony stimulating factor), anti-hepatitis B vaccines and anti-haemophilus, human growth hormones, timosine, interleukine-2, epidermic growth factor and calcitonine.

⁹⁷ The diagnostic reactivities produced in Argentina include products that focus on molecular oncology, determination of antigens of leukocytary differentiation, genetic predisposition to heritage illnesses, cholera diagnoses, infectious illnesses, HIV, hepatitis B and C, “mal de Chagas”, among others. These products are sold mostly in the domestic market.

the national pharmaceuticals industry during the 80's through biotechnology developments which became mature a decade later. The presence of pre-existing national pharmaceutical laboratories (a feature that sets Argentina apart from most other countries in the region) with a long tradition in production, and even in exports in some cases, of medicinal drugs facilitated the takeoff of BHH in Argentina, where it started earlier than in other comparable (and even richer) countries. The fact that these national pharmaceutical had resources to finance medium and long term R&D activities was key. Moreover, many of these labs had accumulated important capabilities in terms of adapting the Argentine pharmaceutical industry to the characteristics and needs of the developing countries markets. These accumulated capabilities gave them an edge for targeting these markets, which were underserved by the rich country laboratories. For instance, as a consequence of the field research done during decades, national labs had developed an ample knowledge of regional illnesses, which tend to be present in most developing countries.

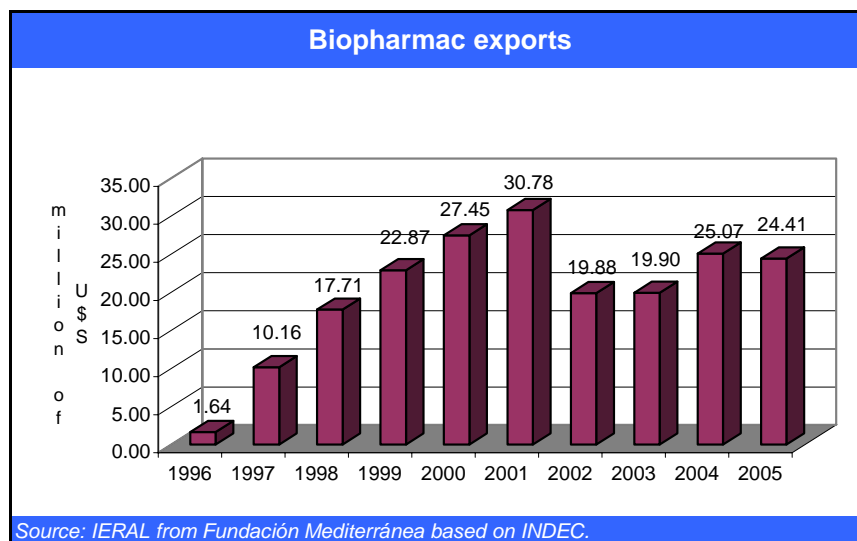


Source: ADI based on UNESCO data

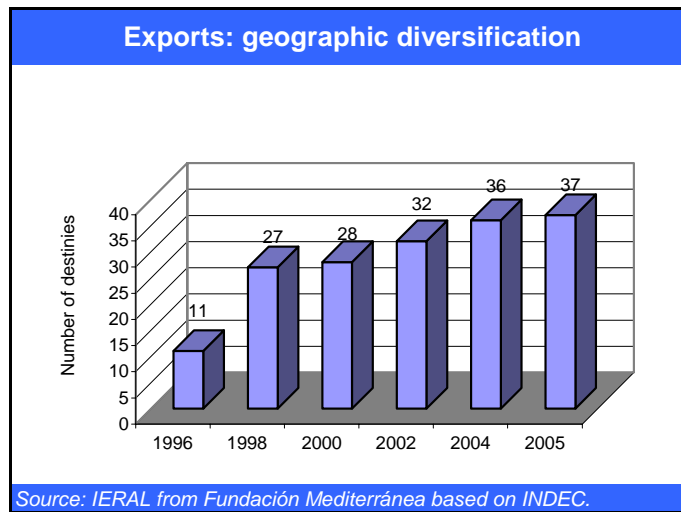
Argentina also benefited from its relatively large endowment of scientifically skilled human resources engaged in biological and medical research. Argentina stands out not only for the quality of its scientists but also for the quality of the available lab technicians. Argentina was missing one important capability that is the availability of local researchers in the pharmaceutical industry, which were not present because national labs were engaged in reverse engineering of existing drugs (that requires no

research effort). Access to local experience in pharmaceutical research would have accelerated the process of successfully developing BHH products. However, the availability of graduates in life sciences, although lacking experience in pharmaceutical research, provided an adequate basis for forming high quality research teams under the surveillance of some researchers with pharmaceutical experience that were brought from abroad. This endowment of scientists allowed the emergence of the sector in Argentina ahead of countries such as Brazil and Chile, which lacked these resources in the early '80s (they have recently reversed this drawback and are currently better endowed than Argentina).

Argentine biopharmaceuticals rapidly gained world market shares during the mid 90s. In just 10 years international sales of these types of BHH products rose from US\$ 1.6 million to approximately US\$ 25 million.



Argentina's exports of biopharmaceuticals not only grew very rapidly, but also showed a remarkable geographic diversification. The number of destinations for these exports jumped from only 11 countries in 1996 to 40 countries nowadays.



This diversification also helped reduce the geographic concentration of exports, reducing the share of exports to Brazil from 65% in 1998 to less than 25% nowadays.

The main export destinations are South American countries (66% of total sales in 2005), the East Asian countries (around 20%) and the Middle East. Id est, Argentinean biopharmaceutical exports are sold to intermediate development countries.⁹⁸

EXPORTS BY MAIN DESTINIES*.

In dollars

Destinies	1996	1998	2000	2002	2004	2005
Brasil	480,091.0	10,107,537.7	17,799,421.5	6,047,294.4	8,421,031.5	6,391,661.0
Uruguay	531,261.0	1,578,979.1	2,772,972.7	1,810,634.3	1,892,853.0	3,364,470.0
Thailandia	0.0	242,480.0	919,484.8	2,588,794.9	3,385,259.4	2,355,288.5
Colombia	27,000.0	1,330,062.0	161,462.6	1,556,100.4	1,106,106.2	1,936,571.1
Peru	0.0	155,737.0	242,839.9	623,829.2	642,425.7	1,322,637.7
India	99,000.0	681,502.0	498,192.0	608,779.5	722,280.6	1,161,874.6
Pakistan	0.0	0.0	0.0	13,078.4	534,499.5	1,029,374.4
Chile	34,520.0	106,660.3	421,065.5	532,858.8	555,384.7	898,099.9
Paraguay	241,921.0	914,482.8	1,589,297.9	930,574.4	750,972.9	883,605.3
Libano	0.0	68,080.0	100,001.0	547,815.3	462,000.0	657,716.0
Venezuela	0.0	556,947.0	61,659.0	1,277,458.2	1,747,603.7	608,631.2
Ecuador	0.0	14,630.0	37,125.0	168,224.5	264,668.7	529,331.3
Panama	0.0	0.0	40,717.7	243,305.9	530,418.7	480,641.8
Francia	0.0	128,870.0	0.0	0.0	1,097,180.0	432,099.7
República Dominicana	0.0	1,842.0	92,731.3	111,877.8	128,533.0	383,604.6
ZF Montevideo	0.0	0.0	23,070.0	101,034.1	144,073.3	374,824.4
Bolivia	16,670.0	72,566.4	342,882.1	685,496.6	360,957.6	262,234.2
Jordania	0.0	181,940.7	63,743.2	52,904.5	192,970.7	232,841.0
Guatemala	0.0	22,916.3	153,506.0	180,713.1	146,988.7	189,372.8
Tunez	0.0	0.0	0.0	0.0	0.0	150,000.0
Canada	0.0	0.0	34,749.2	3,860.3	66,082.0	133,279.5
México	61,080.0	625,683.0	1,819,300.0	1,437,326.5	1,305,984.7	122,752.6
Suma	483,580.0	16,792,914.2	27,176,021.2	19,523,863.1	24,460,271.4	23,902,916.4
Otros	151,250.0	920,353.8	271,200.7	354,265.3	609,240.0	502,223.1
Total General	1,644,789.0	17,713,268.0	27,447,221.9	19,878,128.4	25,069,511.3	24,405,139.5

⁹⁸ The

* Includes countries whose exports surpass US\$ 100,000
 Source: IERAL based on INDEC
 developments whose final market are rich countries.

6.2. Analysis of the emergence of this export sector⁹⁹

6.2.1. Who was the pioneer? Why did it target this new activity?

The pioneer for producing and exporting BHH products in Argentina is Bio Sidus, which is a spin off of Sidus, a relatively large domestic pharmaceutical laboratory with a long tradition of producing traditional human health products (mostly generic drugs). Sidus is also involved in horizontally related biotechnological activities, applied to plants and to animals, through spin offs in these areas.¹⁰⁰

Their initial developments and exports included the interferon-alpha (the first development) and the erythropoietin (EPO) (the firm's main export product).¹⁰¹ Its first developments took place shortly after this activity emerged in industrialized countries, and preceded several years those of other Argentine firms that managed to develop

⁹⁹ The analysis is based on interviews with Bio Sidus executives (Carlos Melo, R&D Manager), Laboratorio Pablo Cassará executives (Jorge Cassará), Foro Argentino de Biotecnología executives (Juan Dellacha, Science Director; Maria Marta de Mc Carthy, Manager), Biocientífica (Diagnosis biotechnology) executives (Daniel Villamayor), Elea executives (Dr. Hector Ostrowski, R&D Manager Director), Massone executives (Raúl Massone), Foro de Biotecnología (J.Carlos Villalpando).

¹⁰⁰ For instance, its research in plant cloning via its plant biotechnology firm, Tecnoplant, led it to enter the blueberries business, where it currently is one of the two sectoral leaders in production and exports.

¹⁰¹ The development of the interferon alpha is relatively easy, but its market is relatively small. On the other hand, EPO is harder to develop, but it has a much larger market.

similar saleable BHH products.¹⁰² Bio Sidus was also a pioneer at a developing country level.

¹⁰² EPO is a glycoprotein hormone that is a cytokine for erythrocyte (red blood cell) precursors in the bone marrow. Also called hematopoietin or hemopoietin, it is produced by the kidney, and is the hormone regulating red blood cell production. Erythropoietin is available as a therapeutic agent produced by recombinant DNA technology in mammalian cell culture. It is used in treating anemia resulting from chronic renal failure or from cancer chemotherapy. Its use is also believed to be common as a blood doping agent in endurance sports such as bicycle racing, triathlons and marathon running. The existence of a humoral factor regulating [red blood cell](#) production was first postulated in [1906](#) based on transfusion experiments in rabbits. In [1950](#), the still unidentified [erythropoietic factor](#) was found to be stimulated in rats breathing a low-oxygen atmosphere, thus establishing the elements of its biological regulation. In the 1960s its source was identified as the [kidneys](#). Human EPO was first purified from human urine by T. Miyake, C. K. Kung and E. Goldwasser at the University of Chicago in [1977](#). Limited quantities of the native human protein were used experimentally to treat patients with [anemia](#). Therapeutic human erythropoietin was initially isolated and purified from urine in 1977. In [1983](#), the [gene](#) coding for erythropoietin was identified by a team headed by [Fu-Kuen Lin](#) at U.S. [biotechnology](#) company [Amgen](#). Researchers at [The Genetics Institute](#) (now part of [Wyeth](#)) independently discovered the gene at approximately the same time. The resulting patent dispute led to Amgen gaining exclusive marketing rights for erythropoietin in the U.S. [Recombinant DNA technology](#) was used to [express](#) the [protein](#) in [Chinese hamster ovary cells](#), which allowed a synthetic form of EPO (rEPO) to be produced in commercial quantities for the first time. Recombinant EPO was launched as a pharmaceutical product by Amgen for treatment of anemia resulting from [chronic renal failure](#) in 1989 under the brand name Eprex. In 1991 it was also approved for treating anemia resulting from cancer chemotherapy. [Johnson & Johnson](#) (J&J), an American pharmaceutical company, markets EPO under license from Amgen for cancer chemotherapy under the brand name Procrit. Amgen's patents have so far prevented other companies from entering the U.S. market. Even though the patents are all based on work done in the early 1980s, the last of them will not expire until 2015, thirty-two years after the date of the original application. A longer-acting erythropoietin analogue, [darbepoetin](#) (dEPO), also known as novel erythropoiesis-stimulating protein (NESP), was launched by Amgen under the brand name Aranesp in 2001. Relative to rEPO, dEPO has a slightly different [amino acid](#) sequence and a greater number of [oligosaccharide](#) residues. Aranesp comes in 40mcg and 60mcg 1mL vials, and 100mcg and 200mcg pre-filled syringes. Its primary advantage is it can be used only once every two weeks in patients without ESRD (end-stage renal disease). Outside the U.S. Amgen's patents did not prevail and two other brands of EPO are available: Eprex (J&J) and NeoRecormon (Roche). Two new long-acting forms may be launched in Europe in 2006: CERA (Roche) and [Dynepo](#) ([Shire](#)). Source: <http://en.wikipedia.org/wiki/Erythropoietin>

Exports took off at the same time as domestic production. Although at the onset of the research these developments were thought for the domestic market, it was soon perceived that they could compete successfully in developing countries that were not targeted by rich country firms. These markets were left unexploited because of differences in IP rights legislation and because they demanded cheaper BHH goods and thus were not profitable for these firms. As a result, Bio Sidus currently exports approximately US\$ 17 million a year (68% of its total sales).

The key reason for targeting these new goods and exports was the need to find new profitable activities that help overcome the profit reduction in traditional pharmaceutical activities caused by more stringent patent protection (Sidus specialized in generic drugs, sold mostly in the domestic market and marginally exported to developing countries, where IPRs and clinical and regulatory requirements are not as restrictive as in rich countries). The resources sunk in traditional pharmaceutical activities generated incentives to consider this new activity.

The company's previous experience in the pharmaceutical business gave it some useful prior knowledge on how to target saleable products.¹⁰³ For instance, they had a successful track record of adapting products to the characteristics and requirements of developing country markets.¹⁰⁴ This feature is common to most national pharmaceutical firms in Argentina, but Bio Sidus was the first to be able to exploit it.

Its scale in traditional pharmaceuticals also gave it access to resources for the internal financing of the required substantial investment in R&D and for obtaining the approval (clinical or commercial) for the new products.¹⁰⁵

Prior knowledge in the pharmaceutical sector also allowed it to choose BHH products where it would take longer for competitors from other developing countries to

¹⁰³ Many of the developments in this industry can be technologically/clinically attractive but fail to meet the market and regulatory requirements.

¹⁰⁴ They had developed a vast knowledge of adapting drugs to the pathologies that are prevalent in Latin American and other developing countries, which gave them an edge for developing BHH products for these markets.

¹⁰⁵ The technological development involves no less than 6 years, and the subsequent approval usually requires about 4 years.

emerge, i.e., that had bigger technological barriers to entry in the relevant market segments that it could target. These products had to be such that they demanded a R&D effort that was beyond the scope of pharmaceutical firms in most developing countries at that time but not beyond Bio Sidus' possibilities.¹⁰⁶

The targeted products also had to be such that they offered learning economies in R&D activities that later allowed them to jump to develop more sophisticated products. Competition had to be avoided not only until the initial investment could be amortized with the monopoly benefits of the initial development but also until the firm had the next product already developed.

Finally, prior knowledge also helped it select products and market segments where it would not compete with leading international BHH firms (mostly Swiss and from the United States) that introduce important barriers to entry. They targeted products that were differentiated along a vertical dimension (quality/price) and less developed country markets that world leaders were less interested in targeting and capturing through the introduction of patent barriers to entry.

There are several reasons why rich country labs were not serving less developed country markets. The relatively laxer IPRs in these markets would not prevent the entry of competing labs from less developed countries that could sell at a lower price. As BHH markets appear not to be segmented, the price reduction to serve less developed country markets would erode the monopoly profits in rich country markets more than it would contribute to bigger profits through the capture of new markets. Rich country labs price determination is as follow. They face much larger fixed and variable costs than their less developed countries' counterparts because of: a) the high cost of clinical

¹⁰⁶ An example of commercial failure due to the choice of relatively unsophisticated pharmaceutical products is given by the case of the development of a particular antibiotic by a national pharmaceutical enterprise, which began its development seeking to enter the international markets at a lower price than developed economies' laboratories. However, by the time the product was fully developed, they had to give up the project because they could not compete with the prices of Asian competitors that managed to develop the product at the same time.

approval of the new goods (US\$ 500,000), b) more stringent quality management standards: labs in rich countries must employ three times more personnel in traceability during the internal processes than labs in poorer countries, c) bigger R&D and commercialization costs in developing original goods and cultivating markets for these goods (US\$ 800 million per new product, on average). For a typical rich country BHH lab production costs represent 5% of gross revenues, marketing costs 15% and R&D amortization 30%, yielding a 50% profit margin (over gross revenues) that allows them to amortize their investment in 3-4 months. A good example of the difference in costs between rich and LDC labs is given by the cost of applying for patents in the US or the EU (about US\$ 500,000) and in Brazil (US\$ 8,000).

The combination of lower costs for LDC labs and monopoly power in rich countries for developed country labs give the former a competitive edge in poorer country markets. Bio Sidus was able to exploit this edge, which may cease to exist in the future as rich country labs are shifting their strategies and starting to patent their new developments everywhere (as in the case of monoclonal antibodies for treating cancer).

Another window of opportunity for targeting this activity was given by the fact that even though requirements in terms of fixed investment in physical capital for production are more important than those prevalent in the traditional pharmaceutical sector, developing BHH products demands a relatively lower investment in R&D. This relatively smaller barrier to entry facilitated the investment of a national laboratory like Sidus.¹⁰⁷

It must be highlighted that their prior history in pharmaceutical activities did not give them any special knowledge on how to do R&D on BHH. They had to start from the scratch, because pharmaceutical laboratories in Argentina did not develop original

¹⁰⁷ The R&D costs for new products in the traditional pharmaceutical activity are much bigger than in BHH. In order to attain a new development, 100,000 molecules have to be synthesized. Then the successful synthesized molecules are subject to cultivation analysis, and the ones that pass these analyses are tested on mice, and so on. This process may last 7 years and end up not yielding any useful result. On the other hand, R&D in BHH is more similar to a reverse engineering process: it is known that the body produces a certain product (the leukocytes, for instance), and what the research does is to try to identify this bodily production process and to replicate it outside the body.

products.¹⁰⁸ Hence they lacked a specific research protocol and an identification of qualified researchers that could successfully develop these new goods. As mentioned in the background section, pharmaceutical researchers were not available in Argentina, and had to be brought in from abroad to supervise the new R&D activity and to train local scientists.

As in the case of chocolate confections, the choice of BHH in general, and of the specific products it targeted in particular, was facilitated its ability to elude, and in turn introduce, barriers to entry through scale economies in R&D. Sidus' previous scale in the production and commercialization of traditional pharmaceutical products certainly helped in this regard.

An extra similarity with the case of chocolate confections is that, albeit being a pioneer at the Argentine level, Bio Sidus was an imitator at the world level. Its current developments are “imitations” of pre-existing products developed elsewhere (although it is now targeting the development of new original products and processes).

6.2.2. Which were the main uncertainties regarding the profitability of exports? How were they solved? What was discovered? Were there any surprises?

Two types of uncertainties had to be resolved before making a breakthrough into the BHH business in the *market segments targeted* by the pioneer. First, Bio Sidus had to resolve a country-wide, systemic, type of uncertainty, which is whether the human capital in Argentina was adequate for developing BHH products of the desired technological sophistication. Second, it had to resolve an idiosyncratic technological uncertainty: whether their research effort would yield the development of the desired product. Bio Sidus avoided clinical and foreign demand uncertainties at the beginning by focusing on “imitating” products that were already clinically approved and well established in world markets.

Ability to develop the good:

¹⁰⁸ They only did reverse engineering in generic drugs, which can be relatively easy with the information contained in patents

When Bio Sidus targeted BHH it was not clear if the human capital available in Argentina would have the ability to develop the new goods. Thus, they had to start searching for capable researchers and “experiment” to see if they could succeed. To this end they initially established contacts with CONICET scientists (which had no previous experience in developing commercially viable products). This endeavor did not succeed, probably as a result of the informal nature of their relation, which prevented a full time engagement in this activity. They did a trial and error process until they found the right researchers who, under the supervision and training of repatriated Argentine pharmaceutical researchers, managed to successfully develop the interferon alpha. Bio Sidus’ history of close relation with scientists in the public sector facilitated the resolution of this uncertainty.

The discovery of this untapped accumulated capability by Bio Sidus was a knowledge externality that is recognized by Argentine newcomers as a key determinant of their entering this sector.

Indeed, Bio Sidus managed to develop these products earlier than in most other developing countries, and even before several more developed countries. The commercialization of BHH in rich countries started in 1989, and Bio Sidus was already and active exporter in the mid 1990s. As a result Argentina is the 17th world exporter of EPO, lagging only very rich countries and selling 66% more than South Korea and Mexico (its two closest followers) and almost three times as much as Brazil.

Then, there obviously was the idiosyncratic uncertainty as to whether the R&D effort would succeed. The success of Bio Sidus was based on focusing its R&D effort on a narrow set of goods (i.e., applying a linear model of innovation). As a result they obtained a high rate of success rate in their investment, (as high as 70%). This knowledge is fully proprietary (a “knowledge niche”), at least in principle. This importance of focus is similar to the case of chocolate confections. However in this last case knowledge was not proprietary and the pioneer had to resort to the introduction of barriers to entry.

Production costs:

Production costs were neither uncertain nor crucial for Bio Sidus’ acquisition of competitiveness. All that it needed was to be able to supply sophisticated products to

countries with relatively lax IPRs at a lower price than its rich country counterparts (which spend more money on product differentiation and in obtaining clinical approval in rich country markets, and are hence less interested in non-IP countries).

Clinical and demand uncertainties:

Original new developments involve three layers of uncertainty: a) technological (the development itself), b) clinical (the new product must be approved by sanitary authorities), c) commercial (there has to be a market for the good).¹⁰⁹

The initial strategy of Bio Sidus was to focus on the development of a product (the interferon-alpha) already existing in the global market, clinically and commercially proved, and to produce it at a cheaper price and with similar quality. This strategy is similar to that of the pioneer in the chocolate confections sector, which undertakes “innovative imitations” of pre-existing products to reduce the underlying uncertainties.

Their focus on “non-IP” country markets (which was not a choice, but rather their only possibility) also reduced uncertainty because in order to enter these countries they only have to demonstrate chemical equivalence of the new products (which is relatively cheap and offers no uncertainties).¹¹⁰

This strategy allowed Bio Sidus to target unattended market segments and behave as a temporary monopolist. This is similar to what the chocolate confections pioneer did.¹¹¹

¹⁰⁹ These original developments also face large fixed costs of entry to the rich country markets that are the more natural targets for these developments (clinical testing for new products costs between US\$ 50 million and US\$ 300 million in rich countries).

¹¹⁰ Developed countries still maintain, and in many cases are extending, patents on these goods. When the patent period expires they are likely to introduce the further requirement of testing for clinical efficiency (on the scientific grounds that chemical equivalence does not apply to BHH because each BHH product is “different”). These extra requirements would not only sizably increase the costs of entry, but also introduce idiosyncratic uncertainty regarding the clinical efficiency.

¹¹¹ One important difference is that there is no branding and product differentiation in the BHH market segments targeted by Bio Sidus and that the scale barriers through R&D are big but not that big. Hence it is relatively easier for newcomers to enter this market.

Commercialization strategies:

There is not much (if any) uncertainty involved in the commercialization strategies in “non-IP” countries, where Bio Sidus exports goods that are only vertically differentiated (and where there were no initial competitors) and hence need no special commercialization strategies.¹¹²

They have their own distributors in the most important Latin American markets and operate with local partners (for commercialization purposes) in the other markets. Association with local partners is done to avoid fixed costs of distribution and in some cases it helps avoid costs and uncertainties in the process of product approval, thanks to the local partner’s local contacts and knowledge of how to get around the local bureaucracy (this is not a real uncertainty, as own distributors could learn over time how to best operate in each market).

Exporting costs/NTB/TBT

There are no significant uncertainties regarding these costs of exporting, as the targeted markets have relatively lax regulations.

6.2.3. Were there any coordination externalities? How were they resolved?

The potential coordination failures involved the lack of a regulatory framework, of local suppliers of inputs, and of a basic infrastructure for clinical analysis of BHH products.

When Bio Sidus started research on BHH there was neither a specific regulatory framework for this activity in Argentina, nor specific public policy instruments to

¹¹² Commercialization can be done in three types of “venues,” depending on the types of BHH goods considered: a) drug stores and pharmacies, b) government procurement through bidding processes, c) bidding processes by clinics, hospitals, and health insurance companies. A mixture of these three types of venues is usually observed, although it may vary from country to country. For example, in Brazil almost 100% of sales are made through governmental tenders, while in Argentina, the three types of operations show a similar relevance.

support this type of investment.¹¹³ The lack of public sector knowledge on how to deal with these new activities made matters such as sanitary or product quality approvals more difficult. There could have been a sort of coordination failure (no regulatory framework and specific support policies because the sector does not exist and vice-versa), which was obviously not large enough (the lack of this framework and policies were not that big an impediment) for Bio Sidus to go ahead with its investment.

As the pioneer made progress with its research, it started to collaborate with (or “instruct”) the involved public agencies in the construction of the sectoral regulatory framework, on how to evaluate BHH projects and on how to design specific promotion mechanisms. In so doing, it provided a public good to followers. However, this was only partially a public good, as the new regulations initially reflected Bio Sidus needs and experience, instead of giving a general framework. In some cases these tailor-made regulations may have operated as a barrier to entry.

Most of the specialized inputs can be imported, eliminating this possible source of coordination failure.

Access to adequate technological infrastructure (accredited clinical analysis labs, etc.) was not too big an issue for the large national laboratories (Bio Sidus, Cassará), which either had them as a result of their activity in the pharmaceutical sector, or could finance them. However there are important deficiencies that may hamper an adequate diffusion of biotechnology to SMEs. This is the case with the lack of a mass spectrometer, which is very costly. Bio Sidus has these analyses done in the UK because the investment in this equipment cannot be amortized by an individual firm’s sales. Initially, Bio Sidus did all the testing abroad. Nowadays, Public Laboratories from National Universities (LANAI) provide most of the basic infrastructure requirements, which generate a huge cost reduction. However, these savings do not affect the ‘break even point’ of BHH projects.

None of the potential coordination failures were critical for the pioneer, which was a large firm that could use its own resources to go ahead and finance its investment

¹¹³ Consider that the most suitable innovation promotion mechanisms at that time, like Banco Provincia de Buenos Aires Argentech credits and subsidies, had a 3-year time horizon, much shorter than the time it takes to develop new BHH products (up to 10 years).

in advance of having the regulatory framework and the domestic basic infrastructure. This activity proved to be profitable even in the worst case scenario of lacking financial support and the basic technological infrastructure.

6.2.4. Why was the investment in new exports successful?

The keys for the success were the combination of entrepreneurial vision, selecting the right R&D team, and lots of luck, according to Bio Sidus executives.

The investment was successful because Bio Sidus managed to resolve the country-wide uncertainty regarding the availability of human capital with the required skills and the idiosyncratic technological risk of developing the BHH products. We can distinguish between the specific actions and strategies that the pioneer took to resolve the uncertainty, and the characteristics of the pioneer that facilitated undertaking this risky investment.

The specific actions to detect the capable human capital involved establishing contacts with CONICET's scientists and undergoing a trial and error process until they found the right ones. This search process included repatriating Argentine researchers working abroad. This is not a trivial process: other important national laboratories sank sizable capital in R&D that failed because of their choice of researchers that lacked commercial vision.

As discussed above, the specific strategy to increase the idiosyncratic chances of success of its R&D effort was to focus on a narrow range of products that were already existing (clinically and commercially approved) and to target a then unattended market (cheaper price and similar quality than the BHH equivalents produced in rich countries).

The success was also facilitated by some of the characteristics of the pioneer. First, its previous experience in the pharmaceutical sector, targeting similar product ranges (generic pharmaceutical drugs with no IPRs, sold at relatively low prices in middle income countries, mostly Argentina). This featured was shared by several other laboratories in Argentina, but Bio Sidus took the first step. Second, this firm was willing to invest revenues from traditional pharmaceutical activities in highly uncertain new developments in biotechnology. This set it apart for a good number of years from the

other domestic laboratories. The ownership structure (family-owned business) was also an asset, as it allowed for rapid decision-making and changing strategies.¹¹⁴

6.2.5. What was done to consolidate the new export success?

The pioneer initially was a temporary monopolist in products that lacked horizontal differentiation and where the only barriers to entry are the scale economies in R&D.¹¹⁵ It exploited this monopoly position while it lasted by trying to sell its products in as many “non-IP” countries as possible, and by applying part of these profits to developing new already existent products that would provide it with new temporary monopoly profits (interferon beta, G-CSF, etc.). Eventually these monopoly positions start being eroded with the entry of newcomers (mostly from East Asia) with their own developments and cheaper prices. Asian countries are able to export lower priced BHH products because of lower traceability requirements and lower demands of clinical security before putting their products in the market.¹¹⁶ To elude this profit erosion the pioneer now applies its profits to the development of more sophisticated products that will take longer to be developed by its followers.

In this vein, it is now focusing on getting ready to get access to high income markets (EU, USA, Japan and Australia, which represent 90% of the world market) in the case where patents on BHH products such as the EPO cease to apply and bio-generic rules

¹¹⁴ Big laboratories in developed countries do not have the flexibility to start these new projects (where barriers to entry are smaller because BHH does not involve large fixed physical capital requirements). Hence technological developments are usually done by small and medium labs and then sold to the big laboratories. Instead in Argentina, the pioneer firm makes almost 100% of the developments “in house,” which demands big flexibility.

¹¹⁵ Having its own distributors and partnerships with local firms for commercialization efforts is another, albeit relatively small, barrier to entry.

¹¹⁶ For instance, in China there about 30 (a big number) of BHH labs that produce EPO. More than half of the developments are of poor quality, 3 or 4 are so so, and only 2 or 3 are good. By going to the market before their products are thoroughly tested, they save a lot of R&D and financial costs. They continue learning as they test their products in the market (by seeing their effects on actual patients), and their products eventually improve, but imposing sizable sanitary prejudices.

are approved for BHH products.¹¹⁷ It is also applying the profits and the acquired learning in BHH R&D to develop original highly sophisticated process and/or products. Some these products and processes have already been developed and patented and are awaiting clinical approval. This new BHH R&D phase, that has yet to bear its fruits either in the technological, clinical or commercial aspects of this business, may have important implications for the pioneer in terms of allowing it to engage in product differentiation and brand development, and of giving it access to higher prices and to bigger and more prolonged monopoly profits. One of these new developments is the “pharmaceutical milk farm” (‘tambo farmacéutico’) that produces human growth hormone, an already existent product, through an innovative process that allows the direct extraction of this hormone from the milk of the cows (from where it is then extracted and purified). This is a much more productive technology than the traditional (biotechnological) methods of obtaining this hormone through the fermentation of biotechnologically modified cells, bacteria or yeasts.¹¹⁸

6.2.6. What impact (actual and potential) did the new exports have on the pioneer and on the sector (knowledge and other spillovers)?

The discovery may have impacts on this sector through different channels. First, it can generate knowledge externalities about the local availability of suitable human capital. Second, it can create technological spillovers via the movement of researchers

¹¹⁷ Bio – generic pharmaceutical rules state that chemical equivalence is enough and there is only need for a relatively cheap security test (more specific clinical tests) that involves little uncertainty. If bio – generics are not approved, then costly, lengthy and uncertain clinical tests of efficiency will be compulsory, hampering the possibility to access these markets.

¹¹⁸ These developments could only take place after the technological and financial consolidation of the firm, and are often sustained by profits from other biotechnological products. This self financing reflects the high risk involved in developing these innovative biotechnological products and the reduced size of (venture) capital markets in Argentina. They are also working in the development of a new product, known as gene therapy (Instead of programming the bacteria, cell or yeast, the genetic programming is done to the body itself, so as to generate self – healing mechanisms). If they succeed in the development of the product, they will probably have to find a partner for clinical trials, as they are extremely expensive (US\$300 millions). Its medium term objective is to export US\$ 100 millions via new and more sophisticated developments.

between firms. Third, in the form of public goods (elaboration of regulatory framework, re-definition of public policies of support to this type of investment, “discovery” of this activity by the public sector, which then introduces *ad hoc* support policies and institutions, specific infrastructure). Fourth, enhanced quality standards are required of the pioneer, which can then be passed on to input suppliers. Fifth, it may improve the functioning of the national innovation system via the promotion of a bigger business orientation of public sector researchers in this area and a bigger availability of suitable human capital.

Other firms in the sector may or may not be able to benefit from these potential impacts for reasons that may be related to credit market imperfections and to the idiosyncratic technological risk that each of them has to overcome through R&D.

Information revelation:

As it was previously discussed, the pioneer revealed the important information that the human capital available in Argentina was suitable for R&D in BHH developments, i.e., that there existed an untapped accumulated capability. This was a knowledge externality that was not however big enough to induce a massive diffusion of this activity, given that the specific knowledge of how to produce the good remains proprietary. Newcomers know that there are researchers that can do this R&D, but they still have to sink to capital to do their own research to develop the good.

Even the revelation that human capital was suitable was for R&D in BHH was not that big a knowledge externality, as Cassará, the most important follower of Bio Sidus, could undertake successful R&D only when they hired some former Bio Sidus’ researchers. Another big domestic laboratory (Roemmers) sank significant capital in R&D and yet failed because of hiring researchers that lacked “commercial vision.”

Technological spillovers – thick labor market externalities

The movement of Bio Sidus’ former researchers to Cassará allowed the latter to succeed in developing the same initial products (interferon alpha) without technical uncertainty and without important sunk costs. It also gave it knowledge on how to perform successful R&D in BHH in general, which later allowed it to introduce new developments in the areas of vaccines (some imitations and some original developments), a different product segment than the one targeted by the pioneer.

Public goods:

As analyzed in the sub-section on coordination failures for BHH, Bio Sidus provided important public goods. First, it collaborated with the involved public agencies in the construction of the sectoral regulatory framework, and in establishing how to evaluate BHH projects and on how to design specific promotion mechanisms. However, this was only partially a public good, as the new regulations initially reflected Bio Sidus needs and experience, instead of giving a general framework. Its contribution to the design and development of specific promotion mechanisms for BHH activities has been especially helpful for newcomers. This point is further elaborated in the section that analyzes the role of public policies.

Development of network of specialized input suppliers:

There was not a big contribution here, as most of the specialized inputs are still imported. There were some important improvements in the quality of domestic packaging (a key input), but not much more beyond this.

Pioneer's learning and productivity improvement and its static and dynamic spillovers:

As discussed above, Bio Sidus initially targeted developments that allowed it to acquire resources and increased learning on general R&D skills, which facilitate new developments farther up the technological ladder. It is important to highlight that there are not big specific technological spillovers between one particular development and the next. Previous developments provide improved research know-how that can save 25% of time in R&D activities (with substantial financial savings), but these previous developments do not provide any increased knowledge as to whether a new molecule is going to work or not.

Exporting BHH products additionally brought forth important internal improvements in the pioneer's production process and also had positive spillovers on its suppliers of specialized inputs.¹¹⁹ The required quality improvement was very important for

¹¹⁹ Bio Sidus had to: a) change the approval criteria for inputs and for the suppliers firms, b) audit the suppliers' quality and demand improved product and process standards from them, c) initiate a policy of controls over processes and documentation in order to have a track record.

packaging, a key input for this kind of products, which had to be upgraded and adapted to exports market's requirements. However, these spillovers may not be too large as most of the specialized inputs are currently imported.

Improvement of the functioning of the national innovation system:

A traditional criticism of the functioning of the national innovation system is that there is a big gap between the research agenda of public agencies and the needs of the business sector, and very little spillovers between the public and private sectors, leading to sub-optimal investment in R&D by Argentine firms (see FIDES, 2006). This has been changing in the last few years. For instance, there is now a mechanism that allows internships of public sector researchers in private firms. Bio Sidus was one of the main promoters of these changes, albeit not the only one.¹²⁰ Bio Sidus' reliance on informal exchanges with CONICET scientists at the onset of its investment, and the difficulty to find researchers with "commercial vision," made it understand very clearly the importance of promoting this synergy.

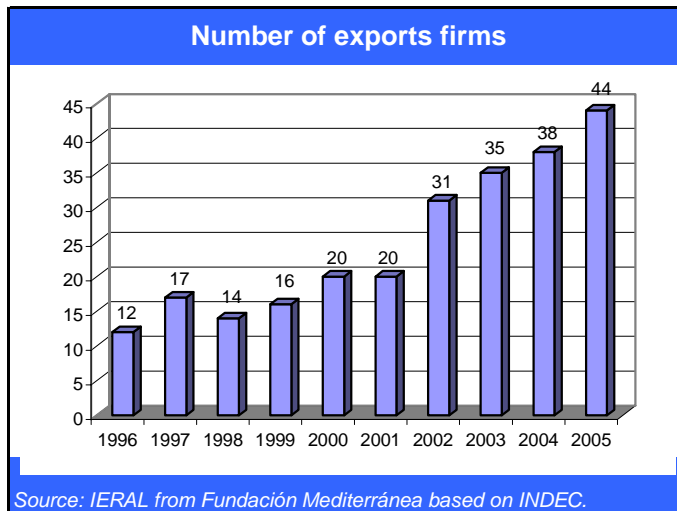
Intersectoral spillovers:

Bio Sidus is also very active in vegetal and animal biotechnology. For instance, it is one of the leaders in the application of biotechnology to plant's propagation, which allowed it to become one of the main producers and exporters of blueberries, another successful new export activity in Argentina. In this the same vein, one of Bio Sidus' most promising new developments in the BHH area, the "pharmaceutical milk farm," combines animal and human biotechnology.

¹²⁰ Some other R&D intensive industries/firms have been promoting it as well. The recent government interest in promoting R&D, possibly fostered by the demonstration effect of Bio Sidus and others, was also very important in this regard.

6.2.7. Was it there diffusion of this export activity? What were the key drivers of this diffusion (or lack of)?

Extent of diffusion among firms located in Argentina:



Although Bio Sidus still explains a large share of these products' exports, a large number of Argentine firms started exporting in the last years. While in 1996 only 12 firms showed exports bigger than US\$10,000, the amount of firms exporting at least this value reached 44 in 2005. This diffusion made the share of Bio Sidus in total sectoral exports fall from approximately 80% during the second half of the 90s to an average 65% in recent years.

The main exporting firm after Bio Sidus is Laboratory Cassará. These two firms are the only ones that have had exports bigger than US\$ 1 million in recent years.

The list of exporters of BHH products includes firms of different relative sizes that encompass international labs, universities and small innovative firms. Their increasing number is an indicator of the existing interest and work on biotechnology applied to human health to Argentina.¹²¹

¹²¹ It must be pointed out that while some of these small and medium firms produce and export their own developments, other firms, mainly international labs, produce with licenses or merely commercialize.

MAIN EXPORTING FIRMS OF BIOPHARMACS*
in dollars

Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
BIO SIDUS S.A.	430,220	7,863,002	14,717,172	17,909,521	20,892,349	24,825,729	13,941,735	14,222,768	17,524,941	14,174,872
LABORATORIO PABLO CASSARA	85,891	69,726	433,521	1,436,758	3,175,208	1,858,710	829,660	1,703,719	1,358,974	2,208,777
INSTITUTO MASSONE S.A.	118,485	316,775	401,717	353,937	234,599	282,538	390,598	483,856	554,919	706,934
UNIVERSIDAD NAC.DE CORDOBA	0	1,688	0	0	43,141	83,276	232,046	132,420	413,069	705,646
FERRING SA.	0	0	0	0	0	198	0	177,772	273,897	563,307
BAXTER IMMUNO S.A.	47,300	127,300	2,876	57,878	56,197	143,167	4,313	63,606	86,045	560,134
BIOPROFARMA SA	0	0	0	0	28,288	4,960	6,383	101,460	192,679	480,958
SANDOZ SA.	26,967	16,658	0	0	0	0	0	153,769	561,119	459,995
PC GEN S.A.	0	0	0	0	0	0	0	180,000	1,097,150	458,715
SCHERING-PLOUGH S.A.	262,465	550,652	454,052	631,357	588,202	271,434	760,164	354,506	326,123	648,464
LABORATORIOS POEN S.A.C.I.F.I.	0	0	0	0	0	0	76,884	163,987	361,722	425,946
PURISSIMUS S.A.	0	563	6,200	221,769	225,841	70,150	101,272	286,597	178,328	394,461
MONTE VERDE S.A.	0	0	0	0	0	0	76,135	91,092	98,462	364,521
LABORATORIO ELEA SACIFA.	195	7,905	5,475	326,101	255,770	178,773	160,332	250,082	246,781	348,035
PRODUCTOS ROCHE S.A.Q.E.I.	188,670	326,158	402,597	620,834	508,236	741,044	1,227,865	482,503	293,769	242,320
AGROINSUMOS S.A	0	0	0	0	0	0	38,328	137,968	261,116	213,420
SERVYCAL S.A.	0	0	0	0	0	0	0	7,163	30,942	204,410
BIOGENESIS S.A.	0	0	0	0	0	0	9,314	4,296	57,886	116,050
GRIFOLS ARGENTINA S.A.	36,926	24,300	6,690	37,014	41,451	11,525	37,000	82,750	77,130	108,800
M.R. PHARMA S.A.	0	0	0	0	0	0	6,290	54,778	317,643	102,787
Subtotal	1,197,119	9,304,727	16,430,299	21,595,169	26,049,283	28,471,504	17,898,320	19,135,089	24,312,695	23,488,552
Others	447,670	850,677	1,282,969	1,273,083	1,398,139	2,305,048	1,979,909	764,169	756,824	916,547
TOTAL	1,644,789	10,155,404	17,713,268	22,868,252	27,447,422	30,776,553	19,878,228	19,899,258	25,069,518	24,405,140

* Firms with annual sales of more than US\$ 10,000 dollars
Source: IERAL based on Customs.

The number of exporting firms and of exported products may become more significant if several ongoing R&D efforts (which take 10 years to mature) bear the expected fruits.

Regional and global competitors

There have emerged a significant large number of competitors in Asian countries and several developing nations that target the same products and market segments than those initially targeted by Bio Sidus. For instance, in 2004 Argentina was in the same club (defined by export value) for the exports of BHH products than South Korea, the Czech Republic and Singapore. Other upcoming exporters are India, China and Russia. In the case of EPO, its exports ranked immediately after those of Singapore and before those of South Korea. India is one of the upcoming exporters for this good. As discussed in a previous sections, many Asian competitors appear to be able to sell at lower prices because they undertake less stringent quality assurance procedures and even release their products before they are thoroughly testing, cutting down on R&D time and costs.¹²²

The case of Brazil, which lags significantly in the development of its BHH sector, is interesting because the Brazilian government is giving important support to this sector, and significant BHH research is undertaken in universities and public agencies. Our interviews suggest that the failure to take off is due to the lack of domestic laboratories with a long standing tradition in pharmaceuticals and enough

¹²² For instance, there have been cases of exports of vaccines through WHO price-based bidding processes that were won by suppliers that lacked clinical approval in the recipient country.

resources to take risks in these developments, and to the initial insufficiency of researchers in the areas of life sciences. We explore more the Brazilian BHH sector when undertaking the counterfactual analysis for the emergence of BHH exports in Argentina.

6.2.8. Determinants of extent of diffusion among locals

Newcomers into this sector in Argentina may benefit from some partial knowledge externalities brought forth by the pioneer, but they still have to sink capital in R&D to resolve their own idiosyncratic uncertainty about the ability to produce the good. By entering later than the pioneer, if they wish to target the same goods and market segments they will face the problem that there are more exporters from other countries already targeting these same markets. Hence they can only do it if: a) rents, albeit smaller, are still large enough to amortize the fixed costs of R&D, b) costs of R&D have been going down, either because of bigger availability of researchers, because of government subsidies or because of technological spillovers, c) they expect that this first step will grant them access to a learning curve that will later allow them to move to the development of different varieties and more sophisticated products.

It must be highlighted that the newcomers do not hurt the pioneer's profits, because of the time lag between the pioneer's developments and those of its followers and because of the relatively small size of the latter vis-à-vis the Asian competitors. Diffusion has not led to an increase in the costs of research thus far. Additionally, followers in Argentina, while initially targeting the pioneer's same goods, are now focusing on different varieties for their subsequent developments.

The Laboratorio Pablo Cassará, the only major follower, got into this business thanks to its association with former Bio Sidus' researchers. This allowed it to "develop" the same initial goods as the pioneer (interferon alpha, G-CSF), without having to face the uncertainty and fixed costs associated to product development and without caring much for relatively low prices at the time of entry.¹²³ Like the pioneer,

¹²³ Cassara started with interferon alpha, which is easier to develop, and only now is developing its own EPO.

Cassara was a relatively big domestic and traditional pharmaceutical lab that decided to invest in, and finance, its own biotechnological research, taking advantage of high profits obtained in its traditional activity. They started later than Bio Sidus, sharing the motivation of the pioneer and several of the other facilitating factors. Cassará had also observed the pioneer's success in finding the adequate human capital. Their search for projects and adequate research personnel coincided with the departure of some of the original researchers of Bio Sidus, the association with whom guaranteed their success. This sets them apart from Roemmers, another big domestic pharmaceutical lab, which sank a lot of capital in the "wrong" researchers (and in different products) and failed to develop new products.

Two interesting features emerge with Cassará. The first is that, following its initial "success" in developing similar products as the pioneer, it decided to specialize in different varieties for its subsequent developments (although they are still both very active in "traditional" BHH products, such as EPO, interferon-alpha and G-CSF). Cassará is currently more specialized in vaccines (developing more sophisticated vaccines), while Bio Sidus is specializing in interferon-beta and on its new developments of a more productive process for producing human growth hormones and of gene therapy. To pursue these new projects Cassará is associating with large international laboratories (like Aventis Pasteur), which will deal with financing the clinical approval in rich country markets.¹²⁴ This specialization is consistent with an

¹²⁴ Cassará created a new vaccine that requires one less dose than the preexistent one. This way they are managing to make advances in the prevention of the hepatitis illnesses because less than 20% of vaccinated actually complete the third dose, losing its effectiveness as a consequence. The development took five years and got started once the existence of an "adyuvante" that speeds up the immune answer of the organism was discovered by American scientists. According to sources from the sector, this vaccine is going to be produced and commercialized at an international level by an international lab with whom Cassará is associating with, or to whom it is selling the product. Therefore, if the vaccine enters the world market as an Argentinean production and is distributed through the global network by a transnational lab, BHH exports would sizably increase in the next years. At the same time the lab is already working in a vaccine of just one dose that has already been approved in animals and is beginning to be studied in humans.

incentive not to sink capital in the same products and split their demand. It also opens interesting possibilities of technological spillovers in a wider range of products.

The second interesting feature of Cassará is that it did not hire the Bio Sidus' former researchers but rather associated with them. This form of partnership probably arose from the bargaining power of the latter, who could "sell" their knowledge to any firm. These researchers formed a SME (named PC GEN) that got the financing of Cassará and developed products for it.¹²⁵ But this SME was free to pursue its own projects. It is also associating with other SMEs to pool financial and research resources for more ambitious projects.¹²⁶ More generally, Cassará is outsourcing specific processes (such as protein purification to PCGen) or particular products (such as hepatitis vaccines, where they were partners with the local branch of Sanofi Pasteur). This organization of the research activity certainly facilitates technological spillovers.

A big hurdle to diffusion is given by credit constraints. Up to now diffusion has been restricted mostly to pharmaceutical firms that have previous experience in related activities and that have enough resources to invest in these new developments. The absence of wide capital markets in Argentina restricts the development of small laboratories and further diffusion.¹²⁷ The large number of SMEs currently conducting research in BHH in Argentina, (as it happens in rich countries) raises the question of whether their future expansion will be associated mostly with selling their projects to large traditional laboratories or whether public support will give the bigger boost to this diffusion and give the small labs a chance to commercialize their own developments. The recent emergence of different support programs to small laboratories raises the odds for this last option.

¹²⁵ As a matter of fact, PCGen was located in the same building as Cassará.

¹²⁶ They formed a temporary association with Gemma Biotech, which had been working for Roemmers in the development of BHH products.

¹²⁷ The reduced capital market in Argentina does not guarantee an exit strategy for new developments, whereas in developed countries with wide capital markets there is a proliferation of small biotechnological laboratories that invest in a single project and sell the enterprise ('project') when they have achieved technological success.

6.2.9. Roles of previously accumulated capabilities, industry specific public goods and public policies

The emergence of the BHH sector was greatly facilitated by accumulated research capabilities in the area of life sciences, especially in public universities and public research institutions such as CONICET, which provided the “general” skills for conducting applied research with a commercial orientation in BHH. Argentina had a long tradition of research in biology and medicine, including a number of Nobel Prizes in these areas.

Another cornerstone was provided by the national pharmaceutical labs with a knowledge of the pharmaceutical market for developing countries (regional diseases, etc.), an ability to distinguish underserved markets, to identify products with larger potential for learning and to staff adequate research teams, and with internal resources to finance the initial R&D efforts. These national labs also had the flexibility to engage in risky investments, which local subsidiaries of multinational labs usually lack. The existence of these labs, which were engaged in the production of generic medicines for the domestic market under IPR controversies with rich country labs and which did not do any pharmaceutical research (they only did reverse engineering of the existent medicines based on the information contained in patents), proved to be very important for the emergence of the BHH sector.

The third foundation, especially for the diffusion of the activity, was the existence of public agencies devoted to the promotion and financing innovation and R&D activities, such as FONTAR. While these institutions were not initially apt for promoting these activities, they could be easily adapted to this end. These institutions were motivated by a concern to promote R&D in general.

We next discuss which capabilities were absent and had to be developed, and how this was done. The most important missing capability was that of pharmaceutical research, which was initially dealt with through the repatriation of Argentine researchers working abroad, and then through their training of local scientists. One particularly important missing capability was that of life science researchers with endowed with a commercial vision. It must be mentioned that even though the availability of this type of researchers has increased, it is still not too large, as witnessed by the failure of the BHH

R&D effort of a big national lab (Roemmers) because of choosing researchers that lacked this vision. Additionally, the main follower succeeded only when it associated with researchers that had previously worked for the pioneer.

As discussed in the section on coordination failures, when the pioneer started research on BHH there was neither a specific regulatory framework for this activity in Argentina, nor a public sector ability to evaluate BHH projects and to design specific promotion mechanisms. As the pioneer made progress with its research, it started to collaborate with (or “instruct”) the involved public agencies in the construction of these capabilities.

Bio Sidus managed to gather support from the public sector from the onset, albeit this support was not always the most adequate. The lack of adequacy arose mostly from the lack of previous government knowledge of, and allocation of priority to, this sector. Government agencies had no ability to evaluate BHH R&D projects. For instance, in the beginning it had access to a Banco Provincia de Buenos Aires Argentech credit that had a 3-year time horizon (much shorter than the time it takes to develop new BHH products) and that quickly became a financial burden, as it was indexed and it was a time of high inflation; Bio Sidus actually had to cancel this loan in advance. The pioneer always had a knack for getting around bureaucratic constraints and was able to obtain both some financing and also to tap researchers from the public sector. After the Argentech credit from Banco Provincia de Buenos Aires it managed to obtain credits from the Secretaría de Ciencia y Tecnología (SECyT) and some subsidies (fiscal credits). Cassará and other smaller laboratories also benefited from credits and subsidies from SECyT.

In the last 10 years there has been a big change in the design of innovation support policies, making them more adequate to the requirements of BHH enterprises. Support allocation rules became more flexible, and specific rules for specific uses were designed (for instance, adapting the time span of credits to the biotechnology development).

The creation of the Agencia Nacional de Promoción Científica y Tecnológica, and its two main instruments, the Fondo para la Investigación Científica y Tecnológica (FONCyT) and the Fondo Tecnológico Argentino (FONTAR), have contributed significantly to the financing of different projects of BHH firms and through this way to

the expansion of the sector and the diffusion of this activity. The lack of adequate public knowledge about the BHH sector was an obstacle for adequately acceding to these incentives at the beginning, but the agency went through a learning process that improved its functioning and the adequacy of its instruments to the needs of this sector. This learning process was facilitated by a joint work with the private sector. The consulted firms valued highly the role of the Agency and its instruments (non reimbursable subsidies and long term credits).¹²⁸

These instruments may be particularly important for BHH SMEs. Nevertheless, if they succeed in their R&D, they will probably have to “sell” their projects to larger laboratories in order to afford the fixed costs of exporting and/or of accessing to rich country markets.

Finally, the after-discovery synergies between the private and public sector have allowed an improvement of the functioning of the National Innovation System, as discussed above.

Access to adequate technological infrastructure (accredited clinical analysis labs, etc.) was not too big an issue for the large national laboratories (Bio Sidus, Cassará), which either had them as a result of their activity in the pharmaceutical sector, or could finance them. However there are important deficiencies that may hamper an adequate diffusion of biotechnology to SMEs.¹²⁹

Despite all the policy and institutional improvements, the lack of a venture capital market to fund long term research in BHH is still a big hindrance for the growth of this activity.

¹²⁸ Government support to foreign market access has also improved. For instance, the embassies' commercial offices now help contact candidates for local licensees. A stand in the 2005 international biotechnology fair was financed by the government, so as to make possible for smaller firms participate and make contacts. The public sector also organized a post fair meeting for evaluating the results.

¹²⁹ This is the case with the lack of a mass spectrometer, which is very costly. Bio Sidus has these analyses done in the UK because the investment in this equipment cannot be amortized by an individual firm's sales.

6.3. Counterfactual analysis

The case of Brazil, which lags significantly in the development of its BHH sector, offers a good counterfactual for understanding the key features behind the successful emergence of this sector. Argentina is currently the 17th world exporter of EPO, selling almost three times as much as Brazil. This is interesting because the Brazilian government is giving important support to this sector, significant BHH research is undertaken in universities and public agencies and there currently is a bigger availability of life science researchers that Argentina had at the onset.

Our research suggests that the Brazilian failure to take off is due to the lack of domestic pharmaceutical laboratories with flexibility and willingness to undertake these risky investments, and with the resources to finance them, and the initial insufficiency of researchers in the areas of pharmaceuticals and life sciences. This suggests that the presence of national pharmaceutical laboratories and life science researchers in Argentina was crucial for experimenting and succeeding in this sector. It was especially important for entering early into world markets, before Asian labs started bringing prices down.

Most of the pharmaceutical firms located in Brazil are local branches of MNCs, which face the usual constraint imposed by headquarters that their local branches focus only in activities with current positive profits, not allowing them to undertake risky investments.

The lack of development of the Brazilian BHH sector is puzzling given the fact that this country one of the 10 largest medicine markets in the world. However, its national pharmaceutical industry is poorly developed and its domestic market is dominated by foreign or multinational firms. Only one out of ten of the most important laboratories (the Grupo Aché) Brazil belongs to national capitals (Magalhaes, 2003). This feature partly explains the low investment in pharmaceutical R&D in this country. It also is one of the biggest hurdles to the development of the BHH sector in this country.

In the 1980s Brazil was self – sufficient in medicines. However during the 1990s multinational laboratories changed their strategy, closing some plants and production lines. The trend to self-sufficiency was reversed, and imports became increasingly important. In 2003 medicine imports were 15 times higher than those observed in 1989,

whereas overall imports increased only twofold during that time span. Accordingly, the net exports of this industry deteriorated markedly: the medicines import/export ratio rose from 2.6 in 1989 to 6 in 2003. Conversely, in Argentina the domestic market is mainly supplied by national laboratories (approximately 15% of domestic sales are imports and the import/export has stayed at 2 since 1990). Brazil thus showed the opposite trend as Argentina -a shrinking national pharmaceutical sector and a growing trend towards importing medicines- which prevented it from accumulating capabilities to develop the BHH sector. This helps explain the slow development in biotechnology applied to human health.

We found two channels by which the absence of national laboratories deterred the surge of BHH. In the first place, decision making is much more difficult for local branches of multinational firms that have to report to their headquarters. Second, subsidiaries in developing countries might not have available resources for investing in these new projects, or for becoming an exit option for local BHH SMEs. Similarly, international firms might not be willing to sink capital in risky projects involving R&D in a subsidiary. Consequently, there is no commitment to the development of new products. and the search of new ‘niches’ at the national level.

The increasing number of mergers and acquisitions in the pharmaceutical industry at a world level during the 1990s made it more difficult to overcome this ‘negative’ feature of the industrial organization of the sector in Brazil. There was not only an increasing concentration among firms, but also some national laboratories that had made some important R&D in new biopharmaceuticals and that were committed to R&D in BHH were bought by international firms that discontinued this line of business. Such was the case of Biobras, which was a producer of insulin and was making important innovations in the area of BHH.

Equally important, the initial endowment of human capital in Brazil was far from adequate. Professionals in life science were scarce twenty years ago and this disadvantage impeded the surge of a BHH industry. Nowadays, this negative feature in Brazil is changing and the supply of human resources meets more closely the needs of the nascent BHH industry. However, the lack of national laboratories is still a hindrance, reducing the commercial usefulness of the increased endowment of life scientists. Nowadays Brazil only has a good research and production infrastructure in

the area of BHH that is applied to immunological products, which is exclusively run by the public sector.

Next, the dearth of skilled personnel in some specific areas, of domestic production of equipment and inputs and the poor technological infrastructure of many public research-related institutions further limit the development of the sector (UNICAMP, 2004). However, this does not seem to be a crucial factor, as Argentina suffered (and still suffers) similar restrictions and yet managed to succeed in the development of the sector.

Last but not least, the timing of the development was not a minor issue. Benefits at the beginning were extremely high whereas now, with the surge of global competitors, mainly from Asian countries, have substantially reduced profit margins.

6.4. Welfare analysis

In this case the pioneer appears to have faced a somewhat smaller degree of uncertainty than the industry average regarding the suitability of local human capital, because of its history of contacts with public sector scientists. However, this knowledge edge was not too big, as the pioneer did not really know beforehand if it would succeed and executive of this firm claim that luck played an important role in its success. Hence, while the uncertainty was shared by everybody in the sector, the information externality was relatively large.

Despite this large information externality, there does not appear to be too little ex-ante investment in discovery. This was due to the technological and scale barriers arising from the proprietary nature of the knowledge resulting in R&D in this activity. Additionally, initial rents were very large and the eventual Argentine competitors were too small as to reduce the profits. Credit constraints were circumvented with self-financing and the relative abundance of skilled scientists also facilitated the endeavor. Finally, focus on a narrow range of goods facilitated investing enough resources in R&D and ensure success.

The currently limited diffusion could appear as inefficient, but this argument must be carefully framed. Let us consider the trade-offs between concentration and diffusion in the presence of limited financial and research resources. All the firms

understand the importance of focusing on a narrow range of products in the presence of large fixed costs of R&D, with the probability of success increasing with the size of the investment (the linear model of innovation appears to apply to this activity). Hence a concentrated sector will probably specialize in a relatively narrow range of goods, although possibly exploiting dynamic learning economies in R&D that allow them to jump up to more sophisticated products and markets. On the other hand, more diffusion could lead to experimentation in a larger variety of BHH goods (so as to avoid splitting demand) and to the discovery of more “knowledge niches” where Argentina is good at, although probably with a smaller probability of success in each of them. This is the usual trade off between scale and variety. Our appraisal is that there should be more diffusion than the one currently observed (at the export level).

The binding constraints for diffusion are: a) the number of firms with large resources from traditional pharmaceutical activities able and willing to sink capital in R&D and/or to buy projects from BHH SMEs), b) the government’s ability and resource constraints to promote this activity, c) whether there are sufficient researchers available, and how large is the stock of non-business oriented public sector researchers that can adjust to the requirements of this activity.

Nevertheless, there are many ongoing research projects undertaken both by large and small labs, which may bear their fruits in the near future and lead to a big diffusion of exports. This bigger diffusion will

Other reasons why we believe that more diffusion is required are that it may increase the number of technological spillovers through the movement of R&D personnel among firms and through the revolving associations between BHH SMEs and the large pharmaceutical firms. Bigger diffusion is also likelier to increase the attractiveness of enrolling in biotechnological careers and conducting business oriented research. But you cannot promote infinite diffusion, as jumping to too many neighboring trees may prevent you from jumping to higher branches.

This statement is also conditioned by the current size of the export market for Argentine BHH firms. As long as the target is the relatively small “non-IP group” of developing countries, the scope for diffusion will be more limited.

The optimal extent of diffusion is also determined by the ability of Argentine firms to shift profits from foreign competitors. More firms that target different varieties will probably steal profits from foreign competitors (along vertical or horizontal dimensions, depending on the degree of sophistication of the product) rather than from Argentine firms. This is another factor in favor of a bigger diffusion than that currently observed.

In this vein, government policies should be aimed at improving the access to financing and the availability of business oriented researchers. Support policies should weigh in carefully the true commercial potential of the new endeavors, as it is possible that many firms target research in products that may face a stiff competition from Asian and other LDC labs when they become mature.

Finally, the choice of this sector appears to offer positive social returns for three reasons. First, because Argentina had an untapped accumulated capability for this activity (national pharmaceutical firms and adequate human capital) that needed to be discovered and exploited. Second, because there are substantial learning economies in this activity. Hence developing it ahead of other comparable countries may generate prolonged and even widening competitive advantages, especially if Argentina manages to develop first bio-generics and original products and processes that can be sold in rich countries. Third, because these sophisticated exports may allow Argentina to jump to more sophisticated trees and branches. HK's product space shows that BHH exports are located in the periphery of the densest part of the forest, and that they appear to accumulate capabilities useful for exports of goods such as 'electro-medical apparatus', 'dairy machines' and some other machinery products, besides 'organic chemicals' and 'other pharmaceutical products' which are in the same Leamer group as BHH products. All these products are of similar productivity as BHH (BHH are among products of high productivity, therefore, upscale products are rare).

This discovery had a positive social return because Argentina entered early into world markets. Had the pioneer delayed its investment, the price erosion caused by the competition of other LDC labs would have rendered the endeavor unsuccessful.

6.5. Conclusions for biotechnology applied to human health

In these conclusions we stylize the case study by evaluating how it fits into our theoretical framework. We conclude that this new export activity was targeted because of:

- Exhaustion of rents in the horizontally related pharmaceutical activity.
- The identification of an untapped accumulated capability.
- Proprietary knowledge (product-specific information externalities are not too big).
- Temporary monopoly rights, due to the time it takes for the imitators to acquire their own proprietary knowledge (10 years since they start their R&D).
- Learning economies in R&D that allow the pioneer to jump faster than imitators to new temporary monopolies in more sophisticated products on the technological ladder.
- Prior knowledge in the pharmaceutical industry, which helped define an adequate production cum export “discovery” and consolidation strategy.

There were sizable uncertainties regarding the availability of adequate human capital that the pioneer solved via a trial and error process with different public sector researchers and with the repatriation of pharmaceutical researchers working abroad. Its previous contacts in the pharmaceutical industry with this type of researchers facilitated this identification. Then there was the idiosyncratic uncertainty regarding product development and commercialization. Key among the strategies that allowed for resolving were the practice of “innovative imitation” (by focusing on products that are already clinically approved and established in some market they eliminated two sources of uncertainty and avoided large costs associated to clinical testing) and their focus on experimenting with a narrow set of goods (which increased the probability of success of the R&D). Market uncertainty was further reduced via its targeting then unattended “non-IP” countries where rich country firms were not significantly present, with sophisticated products that would take long for Asian and other LDC labs to develop.

It is remarkable that all these strategies are somewhat similar to those pursued by the pioneer in the chocolate confections sector. One key difference is that the latter could horizontally differentiate products and introduce scale, sunk costs and brand

barriers to achieve protracted monopoly positions, while the BHH pioneer could only aim for a temporary monopoly (until newcomers arrived) and use the profits to finance new developments that grant new temporary monopolies.

Bio Sidus also contributed to several public goods: a sectoral regulatory framework and the design of more adequate sectoral support policies, along with promoting formal mechanisms for bridging the gap between business firms and public sector researchers.

Other local firms could benefit only partially from this revelation of untapped accumulated capabilities and provision of public goods because of the proprietary nature of the knowledge on how to produce the newly developed good (which demands large R&D effort), together with the difficulties to find the adequate researchers that combine good science with commercial vision. The only major follower (Cassará) benefited from a technological spillover from the pioneer when it became associated with former researchers of Bio Sidus. As public policies are increasingly promoting diffusion and more researchers become attracted to this activity there is emerging an increasing cluster of BHH SMEs conducting R&D that, if adequately financed by large national pharmaceutical laboratories, can give a boost to diffusion. The existence of an important fringe of such national laboratories, with enough funds and managerial flexibility to target this activity is a highly facilitating factor for this potential diffusion.

Our welfare analysis suggests that diffusion should be bigger in order to increase the technological spillovers, increase the range of knowledge niches through the discovery of more BHH varieties, and shift more profits from foreign competitors. However the usual trade-off between scale and variety applies, with the additional concern that scale economies are not only static but also dynamic (as learning in R&D helps jump to the development of more sophisticated products).

A comparison with the BHH sector in Brazil, where there has been a poorer discovery and export performance despite large public support, suggests that the key factors for the success of BHH in Argentina were the availability of adequate (albeit at times lacking the required commercial vision) human capital for research and of national laboratories with enough funds and willingness to invest in an activity where the scale barriers to entry associated to R&D (especially to develop existing products

for “non-IP” countries) were big but not as big as those prevalent in the traditional pharmaceutical sector.

One question that emerges from the analysis of the BHH exports in Argentina is how open is the world to innovative exports from developing countries. The patent extensions of generic BHH products in rich countries, together with the large costs and uncertainties associated with the clinical approval of these goods may leave the exports to “non-IP” countries as the only choice for starting BHH firms in developing countries. It must still be appraised how binding the regulatory and clinical barriers to entry to rich countries will actually be when Argentine BHH firms attempt to enter these markets with original developments. They will have to rely on associations, and sharing the rents, with local firms that provide not only the required funding but also the “certainty” of approval.

One important finding is that BHH is representative of many new activities with downward sloping demands that offer a positive social return only when the country enters early into world markets. The same applies to chocolate confections, and even to blueberries (our third case study) which succeeded despite Argentina entering late into export markets only because its geographical conditions allowed it to become a monopolist in particular off-season period.

7. Case study of blueberries

7.1. Background information

Blueberries are truly a new export product in Argentina and have shown a great dynamism in the past years. Before 1992 the production of blueberries was scarce and disperse, and lacked any commercial value. After that year, some varieties of the plant were imported and planted, the first harvest took place and the first exports were materialized thanks to one pioneer that powered the development of the sector.

Exports in dollars

Firms	1998	1999	2000	2001	2002	2003	2004	2005
Tecnovital SA		213 984	729 642	333 732	1 552 949	1 181 464	5 364 948	6 626 390
North Bay Argentina SA				954 985	1 691 990	2 296 498	3 450 080	5 632 797
Berries del Plata SA		414 334	631 150	980 823	1 215 695	1 699 989	3 251 506	3 524 731
Blueberries SA						75 739	624 728	2 771 965
Vergel SA	798 840	865 368	156 816	892 214	897 953	782 733	1 142 169	1 170 726
Sri Argentina SA				403 146	500 382	690 093	1 096 192	1 041 135
Frutazul SA			30 560	75 630	69 952	81 386	215 531	488 911
Argesa Argentina exportadora SA				26 622	5 060	41 984	93 917	389 099
Hortifrut Argentina SA								261 543
Expofrut SA			137 681	149 892	80 194	72 890	80 820	44 569
Other exporters	208 269	12 672	601 891	7 672	1 494	163 114	1 046 451	6 419 318
Total exported	1 007 109	1 506 358	2 287 740	3 824 716	6 015 668	7 085 889	16 366 342	28 371 183

In 2005, total exports reached US\$ 28 million, becoming Argentina's 7th largest fruit export. This export growth is explained almost entirely by newcomers: in 1998 the pioneer accounted for 80% of all exports, while in 2005 his exports represented only 4% of total external sales of this good.

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

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

7.2. Analysis of the emergence of this new sector¹³⁰

7.2.1. Who was the pioneer? Why did it target this new activity?

The pioneer was the Vergel firm, which was created in the early 1990s by Francisco Caffarena, an individual entrepreneur. He was a pioneer in the nursery, production and commercialization stages. He targeted this sector after a search process oriented to find a product not yet developed in Argentina.

Caffarena had been working as an executive for an important MNC in the automobile industry and wanted to apply his savings to develop his own business. To this end he began to search for investment alternatives that were appraised using a project evaluation methodology. He considered a wide variety of export oriented projects, and concentrated on those products that faced a low degree of competition in world markets. Some of the cases he considered were iguanas, capers, asparagus, raspberries, chestnuts, artichoke, kiwi and goat cheese.

During this search process, which lasted more than a year, he faced important uncertainties regarding the technical feasibility and the profitability of the different alternatives, which he overcame with a combination of experimentation and project evaluation. This experimentation was not facilitated by the Argentine public sector. For example, he tried to import chestnut plants to evaluate the viability of the production of this fruit. This experiment was finally aborted because he was unable to fill SENASA's forms that required him to provide technical knowledge about the plant that he could not have before undertaking production (for example, he had to inform the harvest date which was unknown to him, since this variety was new in Argentina). This is an example of public bads that raise the costs of discovery in Argentina.

The blueberry opportunity came by chance, during a business trip to Italy, where he learnt about this fruit. A preliminary project evaluation of this activity yielded very high

¹³⁰ This análisis is based on interviews to the following: CAPAB – Cámara Argentina de Productores de Arándanos y otros Berries - Jorge Pazos – President, Cuinex – Nursery and farmer – Agr. Eng. Marta Arriola and Agr. Eng. Manuel Parra, Vergel – Nursery, Production and Commercialization – Francisco Caffarena – President, Tecnoplant / Tecnovital - Nursery, Production and Commercialization – Federico Bayá – Manager. Federico Bonsini – Operational chief, SRI – Commercialization – Andrea Dopazzo, Jugos del Sur – Francisco Prado, President; RIGEL Berries - Javier Formichelli, owner.

expected payoffs, given the high world prices in the Northern off season that exceed between two and ten times the seasonal prices. He thus decided to learn about the product and to evaluate the feasibility of its production in Argentina. To this end he went to the US and contacted a nursery, from which he gathered information about production techniques and plant varieties. He also contacted UK importers which confirmed his initial promising estimations of FOB prices and export volumes. He also discovered that commercialization could be easily handled. Costs of inputs and land in Argentina were also known.

However, he faced a technological uncertainty that threatened to undermine these potentially high returns, given that no previous production knowledge was available in Argentina. He hence had to pay an initial cost and to invest in experimentation about production alternatives. Given that these initial pre-competitive experiments were successful and that the expected payoff was so attractive, he decided to invest in production.

In a first stage he imported plants of blueberries from the US, overcoming SENASA barriers thanks to the bureaucratic learning acquired during the unsuccessful experience with chestnuts. He planted 2 hectares that he owned in Zárate, in northern Buenos Aires, without knowing if this was the best location for production. He also contracted a consultant from the US to assist him in dealing with different problems in terms of production and sanitation. This experiment failed (lots of plants died) but it revealed crucial information on the best production location and on the actual prices that he could obtain.

Indeed, the location was such that it allowed Vergel to harvest in October, one month ahead of the harvest in Chile, its main potential competitor in the off season. The Northern Hemisphere price for this month was around \$20/40 per kilo (depending the particular week) and Vergel faced no competition, allowing it to become a (temporary) monopolist.¹³¹ Contrastingly, the price that Chile and New Zealand received was up to ten times smaller. This price advantage made the business profitable even if the worst

¹³¹ The information on this price range was provided by Caffarena and verified by comparing the volume and value of blueberries exports from Argentina during those years that were obtained from COMTRADE.

possible production techniques were used (with Chilean prices the profitability under poor production techniques was not granted).

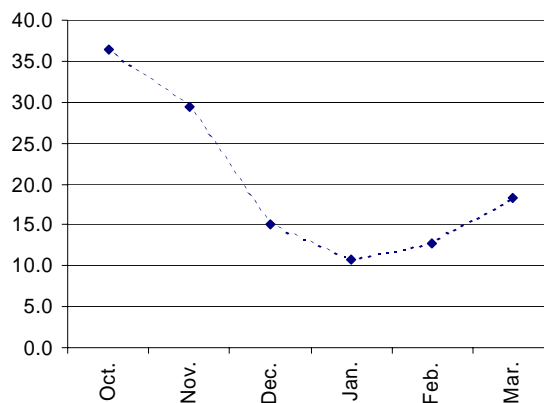
FOB price for blueberries

	Argentina	Chile	Nueva Zelanda
1994	20.11	1.29	4.22
1995	22.11	1.91	5.11

Source: COMTRADE

It must be highlighted that the pioneer was not aware at the beginning that he would be able to reach the Northern markets in the prime months of the off season. However prices were so high enough that the business would be profitable even if he did not harvest before Chilean producers, provided that the right production techniques and plant varieties were used. When undertaking its preliminary project evaluation, Vergel was looking at the whole set of possible prices and comparing them with the expected cost. What was key for him was the fact that costs were one half those of Chile (us\$ 40,000 per hectare vis-à-vis us\$ 80,000) despite the bigger Chilean experience, and learning, in producing berries (also helped by Fundacion Chile).

CIF Prices for 2005/06



Source: Exporters data

Having discovered the robustness of the profitability of this business in Argentina, Caffarena decided to expand production. Since the imported plants were not the most suitable for Argentine soil and weather, Vergel had to integrate the nursery business. This gave it the opportunity to generate a separate line of business which, together with the knowledge and contacts acquired in the commercialization phase,

would allow it to continue exploiting profitable activities even if newcomers at the production level eroded its profits in this activity.

After this initial learning, Vergel invested in a five-hectare plantation, propagating its own plants with local technical assistance. The first harvest was exported in 1994 to the UK. It was experimental, and the first shipment was so limited that he transported it in his own car to the international airport, to be exported by plane.

To sum up, Vergel was the first one to produce plants, blueberries and export them. Prices were so high that allowed Vergel to experiment even with a high rate of failure. Furthermore, the long maturity needed to be able to produce the fruit would give him two to four years of monopoly power.

Two other pioneers at the nursery stage appeared simultaneously to Vergel. They were conducting R&D in micro-propagation techniques which would bear its fruits two years after starting the activity. One of the nurseries, Cuinex, was set up by two agronomic engineers that started up a firm with the objective of assisting farmers in exporting industrial crops. They had been working with asparagus producers and wanted to expand to other related activities to use the installed packing capacity in the off-season. They began a search process about non-traditional crops in 1989. They evaluated blueberry production and its promising payoff (given high FOB prices) convinced them to invest in this activity. The other nursery, Tecnoplant, was developed in 1992 by the pharmaceutical firm Sidus, whose core was biotechnology. Tecnoplant aimed at developing plants, like strawberries and potatoes, via micro-propagation. They discovered the blueberry as a potential new market, given the high commercial value of this fruit. These two simultaneous nurseries targeted this activity since they expected that production would emerge in response to higher prices.

While Cuinex and Tecnoplant can also be considered “pioneers” in the nursery business, the successful development of this new export sector and the potential size of the foreign markets were mainly due to Vergel, which was the first one to reveal the profitability of this activity and to promote diffusion of production, and who also provided several important public goods.

7.2.2. Which were the main ex-ante uncertainties regarding the profitability of exports? How were they solved? What was discovered? Where there any surprises?

“*Everything was uncertain*”. This phrase from Caffarena sums up to what extent the product was new in Argentina. However, the lack of local experience in the production process was the main uncertainty that Caffarena had to face. Cost-benefit analysis and commercialization aspects were far less uncertain than the production process.

Production process:

There were several uncertainties at the production stage. First of all, there was no previous knowledge among agronomic engineers about some important aspects needed to grow blueberries such as climate requirements, soil characteristics, harvest season and diseases, etc. The pioneer was able to overcome these problems by contracting a US consultant. At the same time, he invested in training local technicians.

Second, there was no previous knowledge about which varieties of plants imported from the US were the most adequate for Argentine soil, so Vergel had to import diverse varieties in order to test them.¹³² It also had to experiment with plants in his nursery activity.

Lastly, due to the fact that production was new in Argentina, soils and climates were untested. Despite the general knowledge from consultants, some particular aspects could not be ascertained a priori. Hence an experimentation phase was indispensable. In fact, a significant proportion of plants in the first field died, despite the technical assessment.

These experiments improved the knowledge about the production techniques and helped determine the varieties more adequate for these latitudes. Caffarena admitted that initially Vergel made “all kind of imaginable mistakes.” Once production proved to be feasible, uncertainties were significantly reduced providing useful information for new plantations. However, significant uncertainties would still remain, resulting in a low

¹³² An initial cost that these activities had to face was paying a license for selling a new variety, with uncertain results and commercialization. Caffarena was interested in selling new varieties of plants. Thus, he contacted a university from the US and registered the license in Argentina, paying its costs. Finally, the university sold it to other investor.

productivity of the first plantations. Indeed, Vergel later promoted a limited diffusion of production that allowed it to continue experimenting with new varieties.

Regulatory framework:

Bureaucratic hurdles to importing plants were an important barrier that Vergel had to face, given his failed experience with chestnuts. It was uncertain that SENASA would let Vergel to import new plants and varieties. Nevertheless, Vergel managed to import the plants, after dealing with the bureaucratic barriers.

Location and returns:

There was some relevant uncertainty about investment returns. There was very little uncertainty about costs, as input prices and labor costs for harvest were relatively well known and the most relevant uncertainty was about propagation (multiplication of plants). The actual prices were more uncertain as they vary depending on the date of harvest and according to which transportation method is used. The initial contacts with UK importers gave Vergel some information about these aspects, but final returns were not revealed until Vergel experimented with production.

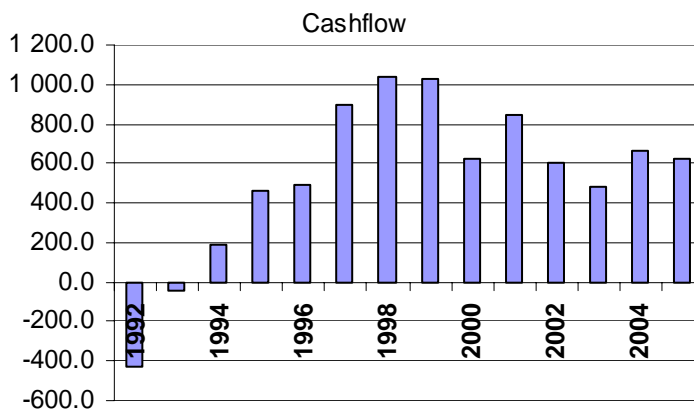
Before starting his experiments, Caffarena did not know the month where he would harvest and the price he would finally fetch. He discovered a good location in Northern Buenos Aires by chance. In order to take advantage of the revealed high prices, Caffarena's next investment was a plantation in Entre Ríos, northward from Buenos Aires, which allowed him to experiment with locations and varieties in different latitudes and climates. This kind of information was so important that imitators followed him closely in these new locations (sometimes so closely that they located in the nearest fields). These revealed high prices allowed Vergel to become profitable even with the high initial rate of failure.

One key issue for the business was to forecast future competition, since investment in blueberries plantations should be evaluated over a 15/20 year period (a plant yield reaches 100% only after 8 years). Newcomers could erode Vergel's prices in this period, as they faced a downward sloping demand in the prime months of the off

season.¹³³ The pioneer's expectation was however 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 that would compensate this price effect. In any case, Vergel was at least two years ahead from any other competitor, which guaranteed it breaking even and several years of monopoly. These aspects reduced the impact of newcomers over Vergel's projected profits. The internal rate of return in 2005 was 25%, with a price that had gone down to US\$15-20 per kilo (from the initial US\$20-40) and with forecasts of lower prices in the future. More recent evidence shows that this profitability may have declined significantly for the newest plantations in 2006. Contrastingly, a preliminary calculation using 1994-2005 actual prices showed a higher than 60% IRR at the onset of this activity.

This suggests that the uncertainty over the stream of future prices was of a second order relative to the technological uncertainty.

Cash flow for a 10 hectare production in Buenos Aires



Furthermore, besides the initial monopoly price, Vergel could be more profitable than its competitors due to its long learning period and its vertical integration. Growing international demand and the opening of new markets was another promising factor for persisting gains.

Commercialization:

¹³³ Later on increased competition ended up eroding the pioneer's profits through price reduction, but did not affect input prices significantly.

Commercialization was not a relevant barrier or uncertainty during these first steps. In fact, Vergel was the only supplier from Argentina and had sufficient commercialization contacts in Europe. As such, it was able to start exporting a modest volume of good quality production without any concern for commercialization strategies.¹³⁴

Market size:

Another uncertainty that appeared at a later stage was the ability to circumvent NTBs in the US, by far the most attractive market. The pioneer had to overcome barriers to sell to the US by developing the export protocol, which was non-existent and took two years to develop.

7.2.3. Where there any coordination externalities at the discovery stage? How were they solved?

The pioneer faced potential coordination failures, which he solved via a low scale vertical integration in all stages: nursery, production and commercialization. This was possible because of the relatively low required investment in each stage. This low scale was facilitated by the fact that he got access to a niche market where he was the only supplier, which gave him flexibility regarding the quantities sold (and the underlying investment). This initial investment was within his financial reach, and the managerial requirements were also within his scope. The unavailability of local experts with product-specific knowledge could have been another hurdle, which he circumvented by importing the services of foreign experts. The latter also helped train local experts.

However, as the endeavor proved to be a successful and he decided to expand his business, he faced financial and managerial scope constraints to continue operating the three stages simultaneously. He hence promoted diffusion of production and specialized in the nursery and commercialization stages, where he would enjoy

¹³⁴ There actually existed some minor commercialization uncertainties which were lessened through experimentation with different commercialization channels. For example, during the first exports to the UK, France and Belgium a trader untruthfully declared a proportion of Vergel's cargo to be of a bad quality. It then started dealing with other traders and this problem automatically ceased.

economies of scale and expected to face smaller competition in the future. Besides, he still had not mastered completely the best production technologies and preferred to transfer the continuation of experimentation with new varieties to new producers.

He thus was able to solve the coordination failure because of the low required scale of his initial investment (this was helped by luck) and because of his superior contacts with importers and American universities.

7.2.4. Why was the investment in new exports successful?

In analyzing the keys for this new export success we must distinguish between the pioneer's specific actions, the pioneer's special characteristics and the accumulated capabilities and comparative advantage at the economy level. We also have to consider the possibility that luck played a somewhat important role.

A big part of the success was based on the fact that the pioneer previously undertook a very careful search of alternative agricultural activities with an untapped comparative advantage, obtaining all the required market and general technology relevant information and conducting an adequate project evaluation that allowed him to pick the activity with the biggest expected returns. This way he was able to reduce substantial uncertainty. Then, given that no local production knowledge was available, he decided to import it from countries that were already producing the good. Vergel had a great ability to network with institutions, universities and experts in the US, which gave it superior knowledge about production techniques and plant varieties. When a relevant research or new knowledge was required (phytopathological problems, for example), the sources of information were not local experts but international ones. This initially gave it access to a more rapid response to specific problems that accelerated its development. He also knew how to optimize the use of his relatively scarce resources in order to obtain quick results and enjoy a temporary monopoly position. This was certainly the case with his choice of macro-propagation techniques for plants, which was cheaper, faster and less uncertain to implement than micro-propagation techniques (which require costly R&D).

The pioneer thus showed superior business planning, commercialization and networking skills than the average farmer, which generated a large externality.

The success was also due to the fact that Argentina enjoyed a natural comparative advantage in this activity, and also to a good dose of luck as the pioneer hit jackpot when first planting in an area that allowed him to harvest one month ahead of the Chileans and hence enjoy bigger prices that covered for any initial production mistakes and “public bads” such as bureaucratic hurdles for importing plants. It also facilitated a low initial investment, financed with family savings and employing a field of its property near Buenos Aires during the experimental phase.

Another important ingredient was due that this product has a much lower perishability (it can stay fresh for 60 days) than other berries (like raspberries and strawberries), which facilitates its exports even when logistics are not very adequate.

Finally, while there were no product-specific accumulated capabilities in Argentina, the country had accumulated general capabilities in agricultural capabilities and agronomic research, which facilitated a quick training of specialized personnel.

7.2.5. What was done to consolidate this new export success?

After his initial success with small scale vertical integration, the awareness of his financial and scope limitations made him choose the specialization in the activities where he would get the bigger profits and face the smaller uncertainty (nursery and commercialization). Later on the definite success of the new activity was based on the opening of the US market by the pioneer.

7.2.6. What impact (actual and potential) did the new exports have on the pioneer and on the sector (knowledge and other spillovers)?

The pioneer’s investment had a significant impact on the sector in the form of information revelation about production techniques and profits. It also solved coordination failures that accelerated the emergence of the sector and provided basic technological assistance and commercial certainty to newcomers. It also provided public goods in the forms of training local experts and of opening the US market and investing in the required fumigation infrastructure (at a later stage). Finally, it also provided some public bads by promoting diffusion of production before having mastered the optimal

production techniques, which led to poor initial results and possibly to an overinvestment in production later stages.

Information revelation:

As discussed in a previous section, the pioneer signaled that production was feasible and profitable. This signaling aspect was more important when Vergel exported significant amounts and when production obtained good results. It also showed the most convenient production location (the initial newcomers located right next to the fields that Vergel was exploiting in the province of Entre Rios). Vergel's investment gave visibility to this activity, helping investors to identify the existence of this new sector and to appraise its profitability. This firm also revealed the required basic technical knowledge to the first newcomers.

Coordination failures solution and promotion of production:

We have already mentioned that Vergel solved coordination failures by its initial vertical integration at a low scale. It later promoted a limited diffusion of production, providing basic technical assistance to farmers, selling plants to them and committing to purchase their outputs. This initial diffusion of production also facilitated the first commercial activities of the nurseries that had simultaneously started conducting R&D on micro-propagation techniques for plant. We will discuss this subject more in-depth in the section that deals with diffusion. If these stages had not been developed by the pioneer, the takeoff of this activity would have been far more difficult.

Development of specialized input suppliers:

This was not a crucial aspect for the emergence of the sector. Nevertheless, the pioneer made some contribution on this front. In order to be able to export Vergel had to develop new packaging that met international standards. Packaging in a 125 grams clamshell was not available and was specially made for Vergel by local producers. Afterwards the development of thermal bags was done jointly with a packaging firm. Now both products became common inputs for the industry.

Public goods:

Vergel initially provided public goods in the form of training local experts in the production of blueberries.

Then at a later stage, when diffusion was more widespread, it provided a key public good by opening the US market and by investing in the development and approval of an infrastructure that was required to meet the phytosanitary standards imposed in this market. In the beginning of the 1990s there was no protocol for blueberry exports from Argentina to the US, and hence Caffarena started negotiations to develop such a protocol. After two years of bureaucratic procedures a blueberry export protocol was approved, which required that the exported fruits were subject to post-harvest fumigation with methyl bromide (to prevent the Mediterranean fruit fly pest) before entering the US. This protocol at first allowed only exports through New York airport, where the fruit was fumigated. This sizably increased costs and complicated logistics. For this reason another alternative was explored, which demanded building up and approving new fumigation infrastructure in Argentina. Trying to simplify export logistics, Vergel presented a project of agreement for local fumigation. The USDA requirements were strict and demanded the construction of a fumigation chamber with the newest technology, not yet developed in Argentina, which demanded the use of specific software. Vergel invested \$200,000 in the development of this chamber without knowing if it was going to be finally approved by the USDA. It was a risky sunk cost because its profitability depended on the evaluation and approval of both the USDA and Chilean experts, while benefits could be eroded if competition appeared and used the same approved fumigation technology. It was finally approved after one year of being at work. Most exporters now use this technology and many other similar chambers have been constructed. Vergel undertook this risky investment because at that time competition was not that widespread and the US market was very large and rich. Hence he expected to enjoy high prices and large sales for a time span that was long enough to recoup the investment. It must be mentioned that while the *approval* of the fumigation technology was a public good, the physical infrastructure developed by Vergel was a private good. Indeed, while Vergel claimed that it did this investment because it needed to be done and it was fit that the pioneer did it, it is also true that this investment helped him sell a new service to its clients (farmers), who benefited from the access to the US but had to pay fees to Vergel for the use of these facilities. Hence until no new competition emerged, Vergel was a temporary monopolist and expected that this new service would consolidate and eventually help it enlarge its farm client base.

This market opening was crucial for having a big jump in the diffusion of this activity (we will analyze this in more detail in the next section). The importance of this openness can be appraised when analyzing the geographical composition of exports, which shows that the US market currently represents the 60% of total exports.

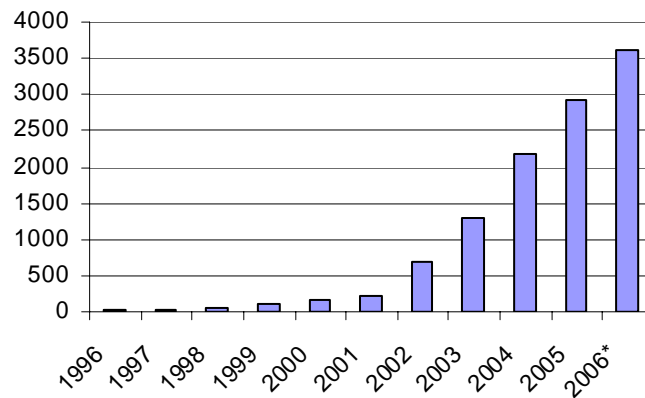
Public bads:

Vergel provided a public good by promoting the diffusion of production, but it also provided a public bad by doing so before having mastered the optimal production technologies. This public bad resulted not only in poor initial productivities, but also sent wrong signals about the path of export prices (by maintaining production low for too long), which have possibly led to an overinvestment in this sector.

7.2.7. Was it there diffusion of this export activity? What were the key drivers of this diffusion (or lack of)?

The diffusion process had three stages. The first one took place at the production level (through 1994 to 1998) and was promoted by the pioneer, who had a limited capability to expand to the monopoly optimum and still had not reached full knowledge of production. This first stage was characterized by a few new producers who bought plants and received basic technical assistance from Vergel and located mainly in northern Buenos Aires. During the second stage (from 1998 to 2002), diffusion occurred at the production, nursery and commercialization levels, and different clusters of producers emerged in different locations. Diffusion of production was boosted in this case by the maturation of the investments of the two nurseries that had started R&D in new varieties and micro-propagation techniques at the same time that Vergel had started producing (and which further promoted diffusion of production) and by the new big exporters that entered the market and that generated new commercialization channels. In turn, the new nurseries and traders benefited from the diffusion of production that the pioneer had initiated. Lastly, since 2002 there has been a still ongoing boom in blueberry plantations that was promoted both by the devaluation in 2002 and by the opening of the US market by the pioneer. This last stage involved the vertical integration of many big players.

Hectares planted of blueberries



Source: Authors' estimation based on production quantities

First wave: limited diffusion (1994-1998)

After his initial success under a limited vertical integration, Caffarena's next natural step should have been to expand the three activities to the monopoly optimum (as he was still facing no competition in the prime off season months). However, he faced financial and managerial scope constraints to do so. The investment required to prevent newcomers from entering was beyond his possibilities, and was highly risky, given that continuous experimentation (varieties, locations, etc) was still essential. He hence concentrated on the nursery and commercialization aspects of the business and promoted a limited diffusion of production.¹³⁵ His choice of activities was based on the bigger economies of scale in the former two activities and in the fact that production was the activity where there remained the largest uncertainty.

It must be highlighted that he only promoted diffusion up to a scale that was smaller than the optimal monopoly level. He did this because he expected that competition would emerge at the nursery level and hence did not want to sink too much

¹³⁵ From the pioneer's point of view an additional hectare planted reduced his profits through a cut in FOB prices (we can assume that Vergel was a monopolist in blueberries fresh market in a particular month or week) but increased its 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 could have maximized Vergel's profits. At the same time, this bounded dissemination reduced the visibility of blueberries and helped to build a controlled competition, and to extend the period of significant market power.

capital in a market that could be contested in the near future. It is also interesting to remark that, according to many farmers interviewed, Vergel would have had a chance to remain a monopolist had he provided an adequate technical knowledge to newcomers. This would have reduced the latter's rate of failure and consolidated a long term relationship with the pioneer.¹³⁶

The pioneer clearly anticipated that competition could erode its benefits. Nevertheless, the initiatives aimed at maintaining some type of monopoly were unfeasible, since all three stages of the value chain are highly competitive in other countries and there were practically no alternatives for monopolizing them.

The actions of Vergel were crucial in the first stage of diffusion and also relevant in the next steps. Initial diffusion would have been rather weak if Vergel had not committed with the diffusion of this activity, vertical integration had not solved coordination failures for newcomers and technical knowledge had not have been made available.

Let us now consider in detail how this first diffusion stage went about. The nursery stage was chosen as the core business from the onset by Vergel. This is due to the fact that the process of propagation is of great importance for the producer in order to guarantee productive and healthy plants. In the beginning of the activity Vergel discovered that it could not depend on plant imports. Hence the development of the nursery business was even a prerequisite for blueberry production, and that is where Vergel put its biggest effort.

Given the lack of knowledge about blueberries production techniques, the relatively high initial investment (US\$ 200,000), the relatively long time for reaching top production capacity (8 years) and the (*a priori*) difficulty of selling the product (only export oriented), any farmer would have been reluctant to initiate this activity on her own. For that reason, the pioneer not only sold plants but also gave technical assistance for production and secured the new firm's sales by signing contracts for buying future production. The pioneer was committed to limited diffusion, offering potential investors

¹³⁶ According to some newcomers we interviewed, the pioneer had significant possibilities of concentrating practically all the exports, but the oversight of particular technical problems led to a failure to retain the farmers that it contributed to generate.

a calculation of blueberry IRR, opening its plantation for extension activities, and providing the basic technical assistance.

Nevertheless, 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 being 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 export data support this view. For example, under a standard productivity the almost 3 tons exported in 1996 could have been produced in only one hectare planted in 1992, which stands in sharp contrast to the fact that up to that point almost 20 hectares were planted, with a potential production of more than 15 tons.

Vergel intended to preserve the control of successful producers by supplying all the relevant parts of the production chain. This scheme was feasible if no competition were introduced in the upstream or the downstream. But, as we will see below, the emergence of micro-propagation techniques and the entry of new commercialization firms of relevant scale reduced the possibility to continue monopolizing this activity.

Second stage of diffusion: (1999-2001)

This second stage was characterized by the entry of new relatively large players at the nursery and commercialization levels, and by a continued diffusion of production driven in good part by the initiatives of the new upstream players. This process was driven by the maturation of the investments made by some nurseries in response to the high expected profits, by the signaling effects of the pioneer's first investments and its limited diffusion of production, and also by the pioneer's opening of the US market.

Two nursery firms were attracted by the potential of blueberries in Argentina at the beginning of the 1990s, simultaneously with Vergel's initial investments. Each of them had a particular strength and a different core business, but both can be considered as pioneers in a particular aspect of blueberry industry: the development of micro-propagation techniques.¹³⁷

¹³⁷ These plants can be propagated using two different techniques. The simpler one is macro-propagation technique, or propagation by stakes. Plants are pruned and its parts are planted to grow a new

As mentioned before, Cuinex was set up by two agronomic engineers that 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 began a search process about non-traditional crops in 1989. They evaluated blueberry production and its promising payoff (given high FOB prices) convinced them to invest in this activity. In 1990 they imported from the US the first plants for testing purposes. They learned through INTA laboratories that these plants had several diseases, and that some of them were specific to the blueberry plant.¹³⁸ As in the case of Vergel, they realized that in order to promote the diffusion of this activity they had develop healthy and high quality plants, which was not guaranteed by importing such plants. In consequence, they decided to conduct research about micro-propagation techniques. The development of these techniques takes more time and it is much costlier than the traditional macro-propagation techniques that Vergel had appealed to. This gave the

plant. On the other hand, micro-propagation technique is the multiplication in vitro of a plant. “It involves production of plants from very small plant parts (e.g. buds, nodes, leaf segments, root segments etc.), grown aseptically (free from any microorganism) in a container where the environment and nutrition can be controlled. The resultant plants are genetically identical to parent plants.” (Reference: “Plant Tissue Culture”, 1996, Department of Agronomy and Soil Science, University of New England). During the interviews we found some controversy about both methods. To sum up the arguments, we will present only the relevant aspects of this discussion and the results of technical research. Macropropagation allows a simply and 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 to this technique argue that: i) as new plants come from a diversity of existing plants, some diseases can be propagated if original plants are infected; ii) the method does hurt original plants, what limits the multiplication of plants and obliged the nursery to use both “good” plants and “bad” plants; iii) the plant has an axial growth, which is inconvenient for the renewal phase. On the other hand, the micropropagation technique demands specific knowledge and important investment in development, laboratory and inputs. The most important characteristic of this method is that it can multiply one plant in millions of plants in less than two years, without hurting the original. This allows to select one plant (the “best” plant) and to multiply it in a controlled environment, free of diseases. One of the critical issues is the extent to which micro-propagation leads to mutation and does not allow an accurate certification of varieties. Advocators say that, on the contrary, the plants are clones, genetically exact as the original plant.

¹³⁸ Import of plants from the US was never forbidden, in spite of their sanitation deficits.

latter the chance to start producing earlier, albeit probably with less reliable plants and a lower productivity.

A direct engagement in production never entered Cuinex's plans. Given the high expected return of this activity, Cuinex expected that production would somehow emerge and that blueberry plantations would boom during 1995/96, i.e., they did not worry about possible coordination failures. Their objective was to produce enough plants to supply this new production. Their estimates proved to be wrong, as only after 1998 the blueberry diffused significantly. They attributed this slow diffusion to the insufficient initial investment of Vergel in learning the most adequate production technologies, and providing insufficient technical assistance and plant varieties that were not thoroughly tested to new the farmers (apparently Vergel only provided the basic assistance to get started). It must be mentioned that they were not aware at the beginning that Vergel had already started experimenting with production.

Cuinex exploited its professional knowledge to develop micro-propagation, a technique that makes possible an exponential growth in plants multiplication and that ensures the provision of healthy plants. Phytosanitation was a main concern for these professionals. To start with the experimental phase, they made an agreement with INTA. Nevertheless, this institution was too slow for their objectives. Hence in 1992 they decided to recommence with their own laboratory, buying different varieties of new plants from US universities. They made a big investment in a two-year experimentation process, after which they finally learned all the relevant issues about micro-propagation techniques.¹³⁹ Informal contacts with INTA professionals were useful in this phase, but they had no other formal assistance from public source. They finally began their plant sales around 1995. In this stage they took advantage of Vergel's promotion of diffusion, which had generated some investment in new plantations.

Meanwhile the pharmaceutical firm Sidus had developed a new firm whose core was plant biotechnology, and which in 1992 became Tecnoplant, whose core was the micro-propagation of plants, like strawberries and potatoes. As Vergel and Cuinex, they

¹³⁹ This endeavor entailed investing US\$200,000 in a laboratory, and also undertaking other expensive investments in required inputs and to sink a large cost in developing the testing procedures.

discovered the blueberry as a potential new market, given the high commercial value of this fruit. In the same fashion of Cuinex, it started investing in the nursery business ahead of the emergence of production because it expected that the latter would somehow emerge in response to the high prices. Tecnoplant was not aware of Vergel's initial investments.

This firm bought from US universities different kinds of varieties to experiment in alternative zones of production. It concentrated in early varieties, in order to differentiate them from the Chilean supply. There was a two year period of experimentation in which biotechnology techniques were adjusted and in which varieties were tested in different climates and soils. During this period, they imported varieties and bought licenses from US universities without a real knowledge about what their yields would be in Argentina.

Both Cuinex and Tecnoplant had similar characteristics but different backgrounds and concerns. While Cuinex wanted to spread the blueberry concentrating in the existing commercial varieties, Tecnoplant core is biotechnology, and is oriented to experimenting with new varieties. Prior knowledge in both cases was a key issue for their success. Nevertheless, some specific knowledge was transferred from US universities and other contacts, as in the case of Vergel. The high expected payoff encouraged them to invest in the experimental phase, although they faced a large degree of uncertainty. In both cases they sank a lot of capital in testing techniques with unknown results. Furthermore, "varieties were bought blindly" in terms of one interviewed. They had also to overcome barriers to the import (and export) of plants and products.

Despite their expectation that production would emerge in response to the high prices, this emergence was uncertain, as they had not invested in this activity like Vergel. This fact forced them to be actively committed with the diffusion phase. For example, Tecnoplant implemented a variety of activities, including the provision of information, project appraisal, technical assistance, financing of packaging plants, and commercialization contracts. Tecnoplant even made a joint venture with a Chilean exporter to strengthen its commercialization business.

Both Cuinex and Tecnoplant were aware of possible increased competition in the nursery business, and defined a differentiation strategy, based on the quality of the

plants. They argue that traditional nurseries (and particularly some opportunistic newcomers) introduced infected plants and inadequate varieties. Thus they relied on their capability to secure plants health and quality to preserve and increase their market shares.¹⁴⁰

It is worth noting that the initial investments in R&D and laboratories operate as barriers to entry to micro-propagation. In this particular case there emerged two suppliers of plants through micro-propagation probably because of the fortuitous fact that the two firms initiated their activities the same year without knowing about each other. The capacity for scaling their production was evidenced in the third stage of diffusion, as each firm boosted their yearly sales from 100 thousand to 1.5 million plants.

The emergence of producers during the first and second diffusion stages also attracted the entry of new players at the commercialization level. The product requires a careful packaging and an immediate cooling and it also demands to be maintained in a cold chain and exported by plane, making commercialization and logistics key aspects for this activity. From this point of view, this industry was attractive for those firms whose cores were trading and/or logistics. Chilean exporters were the main contestants, given that the production from Argentina is complementary to the Chilean one due to the different harvest month. Trading both countries production allowed them to maintain commercial contacts during all the off-season.

Some newcomers implemented strategic alliances with Chilean or American firms, whose core was commercialization of fine fruits. For example, Tecnoplant made a joint venture with Vitalberry, a Chilean firm, in order to commercialize the production. Other cases are SRI and Hortifrut, Chilean firms that began to export from

¹⁴⁰ For example, Cuinex tried to introduce the certification of plants' quality by SENASA. This certification is a common practice for other sectors (citric, for example). Nevertheless, that institution never implemented this particular certification, probably due to lack of resources. Tecnoplant wanted to differentiate itself from other nurseries in the development of new varieties, given that its core business is biotechnology R&D. In the future, if Argentina manages to produce 14,000 tons of blueberries quality will be crucial to remain competitive, and new varieties will be the only way of differentiating the product.

Argentina in 2000. Other newcomers at the commercialization stage were motivated by their knowledge of exports of other food products to the US or EU markets. They added blueberries to the other products' commercialization, typically through initially buying the product from farmers, and only then starting to produce them.

Let us now consider the diffusion of production more in detail. The limited diffusion of Vergel, the active diffusion of Cuinex and Tecnoplant, and the increased competition in commercialization allowed farmers to deal with a more competitive fringe in the upstream and downstream activities, gave them access to enhanced technical information and support and significantly reduced technological uncertainty. Having more alternatives for plants and commercialization offered newcomers an improvement in prices and in quality. It also reduced the uncertainty that could have arisen if the feasibility of the project depended on only one client and supplier (Vergel). This increased the attractiveness of production, boosting a bigger diffusion of this activity.

Another factor that promoted this diffusion was the drop in the opportunity cost of land that had been allocated to traditional fruits. Near Greater Buenos Aires there is a wide surrounding area devoted to producing fruit in small plantations. During the mid 1990s some of these fields had been old and begun a process of re-conversion to renew the old plantations of traditional fruits. New owners, mainly professionals from Buenos Aires city without technical knowledge, were seeking for new activities to invest in and producing blueberries happened to be a promising activity. One particular example can be illustrative. In 1999 Jorge Pazos, a former executive from an important metal mechanics exporting firm, decided to reconvert his 7 hectare production of peaches and plums in Mercedes, 100 km westward from Buenos Aires city. He chose blueberries as a possible alternative and contacted Vergel. He acquired information from Vergel, visited its plantation and received advice about Vergel's production techniques. Nevertheless, he decided to buy the plants from Cuinex, which also offered specialized advice in production.

This phase of production diffusion displays interesting examples of cooperation among farmers in solving some potential coordination failures which, although not

crucial for making production viable, could lower their profits significantly. During the establishment phase of his project¹⁴¹, Pazos powered a union of farmers to improve commercialization and production techniques and to eventually cut costs. He called to a meeting in his home where 25 farmers and potential producers attended. His objective was to enhance the commercial possibilities of small farmers. Finally 13 farmers founded a cooperative. Most of these members were located around the Route 41 and near Mercedes, and had administrative - professional background and working experience. Afterwards, when a packing plant was required the members invested jointly in its provision (the invested amount was around US\$96,000). The cooperative also connected with other producers in distant locations, and eventually led to the formation of a farmers' association that provides some common services (contacting the government, promoting research, increasing SENASA's commitment to the sector, etc.). The CAPAB (Cámara de Productores de Arándanos y otros Berries) now has 600 members. Vergel, the pioneer, does not participate in this association.

On the whole, new producers and exporters arose in those years. While in 1998 Vergel was the only significant exporter, in 2001 there were seven new exporters. Their production and exports would continue to grow in the following years. Furthermore, new producers diffused the activity from Buenos Aires to other locations.

Third stage of diffusion

The last and most important stage of diffusion started in 2002 and was promoted by the currency devaluation and, very importantly, by the opening of the US market by the pioneer. This phase is characterized by a vertical integration of several of the major players. It is also characterized by a possible overinvestment in production in response to prices that remained too high for too long because of the poor yields of the initial plantations.

The market changed substantially during this period in comparison to the initial years. There were many nurseries that supplied different varieties of blueberries plants and propagation systems, numerous farmers and exporters. Furthermore, the incumbent firms signaled the feasibility of production and the profitability of the production and

¹⁴¹ The establishment phase is the period of time dedicated to prepare the field.

export activities, and also generated public goods in the form of refined technological knowledge. Newcomers could take advantage of this diversity of experiences, information and markets to develop new plantations. In addition, the 2001/2002 financial crisis and devaluation generated the odd circumstance that there were many investors that managed to maintain a large liquidity in foreign currency and who 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 in this post-devaluation context, when many investors were looking for alternatives to financial investments.

All these factors encouraged many investors to undertake this activity and hence the blueberry plantations boomed since 2002-2003. Clusters of newcomers proliferated in small plantations. Big firms or groups of investors initiated 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 to 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 US market opening by the pioneer played a very important role during this stage. It was stated in an interview of one of the biggest players that without having access to the US markets, the investment would have been to 200 hectares instead of 2000. In a counterfactual perspective, if the US export protocol had not been implemented blueberries would have had a tepid diffusion at least until an eventual association of firms had cooperated to deal with this issue.

Today blueberry production in Argentina has developed strongly, displaying vertically integrated firms and competition in all the stages, and is the most dynamic fruit export of Argentina.

Overall appraisal of diffusion

Newcomers explain 98% of the total growth of exports of blueberries between the early 1990s and 2005, which increased from US\$ 1 million to US\$ 28 millions. While Vergel increased its exports by 50% between 1998 and 2005, its importance in

the sector was reduced to represent only 4% in 2005. Exports in volume increased from 300 kg to almost 2700 tons in 2005.

Export shares by exporting firm

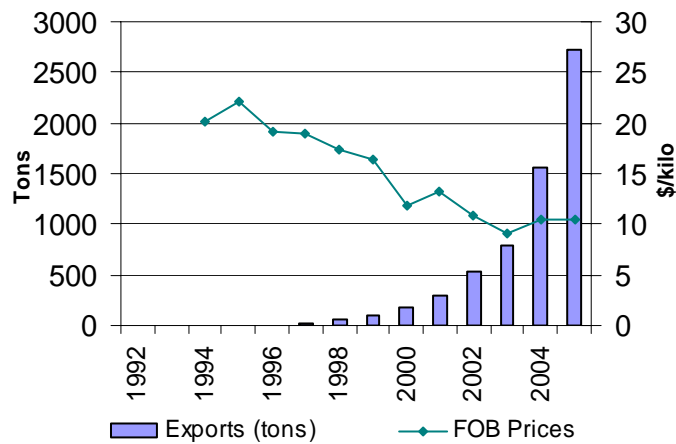
Firms	1998	1999	2000	2001	2002	2003	2004	2005
Tecnovital SA		14.21	31.89	8.73	25.82	16.67	32.78	23.36
North Bay Argentina SA				24.97	28.13	32.41	21.08	19.85
Berries del Plata SA		27.51	27.59	25.64	20.21	23.99	19.87	12.42
Blueberries SA						1.07	3.82	9.77
Vergel SA	79.32	57.45	6.85	23.33	14.93	11.05	6.98	4.13
Sri Argentina SA				10.54	8.32	9.74	6.70	3.67
Frutazul SA			1.34	1.98	1.16	1.15	1.32	1.72
Argesa Argentina exportadora SA				0.70	0.08	0.59	0.57	1.37
Hortifrut Argentina SA			0.20	0.12				0.92
Expofrut SA			6.02	3.92	1.33	1.03	0.49	0.16
Total share	79.32	99.16	73.89	99.92	99.98	97.70	93.61	77.37

Source: Customs Office Exporters Database.

The diffusion process is also reflected in the surface planted, which grew from around 50 hectares in a few locations in the beginning to 3000 hectares distributed in several locations in the present. The number of players rose from around 15 farmers at the onset to 600 producers nowadays, and from one exporter to 22 exporters, nine of which exported more than \$ 1,000,000 in 2005.

This diffusion had a clear impact in prices. While in 1994-1995 the FOB price of exports was US\$22 per kilo (and Chile faced a price below US\$2), the increase in production lowered the price to US\$10. It should be noted that this last average price includes the production in new locations that commands higher prices due to their early harvest season. In a more traditional zone (like Buenos Aires), where there has been bigger diffusion, the export price has gone down more significantly.

Blueberry exports



Source: COMTRADE

There currently exist fears that investment in production in the original zones may have overshot, probably because of prices having remained too high for too long because of the poor productivity of the initial plantations. Relevant evidence in favour of this view is provided by CAPAB’s recent initiative to block legislation that sought to introduce cheap credit lines for new plantations. The CAPAB managed to block the project that was being discussed by the Congress. Their arguments were that prices were already steadily declining and that a massive promotion of new plantations which would mature in seven years could lower the price even below break even point. They also argued that practically all blueberry producers are non traditional farmers that finance their investments with private savings, hence needing no financial support. They claimed that it would be better instead to give support to research on production in new zones that may allow an earlier harvest, or to lower export taxes and income taxes (which would benefit incumbents). Their current lobbying activity is focused on demanding financial support for investments geared towards improving the productivity of the existing plantations.

Our interviews indicate that in 2006 prices were already pretty bad for Argentina. Profitability now is not guaranteed and depends on the scale and efficiency of each individual producer, and the date on which the business was started. It appears that for many of the most recent investors it will take much longer than initially expected to recoup their investments. Nevertheless, the price signal is still not fully functioning and plantations keep growing at a steady pace, and are being financed with trust funds.

While the first movers in the blueberry business knew that it was going to be highly profitable because of the initially astronomic prices, they also knew that some day a convergence to Chilean prices would attain. But it appears that this convergence will occur much faster than expected.

7.2.8. Where there any coordination failures at the late diffusion stages? How were they solved?

The previous analysis has unveiled several coordination failures that could have hampered the growth of this sector. The most notorious one is the one related to negotiating the opening of the US market and investing in the required fumigation infrastructure, which was solved by the pioneer himself. He did it because it gave it access to a temporary monopoly in commercialization to the US, which more than compensated the erosion of profits when new fumigation chambers were set up by the competition. Cooperation between farmers would have been needed to provide this public good in the absence of the pioneer's initiative, and it is difficult to ascertain if it would have occurred. The pioneer showed once more that he was an individual with above average contacts, initiatives and ambition (and was also probably less risk averse).

The CAPAB's actions to generate public goods for farmers (the most notorious one being blocking legislation that could lead to an overinvestment) are other examples of cooperation. In this case they were not crucial for the growth of the sector, but they are very important for improving the current and future competitiveness of farmers. This cooperation is facilitated by the fact that CAPAB provides not only public goods but also club goods.

Finally, diffusion would have been slower if Cuinex and Tecnoplant had not invested in nursery activities using micro-propagation techniques. In this case their investments were driven that the high prices would eventually lead to the emergence of production as it actually happened. As their investments were bigger than the initial demand for plants that they faced given the initially limited diffusion of production, they also had to engage in promoting a bigger diffusion of this activity.

7.2.9. Role of previously accumulated capabilities, industry specific public goods and public policies.

There were no previously accumulated product-specific capabilities (like in the case of Chile, which had a previous tradition of producing and exporting other *fresh* berries) upon which this sector could be built. However, Argentina's comparative advantage in agricultural activities had generated a set of general capabilities which could be quickly adapted to this new product's needs. The country had accumulated general agronomic skills, and had an adequate endowment of well qualified agronomic engineers that could be trained to become experts in this new activity. The emergence of blueberries also benefited from the existence of an entrepreneurial class that was made out of former executives of large exporting firms, agronomic engineers with research and entrepreneurial skills that assisted producers in alternative crops, plus pharmaceutical firms with vast reaching interests and capabilities. In a later stage the entry of other fruit exporters (which had accumulated capabilities in apples, pears, lemons and so on) gave an extra boost to this sector, which further consolidated its growth.

All these general accumulated capabilities provided a good basis upon which to build the required product-specific capabilities. The latter included first having access to agronomic experts with product specific skills. This need was covered at first via the imports of consulting and technical assistance of foreign experts, who were also employed to train local experts. Further technological knowledge was acquired from US universities and nurseries. These imports of foreign experts that transferred knowledge and trained local experts who already had a good, albeit not product-specific, background recalls the case of BHH.

Other capabilities that had to be created were the emergence of nurseries that could develop plants that are suitable to local soils and weather. The creation of these nurseries was facilitated by the existing nurseries devoted to traditional crops and fruits and by the existence of biotechnology firms like Sidus, as this activity is intensive in biotechnological research in the area of plant cloning. Crucial to the growth of the sector was the creation of fumigation capabilities to meet the US sanitary standards, which was done by the pioneer.

This accumulation of product-specific capabilities was entirely done by the private sector, and was motivated by the expected private profits of doing so. In the section on welfare analysis we will argue that at the onset there was a below optimal investment in the accumulation of these capabilities by the pioneer, both because of financial constraints and because of the involved information and coordination externalities.

It must be remarked that these accumulated capabilities and Argentina's comparative advantage allowed to overcome the presence of some industry specific public bads that unduly raised the costs of experimentation and that hurt the competitiveness of local production. Chief among these bads appear SENASA's hurdles to import plants. Another big industry specific public bad has been the lack of eradication of the Mediterranean fruit fly. This pest significantly rises costs by forcing the fumigation of the fruit to enter the US, which additionally accelerates the ripening of the fruit, hence increasing transportation costs. This is a key difference with Chile, where this pest is absent. This pest proved to be an insurmountable obstacle to the exports of fresh raspberries, which ripen in 7 days and cannot survive a fumigation process.

A list of other examples of public bads ensues. According to the players in the sector, the lack of useful public policies has been one of the most important weaknesses of this export activity. The interviewed stressed the deficiencies of local institutions (particularly SENASA, INTA and Embassies) when compared to those of other countries. For example, they stressed that SENASA (the food safety agency) has been a constant barrier to importing the required plants or agrochemicals, and that it has been of little help in controlling the fruit fly or in helping producers to negotiate new protocols with the USDA. Indeed, one of the latest collective actions of CAPAB has been to place formal complaints to the government because SENASA has not yet authorized the use of certain fertilizers which are extremely important to increase productivity and which are being used elsewhere. In the case of INTA (the agricultural technology institute), they criticized its lengthy processes, its lack of knowledge of this particular fruit and the scarce extension activities. They also complained about the roles of embassies, which appear not to have contributed to the opening of new markets.

Specific support programs were also criticized for different reasons. For example, FONTAR, a source for financing innovation activities, would have been useful for Cuinex during its experimentation phase. However, this firm claimed that the allocation of this financing was affected at that time by the political clout of the applying firms than by the innovative and commercial potential of the project. We also obtained evidence that the PREX program, a subsidy for contracting export consulting, never reimbursed the funds to a producer who had access to its support.

Even when the public sector tried to do good almost ended up doing bad, as attested by the attempt to promote diffusion at a late stage when it could actually lead to overinvestment in the sector. This attempt was blocked by the CAPAB, providing a good example of cooperation and on information transmission between the public and private sectors.

The new export activity thus proved to be very resilient to inadequate policies and public institutions and is also enduring export taxes.

The demands of public policies by the private sector to support a non-immiserizing growth of this activity focus primarily on the provision of industry specific public goods (ISPG), and only secondarily on traditional claims of tax reduction.

Examples of ISPG being demanded include: a) support to research for developing new varieties in Patagonia, a region that would compete neither with present locations nor with Chilean production, b) credit support to R&D geared towards enhancing productivity of existing plantations, c) the development of a “cool treatment” protocol, d) agrochemical certification, and e) the provision of proper logistics in ports and airports.¹⁴²

7.3. Welfare analysis

Our welfare analysis suggests that the lack of public policies to support the development of this sector together with the presence of information and coordination

¹⁴² According to the interviews, logistics are not a main problem up to now, but new competition (particularly the export through Argentina of Chilean salmon) would increase the transport costs.

externalities led to a too slow growth of this activity. Due to this externality and to financial constraints, there was too little ex-ante experimentation in production by the pioneer, which was certainly much smaller to that of the social planner. The learning process by the pioneer during the production phase involved small scale experimentation –with not so good quality plants- in order to secure the commercial success of its operations. The investment to solve technical uncertainties was too little due to the small scale of the pioneer, who needed to be vertically integrated in order to be able to export, and to the expectation of future profit erosion. The lack of subsidization or of government involvement in the discovery phase made the pioneer want to achieve the monopoly optimum, which entailed a smaller investment than the social optimum.

The initial limited diffusion process combined with the lack of sufficient knowledge about production technologies resulted in an initially slow dynamism of production and exports together with a high rate of failure in new plantations. As it was mentioned above, following its initial investments the pioneer continued experimenting with new varieties by inducing new entrants at the production stage. As a result, export growth was small compared to the planted area, what caused prices to remain high for too long. This induced too many entrants and many of them of low productivity.

While no demand shifting effects were present, this case somehow fits into Vettas framework as the investments and exports of the pioneer and of subsequent entrants should have updated the beliefs about the market saturation point. However in this case there was a gap between the growths of investments and exports because of the poor productivity of the initial plantations. The demand revelation externalities may have failed here, as exports remained much more subdued than plantations for too long. Hence, while the initial investment was too small, diffusion of production eventually picked up, but possibly beyond the market saturation point. Here we have a case for the subsidization of the initial investment rather than diffusion. The case fits well into Vettas' framework because investment was too small at the beginning because of the demand revelation externality, but also because of the profit revelation and coordination externalities (as in HR).

This is also a case where the pioneer appears to have faced a smaller initial degree of uncertainty about all aspects of the business than the average player in the

sector. This lower degree of uncertainty was facilitated by his superior business planning, commercialization and networking skills. This should have resulted in a larger investment by the pioneer. However, the very large information externality made the pioneer anticipate the erosion of profits, bringing down the size of its initial investment.

The pioneer solved potential coordination failures via low scale vertical integration at the beginning and then through a limited diffusion of production, motivated by the high expected returns. His investment in coordination failures was also sub-optimal because of his aim to reach the monopoly optimum. There were many potential coordination failures challenging the growth of the sector at different stages, which also contributed to a too slow diffusion. Government intervention via subsidization, direct provision of ISPG or coordination of private investments would have been called for.

To sum up, in this *laissez faire* scenario the pioneer invested too little in experimentation to reveal the best production techniques and in the solving of coordination failures. This small investment was due to the combination of financial and scope constraints with the need that the pioneer had to secure a temporary monopoly power to compensate for the knowledge externalities. Diffusion was initially too slow and below its optimal level, and failed to adequately update the beliefs about the market saturation point, possibly leading to too much diffusion at the end.

This activity offers a positive social return, as it is based on the exploitation of an untapped natural comparative advantage. The solution of information and coordination externalities allowed to exploit a monopoly position in foreign markets and to capture positive rents in these markets without needing to shift profits from foreign competitors. These new exports also involved a large diffusion process that was widespread across different geographic areas and that involved the creation and accumulation of an important stock of new export capabilities. This accumulation of capabilities occurred at an industry level rather than within a small number of firms.

When looking at Hausmann and Klinger product space we observe that blueberries (SITC 579) are located in an area that is not too dense, halfway between the densest part of the forest and its outer edges. Moving in the direction towards the core of the forest, the exports of blueberries appear to lead to the accumulation of capabilities for the exports of chilled vegetables, frozen vegetables and vegetable juices, which

appear to offer similar productivities (in the sense of Hausmann, Hwang and Rodrik, 2005) as blueberries. In this vein, the development of exports of blueberry juice could be a fallback option should overinvestment in the sector finally occur. Indeed, there are already exporters of pear and apple juice to the US which are seeking to produce and export blueberry juice but fail to find any local supply of fruits, given the high price they fetch when exported as fresh fruit. While this does not look to be a very promising part of the forest, we must not overlook the fact that the production of blueberry plants via micro-propagation techniques in Argentina is closely linked to R&D in plant cloning and new varieties by firms that are involved in biotechnology applied to human health, animals and plants. Hence blueberries, at least at the nursery stage, could become part of a dynamic biotechnology cluster that generates technological spillovers across different activities.

Finally, this new export offers a large scalability in terms of future export growth, through the maturation of the most recent plantations and the incorporation of new regions that allow harvesting earlier than it is currently done and hence to continue enjoying monopoly power in Northern Hemisphere markets. It is estimated that in five years time the exported volume will multiply by eight and the exported value would reach US\$180 million (taking into account the decline in prices that would accompany this export expansion). These forecasts are based on the estimations of the area currently planted, and on the assumptions that productivity does not decline and that the sector would not face bottlenecks and would be able to implement “cold treatment,” among other things.

7.4. Counterfactual analysis ¹⁴³

We can isolate the most important factors permitting the emergence of blueberries as a new successful export activity by comparing its success with the lackluster experience in exporting other berries (fresh and frozen raspberries and strawberries) that share several basic traits with blueberries, but also differ along some important dimensions. We can also identify the factors that led to a socially sub-optimal initial investment in experimentation by the pioneer and to a too slow initial diffusion by contrasting the emergences of this sector in Argentina and in Chile, which differ in terms of the previously accumulated capabilities, the provision of ISPG and the intervention of the public sector in promoting discovery and diffusion.

We first provide a quick summary of the conclusions of this counterfactual analysis, and then provide a more in depth illustration and justification of the findings for Argentine raspberries and strawberries.

¹⁴³ **The following case description is based both in interviews and in bibliographic sources.**
Interviews: Cuinex – Nursery – Mercedes, Argentina – Marta Arriola, Finca el Martillo – Farmer – San Juan, Argentina – Enrique Meilioli, Mapuhue – Farmer – Necochea, Argentina – José Agustín López, Berries SA. – Production and commercialization – Neuquén, Argentina - Edmundo Grifoi , Vivero Humus – Nursery, Farmer and exporter – El Bolsón, Argentina – Luis González, Hortifrut – Commercialization – Chile – Carlos Vial, Tecnoplant / Tecnovital - Nursery, Production and Commercialization – Federico Bayá – Manager. Federico Bonsini – Operational chief, INTA– Esquel, Argentina – Agr. Eng. Raúl Copa, Agr. Eng. Esteban Guitart, INTA – El Bolsón, Argentina – Agr. Eng. Eduardo Martínez. **Sources:** INTA– Estación Experimental Agropecuaria Balcarce: “La Frambuesa”, July 2002. , INTA– Estación Experimental Agroforestal Esquel: “Evaluación de variedades de frambuesas”, Aug. 2003. Ministerio de Economía y Producción - Secretaría de Agricultura, Ganadería y Alimentos – Alimentos Argentinos – Cadena Alimentaria - “Frambuesa”, Universidad Nacional de Cuyo – “Frutas finas”. 2004, Universidad Católica de Chile - Facultad de Agronomía e Ingeniería Forestal – José Ruiz-Tagle. “Análisis de mercado y Rentabilidad de la frambuesa” June 2003, Chilealimentos – Cristian Stewart L., “Visión general de los Berries Congelados”, La Voz del Pueblo. Newspaper. “Fiesta de la frambuesa”, Clarin – Newspaper – “Agronegocios: producción y comercialización de frambuesas y otros berries” – sep. 2004, Diario de Cuyo – Newspaper – “El cultivo de frambuesas crece en Argentina”, Chacra – Sectoral magazine. “Breve panorama del Mercado de la frambuesa” Dic. 2003, Agrobot.com.

A failed attempt to export fresh raspberries and the inability to export fresh strawberries and frozen raspberries teach that the exports of fresh blueberries could emerge because of:

Classical comparative advantage. Because of geographical advantages fresh blueberries could be exported to the Northern Hemisphere during a period where they faced no competition from other Southern Hemisphere producers. These geographical advantages were not available to the other fresh berries, which had to compete with other established exporters, faced low prices and had no profit margins for undertaking protracted risky experimentation. The key feature was that for these other berries the activity proved to be unprofitable even if coordination failures were actually solved. Argentina could afford to enter relatively late into the world blueberry markets, while the other berries never stood a chance.

Low perishability. Blueberries take almost ten times longer to ripen than the other berries. This allowed it both to be exported fresh even using an initially unsophisticated logistics infrastructure and to survive fumigation to get rid of the Mediterranean fruit fly and be permitted to enter the United States market. These options were not available to the other berries.

In the case of blueberries there was a sophisticated entrepreneur that gathered all the relevant information and conducted a careful search and project evaluation before targeting this product. In order to start production he obtained adequate technical assistance from abroad. Pioneering micro-propagation nurseries shared somewhat similar attributes. This resulted in a bounded uncertainty for the pioneer. In the case of fresh raspberries the investment in discovery was undertaken by poorly informed farmers that appear to have been following a fad. In this case there was some experimentation by these farmers, but it showed a negative profitability.

In the case of blueberries the expected profitability after the initial experimentation by the pioneer was so large that it justified solving the coordination failures and investing in the opening of the US market by the pioneer himself. In the case of fresh raspberries initial experimentation revealed a low or negative profitability which did not justify investing in solving coordination failures, either individually or through cooperation among farmers.

Blueberries had no demand in the domestic market. The other berries faced a strong domestic demand (fresh, frozen or processed as inputs for the food industry) yielding sure profitabilities in the local market that exceeded the certainty equivalent of uncertain profits in export activities.

All these factors, especially the first two, suggest that exports of fresh raspberries were doomed to fail from the onset, even if sophisticated entrepreneurs had targeted this sector.

The factors underlying the bigger and faster diffusion of blueberries in Chile suggests that the initial investment in blueberries by the pioneer in Argentina was small and did not fully dissipate the technological uncertainty and that diffusion was initially slow because:

There were no previously accumulated product-specific capabilities in exporting berries. Chile had an important cluster of producers and exporters of other berries and local agronomic experts and nurseries with berry-specific knowledge that was adjusted to Chilean conditions. This was very important because Chilean blueberry exporters faced significantly lower world prices than the Argentine pioneer (and even higher costs of land). Hence their investment in this new activity could not afford to face the same period of experimentation with high failure rate that the Argentine pioneer and the first newcomers in production endured.

The pioneer in Argentina was financially constrained. Chilean pioneers had government support under a program to develop the berry sector in this country.

The state was not involved in experimentation in Argentina and gave no support to this activity (it actually provided some public bads). Hence Argentina featured too little investment because of the expected profit erosion that would follow the revelation of profitability by the pioneer. Additionally, the pioneer was initially a monopolist in world markets and sought to exploit his monopoly position before having learned about the most adequate production technologies. Finally, the Argentine pioneer invested relatively late in the opening of the US market also because he was considering only his private benefits. Contrastingly in Chile the discovery and diffusion of this sector was promoted by Fundacion Chile, which participated in Berries La Union, a public-private joint venture that did the socially optimal experimentation. Additionally Fundacion

Chile had also previously promoted investment in exports of other fresh berries, which had led to a significant accumulation of berry-specific knowledge and to the creation of a cluster of producer/exporters which were ready to take advantage of the technological and price information (harvest period) revealed by Berries La Union.

A key ISPG such as the eradication of the Mediterranean fruit fly pest was not provided. Hence the Argentine pioneer's initial investment and the first phase of diffusion of production were targeting only the relatively smaller EU market (plantations in Argentina boomed only when the US market was open). In contrast Chile was free of this pest, and the investments of blueberry exporters were always of a relatively large magnitude which was consistent with their access to the US market.

This assessment of the differences between Argentina and Chile are based on a comparison of the findings of our case study on blueberries in Argentina with those obtained by Bravo-Ortega and Agosin (2007) for the case of Chile.

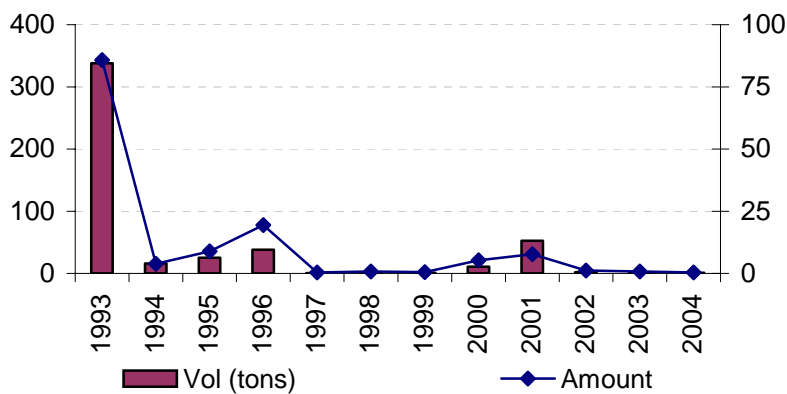
We now turn our attention to a more detailed account of the cases of raspberries and strawberries in Argentina.

Raspberries

We start by providing a brief sectoral background on this activity and then concentrate on justifying the points made above.

Raspberries are not a new product in Argentina, as they 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 US\$350,000, in exports announcing the possible emergence of a new successful export activity. Nevertheless, these exports went down to insignificant levels in the years that followed.

Export of Raspberries - Argentina



Source: COMTRADE

Production of these berries is traditional in the South and expanded northward to Buenos Aires and Santa Fe around 1989. Plantations in those areas boomed in 1993. The plantations were limited in size: from 1/2 to 5 hectares. The expansion in Buenos Aires and Santa Fe demanded planting around 40 hectares. This boom was driven by the following factors: the growing trend in world demand, the perception that it was feasible for Argentina to become a competitive supplier, cost- and quality-wise, of world markets and the possibility of cultivating this fruit in new areas to supply the Northern Hemisphere in the off season. There was not an identifiable first mover. Raspberry farmers wanted to export fresh production, based on the Chilean success. Initial plantations were limited in size, from 1/2 hectare to 5 hectares. These farmers gathered information from specialized publications.

The initial experimentation quickly revealed that Argentina had no comparative advantage in this product. Unlike the case of blueberries, Chile exported during all the off season.¹⁴⁴ These Chilean exports provided relevant information on the expected price range. While prices fluctuate according to the particular month, the amplitude rounds US\$2 to US\$4 (blueberries goes from \$3 to \$40). Logistics costs were instead unknown in the first exports and depended on the exported volumes, introducing a coordination problem. Exports on the other hand faced the challenge that domestic

¹⁴⁴ Argentina has to compete with Chile that has extended its production season from October to May. In Argentina, the harvest season goes from December to March. Additionally, recent Mexican and southern Spain competition in the crucial months of October and May had changed prices, what is affecting even Chilean exporters.

demand was very attractive. During the early 1990s the peso appreciation and the rise in the cost of labor affected the competitiveness of the sector. Furthermore, the local market demanded more raspberries than the local production capacity, leading to yearly imports of 260 tons frozen raspberries. The gains from exporting were low compared to its significant risk in logistics and commercialization. Local prices are around AR\$12/kg (US\$4), while export prices (in Chile) varies from US\$1.75/kg to US\$4.5/kg and the experiences of exports from Argentina show a price around US\$4. The frozen local market price is AR\$8/kg (US\$2.5) while FOB export price is around US\$2. In fact, Argentina had been importing (from Chile) an important proportion of its consumption. The local market (both for fresh and frozen raspberries) still has high prices relative to international ones. The devaluation of 2002 promoted the production of raspberries, that was oriented to import substitution rather than to exports. The competition with the domestic market is also reflected in the fact that the most popular and disseminated variety in Argentina (Autumn Bliss) does not have the required consistency for export. Nevertheless, given its particular flavor, is the variety with greater demand in local market and for jam production. Thus, there are low incentives to plant a particular variety for which domestic demand is lower.¹⁴⁵

Profits were thus significantly higher for blueberries. For example, blueberries have a yield of 8/10 tons per hectare and currently fetch a minimum FOB price of US\$8/kg FOB (US\$20 in the beginnings of the activity). Raspberries have a (riskier) yield of 5-10 tons per hectare and a FOB price of US\$4/kg. Additionally, raspberries costs of harvest are almost 3 times the ones of blueberries. The low yields of initial plantations were an inconvenient for blueberries but did not jeopardize its sustainability. However, for raspberries, initial shortcomings were a definite failure for several farmers. The competition with Chile explains the difference in prices. It also explains

¹⁴⁵ The most important variety for export is the Heritage, but some countries have particularities. For example, France demands Meeker almost exclusively. The production of Chile concentrates in these varieties: the Heritage represents 82%, while the Meeker variety accounts for 8%.

the lack of interest from importers from Europe, and inhibits the possibility of starting only small amounts in the beginning as in the case of blueberries.¹⁴⁶

Hence the problem was that export prices were too low and costs were too high. In the case of logistics costs the problem was exacerbated by a coordination failure in production, but the activity was unprofitable even with more competitive logistics costs. The lack of comparative advantage is confirmed by the fact that even Chile is having problems now to export fresh raspberries due to increased competition in the off season from countries that are closer to the main consumption centers.

Fast perishability added significantly to the costs of logistics. The post-harvest period for commercialization is very short. While blueberries have 30 days for consumption after harvest, raspberries have only 3 to 6 days to be consumed (which requires it to be shipped to the export destination in only one day). This demands an excellent logistic and commercialization procedure. The process includes a manual and delicate harvest (with 15/25 workers per hectare¹⁴⁷), the immediate cooling and packing of that product (including fumigation), its transportation by truck to the international airport, and by air to Northern hemisphere to its immediate distribution. Due to this fast perishability, the transportation by truck and then by plane demanded a level of coordination in the logistics that was never reached. What is more, perishability conditioned severely the possibility of choosing the optimal soils and climates for planting exportable raspberries, as localization near an airport is crucial for raspberries (but not so for blueberries).¹⁴⁸ Finally, perishability disallowed exports to the US, as the

¹⁴⁶ Furthermore, while the blueberry sector benefited from Chilean FDI in commercialization, raspberries did not attract the attention of Chilean traders because the harvest season in both countries coincides.

¹⁴⁷ While for local production 15 workers are enough, export quality and homogeneity of the fruit is reached only with 25 workers per hectare. A fruit that in the morning has export quality, at noon is inadequate.

- ¹⁴⁸ For example, the exports from Patagonia are an example of the difficulties in this matter. The fruit is harvested during day, packed and cooled; transport to the nearest airport takes more than four hours, and the lack of adequate trucks are an important limit; the first plain to Buenos Aires (generally at midday) transports the cargo to national airport, from where it should be carried to international airport and to its final destination. Thus, more than two days are required to transport the fruit with the additional risk of

fumigation required to get rid of the Mediterranean fruit fly would ripen the plant before it could reach its foreign consumption market.¹⁴⁹ This is a significant difference with Chile, the fifth world exporter of raspberries, which is recognized as free from this plague.

The lack of sophisticated entrepreneurs with superior business planning skills, commercial contacts and ability to network targeting this activity also had a negative impact, as the pioneering farmers gathered poor information and technical assistance. The main uncertainties that producers had to deal with were related to production and commercialization. Raspberry plants are quite fragile and several diseases can damage the plantations easily.¹⁵⁰ Such uncertainties could have been solved with adequate technical advice, which unfortunately was not easily available in Argentina, given its tradition of producing extensive crops, rather than fine fruit production. Hence farmers did some experimentation that revealed important information about profits and logistics, but they had to sink more capital (40 hectares that are costlier to plant and harvest) in experimentation than the blueberry pioneer (only 5 hectares in the beginning). The experience in Buenos Aires revealed that producing raspberries in alternative zones was feasible, but that exporting them was not profitable, given prices, local costs and the existing coordination problems. Furthermore, this kind of experience evidenced other additional aspects that restricted raspberry exports from Argentina.

interrupting the cool chain. In spite of all these problems, tests had been made to export from Patagonia. The locations such as Tandil, southward from Buenos Aires, match logistics requirements better: it only needs less than six hours of transport to international airport. Nevertheless, logistics is the main problem and an important cost.

¹⁴⁹ The most important markets are Germany, the US, United Kingdom, France and others. It is worth noting that the US market was not open in 1989 (there was no export protocol) and that now the product can only be exported to that country frozen.

¹⁵⁰ Production needs a soil with high PH, the weather should ideally be characterized by a cold winter and a fresh summer, with amplitude of temperatures between day and night (in order to increase the sweetness of the fruit). It is important to avoid winds that can damage the fruit, and frosts that affect both the flowering and the fruit. The harvest should not coincide with a rainy season to avoid fungus propagation. The plant requires 900mm/year of water, what usually demands irrigation infrastructure. Additionally, the plant requires a structure to grow and intensive prunes.

Better ex-ante informed farmers probably would have not invested in experimentation at all.¹⁵¹

Raspberries presented bigger coordination externalities than blueberries that would have benefited from having a leading entrepreneur solving them. However, even if this had been done still it would not have been an attractive business. Let us consider the coordination requirements for raspberries.

A plantation has to cover several markets given that the fruit quality is not homogeneous (only around 35% goes to the fresh market, while the rest has to be frozen or processed). One hectare during harvest season produces approximately 100 kg per day. Hence in order to export a relevant quantity (say 1000 kg) at least 30 hectares planted are required. Thus all the new farmers (which were exploiting small farms of 1 or 2 hectares) should be in strict coordination. The coordination is required to amortize the costs of logistics and to allow for the emergence of a commercialization channel. This coordination in production appears to have fleetingly occurred in 1993, but was discontinued as exports proved not to be profitable 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 ½ hectare to obtain 1000 kg of exportable, while raspberries require 30 hectares. This difference arises mostly because raspberries require to be shipped every day, while the production of blueberries can be stored for several days.

One other differentiating factor is that the comparative advantage in blueberries, together with its being targeted by sophisticated entrepreneurs and its low perishability, made it resilient to public bads, which did not happen in the case of raspberries. Public policies did not offer any support. For example, INTA's research activity and extension

¹⁵¹ Several technical aspects limited exporting this fruit. The production in the new locations was based on the experiences of Chile and Patagonia, imitating techniques and varieties. Nevertheless, these varieties of raspberries were inadequate for the Buenos Aires climate, and required some adaptation. The farmers had no experience in producing fine fruits, and the zone was not prepared to this new production: technical advice, suppliers, soils, etc were not adapted, impeding plantations to reach the minimum yield required to break even. The poor quality and sanitary conditions of the implanted material that were imported from Chile was also a relevant inconvenience.

assistance lagged behind private investment. In the experiences developing new locations, these kinds of institutions mainly analyzed *ex-post* the endeavour that private agents undertook rather than giving technical assistance. Logistics and infrastructure for exporting fresh fruit is not adequately facilitated, particularly in handling of the fruit in airports. Nevertheless, given the revealed lack of profitability it is hard to argue that support policies should have been in place for this sector. It is however the case that these public institutions often raise the cost of experimenting, as it happened for blueberries and raspberries, which is bad for self-discovery.

Finally, the comparison with Chile shows that while Argentina could afford to enter relatively late into the world markets for blueberries, this possibility was not made available in the case of raspberries. Raspberry production in Argentina competes with traditional and profitable extensive crops, which conditions the accumulation of capabilities and the experimentation in new activities. Contrastingly, fruits are one of the main export items in Chile, reaching a value of US\$ 2100 million in 2005 (5% of all exports). The raspberries sector in Chile expanded in the 1980s, with big plantations of about 50 hectares. This investment validated the infrastructure construction for cooling logistics, coordinated by the government support.¹⁵² But mostly, Chile entered the market first, what allowed them to finance logistics costs and experimentation phases.

Strawberries

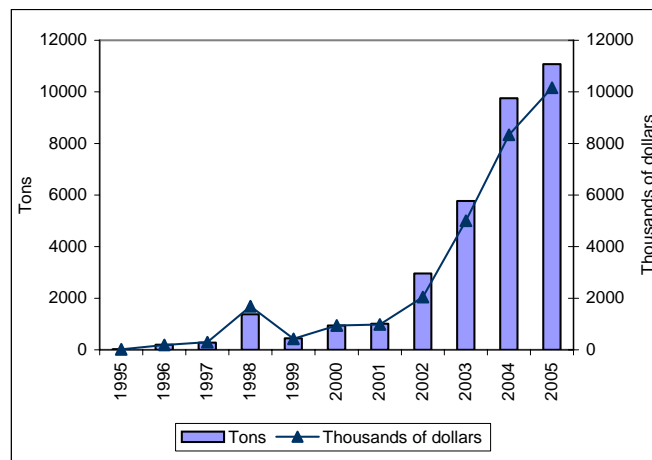
This fine fruit offers another example of lack of Argentina's lack of comparative advantage for exporting any fresh berries other than blueberries. However, there is a big production of this good in Argentina and there has been a recent boom in the exports of frozen strawberries, which contrasts with the case of raspberries, which are not exported in any form. This difference between frozen raspberries and strawberries is due to the fact that the latter were traditionally produced at a relatively large scale for the domestic market, especially as an input for the food industry, which led to the accumulation of

¹⁵² They harvest and transport to Santiago during the night, to export in the first fly of the next day. Prices have lowered because of the competition of Mexico and Spain and big plantations (with salaried workers) are not profitable any more. Exports are from small plantations (with family work) that commercialize jointly, grouping in origin in packing plant that generates the scale for export.

production and logistics capabilities that facilitated the exports of frozen strawberries when the devaluation substantially reduced labor costs. However, there has not been any investment in export oriented production. All the new exports were based on a substitution of the domestic for the foreign market without increasing the planted area or investing in new technologies or varieties. It is not yet clear that these new exports would survive an exchange rate appreciation, as the domestic and foreign markets appear to be close substitutes.

Let us start by providing a brief background on the sector. Due to the diverse climates present in Argentina, strawberries can be cultivated all year long. Its production is not a new activity in the country, as the first plantations in Coronda (Province of Santa Fe) date from 1919. There were not significant exports, neither fresh nor frozen, until 1992, when exports of frozen strawberries got started. These exports began to grow very fast after 2002.

Argentina: Frozen strawberries exports



Source: IERAL de Fundación Mediterránea based on Direction of Eating Industry

Strawberry plantations currently reach 1,100 hectares, and Coronda has the largest cultivated area (450 hectares). This zone produces approximately 10,000 tons of strawberries per year. In Tucuman, 290 hectares are destined to this plantation. The rest of the production is distributed between the Northern provinces and Buenos Aires.

Between 30% and 40% of all this production is sold in the domestic market (half of it is sold fresh and the other half is sold frozen to the local food industry). Although the amount of hectares planted grew over time, the fundamental drivers of the increase in production were the productivity gains during the 1990s, when the production of strawberry experienced important technological advances which allowed increasing the yields.

As in the case of fresh raspberries, Argentina does not enjoy a natural comparative advantage in fresh strawberries. World markets are populated with suppliers from across the globe all year long, and transportation costs are an insurmountable disadvantage (for Chile as well), especially given the fast perishability of this fruit. The main exporters of fresh strawberries are the US (which is also the largest producer and consumer) and Spain. The average export price for the Argentine exports of fresh strawberries during the 1990s fluctuated between US\$ 1.5 and US\$ 2.9 per kilo, and the high costs of transportation by plane and the required cooling facilities made it an unprofitable endeavor.

In 2005, from the total volume of strawberries' exports, 99% corresponded to the frozen ones and just 1% to the strawberries in fresh conditions (11.074 tons of frozen strawberries versus 116 of fresh strawberries). There is even doubt that Argentina may enjoy a comparative advantage in frozen strawberries that sustain these exports if the local currency appreciates. The biggest exporters of frozen strawberries are Poland, China and Mexico, while the biggest importers are Germany, the US and Japan. Chinese exports of frozen strawberries have been growing at dramatic rates, increasing 1000% during the past 10 years and reaching 86,330 tons. Argentina, which sold 11,000 tons in 2005, is the 10th leading exporter of frozen strawberries but is at a disadvantage transportation-cost and scale wise (smaller scale economies).

Argentine exports of frozen strawberries started to pick up in 1997 because of bilateral exchange rate advantages vis-à-vis Brazil. In 1999 exports suffered an important decrease (68%) because of Brazil's devaluation at the beginning of that year. The second export jump was in 2002, mainly as a consequence of the devaluation of the Argentine peso. Strawberries sales are very sensitive to fluctuations in domestic purchasing power, which was severely affected after the crisis, so most of the exports after 2002 resulted from re-direction of domestic sales and not from an increase in total

production. Exports allowed using the idle capacity caused by the domestic recession. After the 200% growth of the export volume in 2002, the exports continued growing, but at smaller rates year after year.

The re-direction of sales towards foreign markets in response to the devaluation was made possible by productivity gains, investments in logistics and in quality upgrading and solutions of several coordination failures made during the 1990s, originally with the purpose of meeting increased quality demands from the domestic food industry. Technological innovations during the 1990s elevated productivity from 11 tons per hectare to 40 tons per hectare nowadays. The innovations involved changes in planting techniques and in irrigation and fertilization methods, and the introduction of new varieties. Better yields and quality also resulted from moving nurseries to new colder and more elevated zones (almost all the plants used in Coronda are generated in Rio Negro, Mendoza and Chubut).

It is interesting to highlight that the emergence of the frozen strawberry sector was motorized in the 1990s by traditional strawberry producers which were trying to meet the increasing demands of a local food industry that was upgrading its quality in response to a more sophisticated domestic demand and to the opening of the export business. These first movers resolved the relevant uncertainties and coordination failures, often times in cooperation with downstream firms in the food industry. The pioneer was Fruticor, located in Corrientes, who produced frozen strawberries exclusively, but played no key role for developing this activity. This was a strawberry processing firm that was a supplier of the local industry and then started using the same freezing process to export this fruit to Brazil. However, a rise in the local price of fresh strawberries caused a shortage in the fruit available for freezing, which made the firm be sold. Frozen strawberries exports started to be exported at large scale after the devaluation by either already established companies or associations of producers (*Cooperativas*). Most of the producers had already experience in supplying the internal market, and benefited from experience in handling frozen strawberries, and started exporting when the foreign market became attractive. Cheap capital goods in the early nineties allowed a modernization of the industry. In Tucuman and in Santa Fe, the main producing areas, the first exports of frozen strawberries were undertaken by firms and cooperatives that were selling these frozen fruits in the domestic markets to large food

firms such as Arcor and La Campagnola (to be used as fillings and for the preparation of preserves) and to the local dairy industry.

Exporting to the Northern Hemisphere (66% of Argentine exports are shipped to the US) introduced some specific requirements that could be met only by the largest firms and by those which organized in cooperatives (as in Coronda) to provide some required ISPG in the area of logistics and quality. Smaller, less technologically updated, firms could not export. It is interesting to highlight that while cooperation emerged among small producers in Coronda

Currently, nine firms concentrate 70% of all Argentine exports of frozen strawberries, with four of them supplying 55.8% of these sales. This is quite a contrast to 1998, when the two major exporting firms accounted for 55.2% of total exports. It must be stressed that the share of the major exporter in 1998 (35.2%) declined to 0.83% in 2005, whereas the two biggest exporters in 2005 (with respective shares of 19.4 and 14.9%) were not exporting in 1998.

There were uncertainties related to the production process and the quality of the plants and to the limits and regulations imposed by export destinies to the uses of pesticides. The main producers could overcome these uncertainties because either they individually had the resources and accumulated capabilities to invest in testing, etc, or because the cooperatives coordinated their investments. Unlike other cases, producers agreed on the positive role of public institutions (INTA, etc.) in gathering information and providing them with advice to develop the activity.¹⁵³

This is an interesting case because it reinforces the finding that being able to export fresh blueberries is an exception among berries, thanks to its lower perishability and lack of competition from other countries in certain off season months. It is also interesting because in the case of strawberries there were clusters of well organized producers that could coordinate to provide ISPGs and to solve uncertainties, and yet could not export fresh strawberries. Even in the case of frozen strawberries, this coordination capacity had a value only when the currency was devalued.

¹⁵³ For example, INTA has an experimental station to produce strawberries through which it diffuses best practices, provides training, etc.

The role of INTA and other public sector agencies in accompanying the growth of this sector is remarkable, as it was absent in the other berry cases. We conjecture that it was due to the long standing tradition of this activity (almost a century), its large scale (11 thousand tons of exported frozen strawberries vis-à-vis 2.8 thousand tons of exported fresh blueberries), and its identification as a sector populated by SMEs with a relatively large employment impact in some more backward regions.

7.5. Conclusions of the blueberry case

This case is the one that fits more nicely into HR's framework of discovery and diffusion, albeit with some interesting twists, especially in what concerns the actions undertaken by the pioneer to deal with the involved externalities.

Our case study analysis reveals that the exports of fresh blueberries in Argentina were successful because:

There was an untapped comparative advantage, resulting from relatively low competition in the Northern off season market and from the low perishability of this fine fruit.

General accumulated agronomic capabilities were available, allowing the rapid acquisition of product-specific capabilities.

It was targeted by a pioneer with superior business planning skills and ability to network, whose information collecting process allowed him to face a smaller uncertainty than the industry average.

The pioneer could compensate the knowledge and coordination externalities with a temporary monopoly power given by the time lag it would take for the investments of followers to mature.

There were sizable uncertainties regarding production technologies, locations, harvest dates and returns, which were solved by the pioneer through experimentation in anticipation of temporary monopoly profits. His luck in finding the most profitable production location allowed him to start producing with positive profits even with inadequate initial technologies. There were also potential coordination failures in the emergence of all the involved production and commercialization stages, which the pioneer solved through small scale vertical integration at first and limited diffusion of

production later on. This small required investment was facilitated by the fact that the pioneer faced no competition from abroad in the off season market it sold its first exports. The solving of coordination failures by an individual firm was possible only because of the very high profits revealed by the pre-competitive experimentation of the pioneer.

However, the lack of government support and/or intervention made the ex-ante investment by the pioneer be sub-optimal, leading to low initial productivity and small initial diffusion, which may now result in an overinvestment as export prices remained high for too long. *Id est*, the lack of government intervention resulted in small initial experimentation, productivity, production, exports and diffusion, and in too much production in the end.

The fact that two other pioneers emerged simultaneously at the nursery stage in expectation of a positive response of production to high prices suggests that the activity would have emerged anyway, but without the pioneer it could have taken even longer than it did.

This case represents a class of activities with large information and coordination externalities that can emerge in competitive equilibrium only when there is a clear untapped comparative advantage which more than compensates these externalities and the presence of public bads.

8. Development implications

Hausmann, Hwang and Rodrik (2006) show that increasing the sophistication of a country's exports contributes significantly to economic growth, and argue that this increase in sophistication requires that entrepreneurs invest in the discovery and diffusion of new export activities that are fraught with information and coordination externalities.

Hence the most important development implication is what the new exports we analyzed tell us about the drivers of discovery in Argentina, and on the returns to investment and their appropriability, in the manner proposed by Hausmann, Rodrik and Velasco (2006).¹⁵⁴

The discoveries analyzed here are associated to pioneers that manage to capture (temporary or permanent) monopoly rents to compensate for the knowledge externality through the introduction of barriers to entry and that have the scale to self-provide the required ISPG. We did not find any case where there was government support or intervention in the discovery and diffusion processes. In the case (blueberries) where the pioneer could not introduce permanent barriers to entry, there was sub-optimal investment in discovery but diffusion eventually emerged, albeit later than it was socially optimal. In the other two cases, where the pioneer could introduce more prolonged barriers to entry, investment in discovery was not sub-optimal.

This suggests that, if these cases were representative of new exports in Argentina, discovery may be failing to occur in more atomized activities where the pioneer may not enjoy temporary monopoly power, because of the lack of subsidization of discovery or because of inability to coordinate in the provision of ISPG. This tells us that it is possible that there is a low appropriability of the returns to investment in self-discovery which is detrimental to development in Argentina.

On the other hand, the fact that some new exports have succeeded in the absence of government intervention suggests that there are new profitable opportunities which, when exploited, lead to learn about new opportunities, thus sustaining investment. It also suggests that, given the availability of good opportunities (with a vast range of

¹⁵⁴ "Growth Diagnostics," HRV (2006), mimeo.

accumulated capabilities in different sectors arising from import substitution, university education, more traditional exports, etc.), policies and public investments that promote discovery and that facilitate experimentation could have a big impact on development.

The cases analyzed here also reveal interesting information about the roles of accumulated capabilities and their implications for development. For instance, biotechnology applied to human health (a highly sophisticated or productive activity) could emerge only because Argentina had accumulated a relatively large stock of researchers in the area of life sciences that were conducting basic research in public universities and research agencies, and which could be re-oriented towards commercially oriented R&D in BHH. In this sense it is a good example of getting access to large payoffs from public investing in basic science that could not be foreseen when this investment decision was made. This discovery was also made possible by the presence of large national pharmaceutical laboratories which previously had not conducted any research but had the resources and the need to invest in these new activities, and which also could identify the most interesting niches in BHH for a country like Argentina. This was another unexpected payoff from having a regulatory framework that facilitated the existence and operation of these laboratories. This activity is also very interesting in that it leads to the accumulation of capabilities (in the form of general learning about R&D in BHH) that facilitate targeting more sophisticated BHH products and richer markets, and also to discover new exports in other related activities such as electro-medical apparatus, dairy machineries, organic chemicals and other pharmaceutical products. This is a sophisticated new export which offers technological spillovers that have led to the creation of a dynamic cluster of BHH firms of different sizes. Another point to be made is that it is a case of created comparative advantages. The combination of good general research capabilities in life sciences and of entrepreneurial capability and animal spirits led to an accumulation of industry-specific knowledge that resulted in a created comparative advantage. This created comparative advantage is likely to deepen over time as local BHH firms accumulate bigger R&D abilities and as more sector-specific human capital is accumulated.

The case of blueberries was based on the accumulation of general agronomic skills that Argentina had, which could be adjusted to the new product specific needs after adequate training, acquisition of foreign production knowledge and local

experimentation. It also benefited from having access to a sophisticated entrepreneurial class that was actively seeking for new agricultural activities where Argentina could enjoy a comparative advantage and where there would be limited foreign competition. This case displays an increased accumulation of skills and capabilities (in production, logistics and commercialization) for precision agriculture activities in general, which may be useful for jumping to new agricultural activities of higher sophistication and value (such as exporting chilled vegetables and fruits, new fruit juices, or finding new niches). This case also offers the possibility of accumulating increased R&D capabilities in biotechnology applied to plants, which may have cross-sector externalities, as much of this R&D is being performed by firms that are involved in biotechnology applied to human capital and to animals as well. The accumulation of capabilities in this case occurred at a widely diffused industry level.

The case of chocolate confections is interesting in that there is a reversal of a revealed comparative disadvantage. This is an industry which at a world level is dominated by a few vertically integrated firms from rich countries which also have a large degree of monopoly power in their home countries. The market for these goods is populated by brand, technological and scale barriers to entry. Hence, it is remarkable that a firm from a developing country could become an active worldwide exporter. To this end it had overcome others' barriers to entry and to introduce barriers to entry of its own. The industrial organization of this good's market made it necessary that the accumulation of capabilities and diffusion of production occurred at an intra-firm level. Some capabilities were also accumulated by suppliers of specialized inputs, which nevertheless appear to work almost exclusively for the pioneer. These accumulated capabilities could result in future exports of original new chocolate and sugar confections developed through R&D activities, which contest rich country markets. Chocolate confections are in the periphery of the densest part of HK's product space and could lead to new exports of aluminium wrapping, packing material and related goods.

Our case studies also provide interesting insights regarding the links between diffusion and contribution to development by the new exports. A common view is that the contribution to development will be bigger the bigger is the diffusion. However the validity of this view will be conditioned by factors such as the industrial organization of

the new goods markets (ability to compete in oligopolic markets), the roles of financial resource constraints, and the ability to overcome coordination failures through collective action. For instance, in the case of chocolate confections a bigger diffusion would probably result in duplicated sunk costs and a split of foreign demand by local exporters, leading to a possible immiserizing growth (and the accumulation of fewer capabilities and ability to overcome coordination failures for subsequent new exports). In the case of BHH, the absence of a venture capital market requires that firms internally finance their risky R&D in new BHH products, hence calling for relatively large profitability. Additionally, in the case of BHH there is a trade-off between scale and variety which puts a ceiling (not yet reached) to the optimal level of diffusion.

The cases analyzed here show diversity regarding the size of the initial investments to be made by the pioneer to solve the involved uncertainties and coordination failures. These investments were relatively large in the cases of chocolate confections and BHH and relatively small in the cases of blueberries, which also benefited from a clear cut comparative advantage. These differences in the required initial investments are naturally going to lead to different market structures in the newly discovered activities, as the former two required the presence of relatively large firms with access to internal financing.

Hence when we look at which activities should be promoted we should look at their sophistication and to the expected accumulation of capabilities for subsequent discoveries, regardless of whether this accumulation occurs at a firm, industry or economy level. This argument is made more complicated by second best considerations when there are capital market imperfections and the government is an absentee landlord.

The case of chocolate confections is also typical of many activities in a semi-industrialized economy like Argentina in that the most important uncertainty will usually be related to foreign demand and commercialization strategies rather than to local costs or the ability to produce the good. In this sense, a good development strategy should include policies and initiatives geared towards supporting the acquisition of foreign commercialization capabilities, especially in those activities populated mostly by SMEs.

An important feature of demand and commercialization uncertainties is that their resolutions may generate cross-border externalities (as in the case of chocolate

confections), which lead to a regional or international profit-eroding diffusion rather than to a local diffusion. When we look at the contribution of these new activities to development we should thus define if we are concerned with local or regional development. If we are worried about local development then these activities would probably not be the most attractive, unless they were able to introduce barriers to entry that offset the cross-border externalities (in which case we would have to accept limited or no local diffusion) or the government implemented strategic trade policies.

The cases of chocolate confections and BHH also highlight that for new exports to succeed and to contribute positively to development in markets where there is some degree of vertical or horizontal differentiation it is important to enter world markets at an early stage of the product cycle, and to accumulate capabilities for jumping early to new products when international competition in the original goods markets is becoming intense. A late entry into some markets may render commercially useless the previously accumulated capabilities.

In all our case studies national firms played a key role in the process of discovery of new export activities, whereas local subsidiaries of MNCs were not involved in any discovery and in some cases got involved in the diffusion stage. Our interviews with both local firms and MNC subsidiaries that are present in the analyzed sectors suggest that the lack of involvement of local branches of foreign firms is due to the fact that they are usually constrained by headquarters to engage only in activities which offer a positive return with as little uncertainty as possible. The intra-company competition with subsidiaries of the MNC in other countries also reinforces this conservative approach to engaging in new risky businesses. Hence they cannot invest in risky experimentation and foreign market promotion, which are the bread and butter of the discovery of new successful export activities. MNCs can be active participants of the diffusion process once the new activity has proved to be profitable and to have bounded risks, as in the case of Chilean fruit traders entering the commercialization phase of the blueberry sector in Argentina, or the cases of Nestle-Garoto and Kraft-Lacta in Brazil, which entered into the regional export market for chocolate confections once Arcor experimented and revealed regional demand and the best commercialization strategies. As such, FDI can be a useful contributor to the diffusion process and possibly bring some spillovers in the form of improved commercialization and production

techniques and technology transfers once the activity has been discovered. However, discovery appears to require giving support to experimentation by local firms and to the facilitation of their acquisition of foreign production and commercialization knowledge (through the hiring of consultants, for instance), when needed.

A final consideration which arises from the case studies we analyze here refers to how open the world markets are to the discovery and diffusion of new export activities from LDCs, especially in some activities that entail bigger export sophistication. This is the case for BHH, where there exist huge barriers to entry to rich country markets, and for chocolate confections, which face large tariff and non-tariff barriers to enter the EU markets, for instance. While world markets may be open to many industrial manufactures, new exports that are based on an increasing sophistication of agriculture-based goods (a natural area for discovery in many LDCs) face stringent protectionist measures in rich country markets, and the same applies to pharmaceutical and BHH goods, and possibly many exports of services. Additionally, while many industrial manufactures may face low tariff barriers, they still have to deal with growing and more opaque technical barriers to trade in rich countries, which at times may be justified on scientific basis and/or reflect increasing consumer demands for product reliability but which often reflect a pure protectionist aim. In the face of these protectionist measures, the scope of relying on the emergence of new and more sophisticated exports as a passageway to development may be constrained.

9. Policy implications

We must distinguish policies according to the particular aspect of the emergence of new successful export activities they seek to foster or to facilitate, and to the natures of the involved information and coordination externalities. The aspects that must be considered are:

- General facilitation of experimentation
- Targeted promotion of pre-competitive experimentation
- Targeted promotion of continued experimentation once pre-competitive experimentation revealed technological and commercial viability of new activity.
- Resolution of coordination failures.
- Promotion of diffusion.
- Accumulation of capabilities and provision of ISPG in advance of the emergence of the new export.
- Accumulation of product-specific capabilities and provision of ISPG that were absent when the new export was discovered.
- Whether the uncertainty involves local costs, production capability, foreign and/or commercialization.
- Whether there are cross-border externalities.
- The use of strategic trade policies when there are cross-border externalities.
- Financing of discovery and diffusion when venture capital is not available.
- The need to overcome technical barriers to trade.

The first policy implication of our case studies is that bigger government support to discovery is required, as in the cases where the pioneer cannot secure permanent monopoly power there is a sub-optimal investment in experimentation and diffusion occurs too late.

An important lesson we obtain is that there is ample room in Argentina to promote discovery via improvements in the functioning of public institutions that are involved with technical assistance and regulation of different activities such as SENASA (the food safety agency), INTI (the National Industrial Technology Institute)

and INTA (the National Agricultural Technology Institute), to name a few. The case study of blueberries shows how the poor bureaucratic functioning of SENASA and inadequate technical assistance from INTA operated as public bads that could be circumvented only because of the very high revealed profits. There could be many other activities with positive social returns that fail to be discovered because the expected profits are not large enough to overcome the bureaucratic hurdles and the lack of adequate technical assistance.

The blueberry case also raises the issue of whether the government should be involved in giving targeted support to pre-competitive experimentation (as in the case of Fundacion Chile), or if it should design and implement mechanisms that support discovery after the pre-competitive experimentation has revealed the new activity to be profitable and to have a potentially high social return but the pioneer still has not sunk significant capital in production. If this support had been available, there would have been a much bigger investment in fully mastering the production technologies and a faster diffusion. The same applies to the solution of coordination failures. In cases like blueberries it probably would not have made sense to have the government trying to promote coordination in nursery, production and commercialization before the pioneer revealed this to be a profitable activity, but it certainly would have been socially optimal to do so after the pre-competitive experimentation. In the same vein, it would not have made sense for the government to negotiate the opening of the US market before the sector actually existed in Argentina, but it would have been socially optimal to do this once the sector got started.

Our case studies also reveal that the implementation of policies that promote diffusion does not always offer a positive social return. This would be the case with chocolate confections, where world markets call for large integrated firms that can introduce and maintain barriers to entry, and where local diffusion could be immiserizing. The timing to promote diffusion also matters, as in the case of blueberries which should have been promoted early and not a late stage when there is the risk of overinvestment in this activity.

When diffusion is advisable, the best policies are not always financial support or subsidies, but could entail the provision of ISPG such as improved technological assistance or the opening of the US market, as in the case of blueberries. In the case of

BHH, which is a R&D intensive activity and where more diffusion is desirable, the best policies include providing access to long term financing through credit channels like FONTAR (Fondo Tecnológico Argentino, funded by the IDB) that substitute for the absence of a venture capital market. Other policies include those geared towards accumulating more human capital with sector specific skills, for instance by giving grants to study and do research in the life sciences area, by allowing for public sector scientists to engage in internships in private BHH firms (as it was recently done), and by interacting with private BHH labs in the definition of the educational contents of the involved careers. More generally, the cases of blueberries and BHH suggest that the government need not be involved directly in the provision of many ISPG, but rather that it could help by promoting the coordination among private agents to this end.

Another interesting issue is whether the accumulation of sector-specific capabilities and ISPGs should be done ahead of the discovery. The cases analyzed here suggest that general accumulated capabilities and ISPGs were extremely important for the discovery and the sector-specific capabilities and ISPGs could be developed afterwards. However, the direct provision by the private sector was usually smaller and slower than optimal (save for the case of chocolate confections, where the monopolist appears to have undertaken the socially optimal investment). Hence there is need for the public sector to become engaged in providing a quick response in the areas of capabilities and ISPGs.

We also obtained important lessons regarding the links between the nature of the externalities involved and the desirability of policy support to the new exports. For instance, in the case of chocolate confections there were cross-border externalities together with barriers to entry that prevented that local firms take advantage of the information externalities. This is thus the case of an activity where the case for the subsidization of discovery is attenuated. Furthermore, this is an activity where a private monopolist undertakes the same investment that a social planner would undertake because of its ability to introduce barriers to entry. The promotion of the discovery of activities where there are cross-border externalities and where the pioneer cannot introduce barriers to entry calls for a combination of support to discovery together with strategic trade policies that prevent foreign competitors from taking advantage of the information externality. This would complicate the welfare analysis as the optimal

strategic trade policy depends on the generally unknown mode of competition, and also because it is not socially optimal from a global point of view.

Improving market access through trade negotiations, mutual recognition agreements in the area of technical regulations and sanitary and phytosanitary standards, technological assistance to comply with technical regulations and product standards, and so on, would increase the attractiveness of investing in new export activities. Several of these issues were present in the blueberry case.

Policies that facilitate import substitution appear to have led to some accumulation of the required capabilities (national pharmaceutical labs) for the emergence of BHH exports. However, it is easy to find many counter-examples of protected activities that offer no perspectives of becoming a new successful export activity. Hence it is not advisable to prescribe import substitution as desirable new export promotion policy. Indeed, the incentives may go the other way by introducing an anti-export bias. In the case of BHH this bias was overcome only because of the exhaustion of rents in traditional pharmaceutical activities.

The cases analyzed here emerged during the 1990s, when the currency was not depreciated. The 2002 devaluation only had a sizable impact on the production and exports of blueberries, partly because of reduced labor costs and partly because the devaluation attracted many local investors with a large liquidity in foreign currency which lacked alternative financial investments. Instead, in the cases of chocolate confections and BHH, which are much more capital intensive, the devaluation had a neutral effect. Indeed, currency appreciations in some cases favor discovery by lowering the costs of importing capital goods with incorporated technological knowledge and the costs of acquiring technical consulting services from abroad. Our counterfactual analysis for blueberries shows that the devaluation bolstered the exports frozen strawberries, but by re-directing sales from the local market to foreign markets and without no increased investment in production. Hence an eventual currency appreciation could easily bring down these exports. Indeed, this happened in 1999 with the devaluation of the Brazilian currency. Hence our case studies offer no general lesson regarding the role of devaluation on discovery and diffusion. The more than we can conjecture based on these cases is that devaluation may favor the discovery of labor-

intensive activities but may have a negative effect on the discovery of capital-intensive sectors.

10. Conclusions of case study analysis

The conclusions of this study are spread in the analyses of each case study and in the evaluation of the development and policy implications of the new exports analyzed here. In this section we summarize and put together these conclusions.

New successful exports can range from discovering untapped comparative advantage (blueberries) to the creation of comparative advantages (through product differentiation and accumulation of product and process specific knowledge, as in the cases of BHH and chocolate confections).

These new exports may reflect self-discovery of comparative advantage (blueberries), exploitation of knowledge niches (BHH), or the introduction of barriers to riches (chocolates) which in some markets for horizontally differentiated goods may actually be barriers to poors.

In the absence of government intervention, new exports are more likely to emerge in those sectors where there are entrepreneurs with superior international networking and business planning skills and/or there are larger firms that can self-provide the required ISPG.

The availability of accumulated capabilities and ISPG in related activities was a key ingredient in all the new exports analyzed here. These accumulated capabilities and financial resources helped finance the new developments, ex-ante reduce some of the involved uncertainties and focus on the projects with the biggest chances of success. This means that not all the potential new export activities are alike and that there may be path dependence in the choice of these activities.

In the absence of government support to, or involvement in, discovery processes, it is more likely that new exports will emerge when the pioneers can introduce permanent or dynamic barriers to entry. If they can only introduce temporary barriers to entry, the *laissez faire* investment in experimentation will be sub-optimally small.

The new exports analyzed here included pioneers that were either better informed and had superior networking and business skills than the industry average (blueberries) or that had accumulated the required capabilities at an intra-firm level (chocolates) and had the scale and resources to finance the required ISPGs (chocolates and BHH) and to solve the potential coordination failures by themselves.

These findings point to the possibility that we may see relatively little investment in discovery in activities with more competitive fringes. In addition, the revealed poor functioning of support policies and institutions appeared to tip the scale in favor of pioneers that are “insiders,” i.e., which have bigger informal access to public sector support.

The pioneer’s commitment to exporting and/or to undertake risks was very important. Indeed the pioneers are all national firms/entrepreneurs that were willing and able to take chances in risky investments in the discovery of new activities. This sets them apart from the local branches of multinational corporations.

The emergence of new exports can involve solving uncertainties about local costs, production technologies and foreign demand and commercialization strategies. Each type of uncertainty has different implications for the optimal diffusion process and the optimal policies.

Success in the discovery of new activities, particularly those that involve differentiated goods, is facilitated when the pioneer focuses on a relatively narrow range of goods to increase their chances of success and targets products that already exist somewhere (innovative imitation) so as to get rid of uncertainty as to whether there is a market for these goods (in the case of BHH this strategy also eliminated the clinical approval uncertainty). The chances of success are further enhanced when the pioneers focus on market segments that were not targeted by rich country competitors.

Some of the cases analyzed here display demand shifting effects (foreign demand increases as exports grow because of reputation and networking externalities), which also lead to sub-optimal initial investment in a *laissez faire* scenario. In the presence of demand revelation externalities and demand shifting effects a monopolist (as in the case of chocolate confections) undertakes the socially optimal investments.

Demand revelation externalities can generate an overinvestment in diffusion when there is a relatively long time lag between investment and production and the country faces a downward sloping demand, as there may be a delay in the price signal to halt new investments.

Our findings suggest that there is no unique policy recipe for promoting the emergence of new successful export activities. Depending on the types of uncertainties

and coordination failures involved and the previously accumulated capabilities, these policies may range from subsidizing a continuous investment in experimentation following an initial pre-competitive experimentation which proves profitable, to the provision of ISPG by the government or through a public coordination of private investments once the sector has been discovered.

Indeed, the cases analyzed here also reveal that the set of policies required to facilitate the emergence of new export activities will go beyond those required to promote self-discovery (targeted support to catalyst firms, etc.) and must be expanded to include support to R&D, technology adoption and foreign market cultivation. The case of BHH also offers the controversial possibility that laxness in IPRs leading to the emergence of national pharmaceutical laboratories may have facilitated the investment in this new activity. An institutional and regulatory framework that reduces the costs of experimentation is highly recommended.

The cases we analyze show that the new exports trigger the accumulation of new capabilities that may allow jumping to higher branches (more sophisticated chocolate confections and BHH products) or to other more sophisticated products that lie nearby in the product space (these cases are in the periphery of the densest part of the forest). This dynamic accumulation of capabilities reflects both the acquired learning economies and the fact that it is becoming increasingly harder to capture rents in the initial market segments due to rising competition, mostly from other developing countries. Indeed, new exports of goods with horizontal or vertical product differentiation and downward sloping demand are more likely to succeed when they are targeted at an early stage of the product cycle. The emergence of BHH is a nice example of realization of the payoffs of investing in research activities by public agencies, as the availability of qualified biologists in these agencies was a *sine qua non* for being able to target this activity as soon as it emerged in the world (the pioneer started investing relatively soon after rich country firms did so).

We conclude by comparing our findings to the original HR model. In the HR world there is perfect competition and the country is a price-taker, which makes ex-post specialization (large diffusion) a desirable outcome. In the real world, foreign demand may be inelastic, there may be strategic interaction among domestic and foreign firms, and there may be dynamic and scale economies, which limit the scope for diffusion and

for extreme specialization. In some cases diffusion may even be welfare-worsening. What remains true is that when knowledge externalities are relatively large, ex-ante investment in the activities chosen by the pioneers will be relatively low. Additionally, in a world where the government does not implement policies that compensate pioneers for information externalities, there may be a preference for activities that offer bigger possibilities to capture temporary or permanent monopoly rents. This feature may lead to the lack of discovery of many potentially attractive new activities. For instance, a government promotion of exports of fresh raspberries before the emergence of the Chilean sector could have created a comparative advantage for this activity. As it was, private entrepreneurs experimented in this activity only after the Chileans had succeeded, with negative results.

11. Statistical Appendix

11.1. Aggregate and sectoral export growth

Let us first consider the overall export growth. Argentina's exports have not been particularly dynamic during the past 25 years. From 1980 to 2005, Argentine export growth was slightly below the rate of growth of world trade (see Table 1). As a result, Argentina's share in total world exports was 0.43% in 1980 and 0.4% in 2004. In contrast, Chile almost doubled its participation in world trade during this period (from 0.25% in 1980 to 0.4% in 2005), whereas Brazil increased it to 1.17 in 2005 from 0.91 in 1990 and 1.07 in 1980.

Table 1

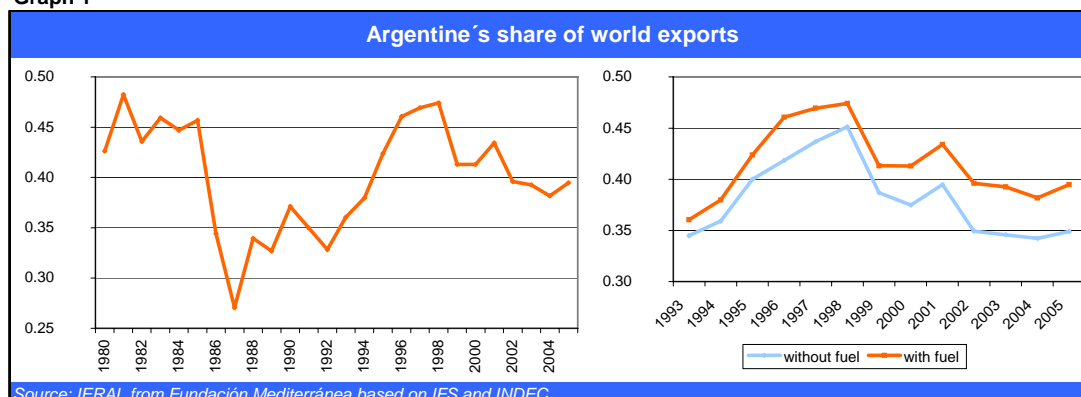
Exports dynamics

<i>Annual growth rate</i>	1980-1989	1990-1999	2000-2005	1980-2005
World	5.04	6.05	9.72	6.97
Argentina	1.99	7.31	8.73	6.64

Source: IERAL from Fundación Mediterránea based on IFS and INDEC.

Aggregate export growth was not uniform throughout the different sub-periods. It was very poor from 1980 to 1989, when it significantly underperformed world exports (this decade was characterized by large macroeconomic volatility, capital flight, very high and recurrent inflation ending in hyperinflation in 1989, negative per capita GDP growth, and high but fluctuating real exchange rate). In this period, its share in world export fell to 0.27% in 1987 (see Graph 1). Conversely, Argentina recovered its world

Graph 1



trade share during the '90, a period that was associated to macroeconomic stabilization, trade liberalization, deregulation, privatization, large inflows, real exchange rate

appreciation, fast GDP and productivity growth. Its share in world trade started to decline again with the devaluations in Brazil and other emerging countries after 1998. It is worth mentioning that, despite the large devaluation of the Argentine peso in 2002, exports have failed to grow faster than world trade and Argentina has not been able to increase its share in world trade. To provide some perspective, between 1998 and 2005 Argentina's exports grew 52%, world trade expanded 60% and Brazilian external sales rose 119% (allowing it to jump from 0.9% of world exports in 1998 to 1.2% in 2005).

Mimicking and surpassing the behavior of aggregate exports Argentine foreign sales of goods with high technological (according to the OECD classification), rose more than four-fold between 1993 and 2000, when they reached their peak (see Graph 2). These exports declined slightly after Argentina's devaluation, but still increased their participation in total Argentine exports (1.3% in 1993 and 1.9% in 2004).

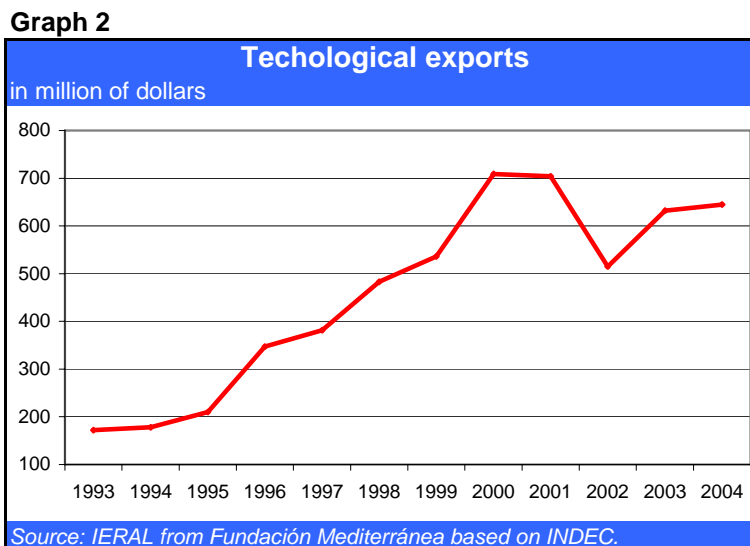


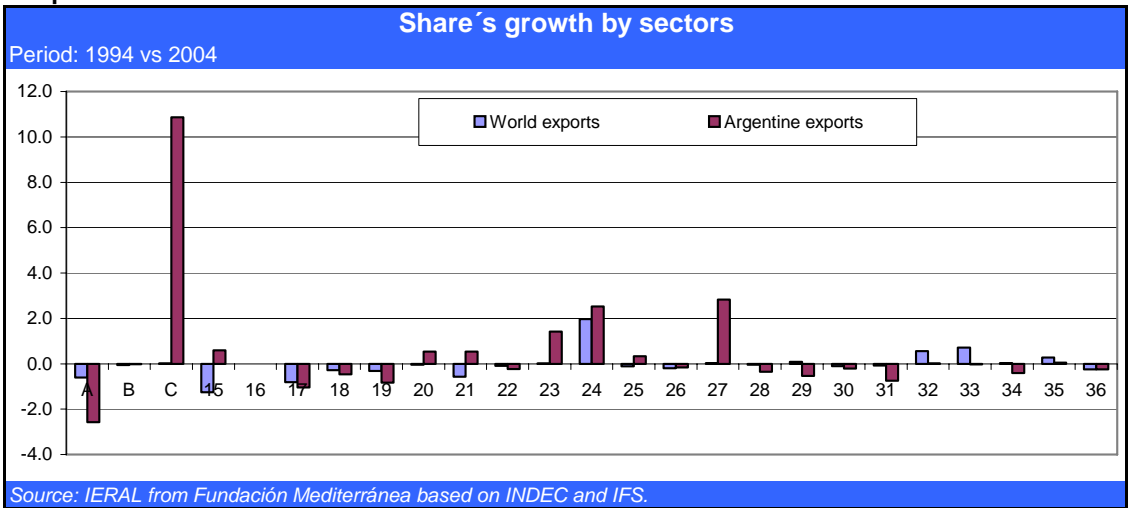
Table 2 shows that the fast export growth between 1993 and 2000 led to a small improvement in Argentines technological exports vis-à-vis world technological exports.

Table 2
Technological export's share in world exports

	1995	2004
Total	0.04	0.05

When focusing on the sectoral structure of Argentine exports, we observe that manufactures of chemicals and chemical products was the internationally most dynamic sector both for the world and for Argentina. The importance of this sector in world trade grew from 8.44% in 1995 to 10.42% in 2004, whereas in Argentina this share grew from 5.8% of total Argentine's exports in 1993-94 to 8.3% in 2003-04 (see sector 27 in Graph 3). However it was the Mining and Quarrying (sector C) which showed the biggest increase in its share of Argentina's exports (this share rose 10.87 percentage points between 1993-94 and 2003-04).

Graph 3



We next consider the evolution of unit prices of exports vis-à-vis the world prices, which for some industries may indicate quality changes. Table 3 shows that relative unit export prices (vis-à-vis) rose for 10 sectors at the 2-digit level.

Table 3

Price's annual growth rate

Period: 2004-2003 vs 1994-1993 for Argentina

Period: 2004 vs 1995 for World

ISIC2d	Sectors description	Argentina (%)	World (%)
35	Other transp. equip.	16.32	9.08
C	Mining and quarrying	11.54	3.70
23	Coke, refined petr. prod. and nuclear fuel	9.01	3.98
15	Food prod. and bev.	5.54	-1.25
21	Paper and paper prod.	4.15	-4.51
A	Agric., hunting and forestry	2.82	-0.26
17	Textiles	1.53	-11.42
B	Fishing	0.81	0.46
20	Wood and prod. of wood and cork	-0.60	-19.82
27	Basic metals	-0.89	-1.21
19	Tann. and dress. of leather; manuf. of lugg. and footw.	-1.50	2.23
34	Motor veh., trailers and semi-trailers	-2.41	1.80
29	Mach. and equip. n.e.c.	-4.05	0.26
24	Chem. and chem. prod.	-4.32	1.09
26	Other non-metallic min. prod.	-4.50	1.66
32	Radio, telev. and comm. equip.	-4.52	-1.51
25	Rubber and plastics prod.	-4.63	-0.15
16	Tob. prod.	-5.59	2.44
28	Fabr. metal prod.	-5.71	-9.29
33	Med., precision and optical instr.	-5.79	3.36
22	Publ., printing and repr. of recorded media	-6.20	-0.90
18	Wearing app.; dressing and dyeing of fur	-6.67	-2.03
30	Office, accounting and comp. mach.	-7.91	-4.16
36	Furn.; manufact. n.e.c.	-10.64	-1.23
31	Electr. mach. and app. n.e.c.	-11.31	1.32

Source: IERAL from Fundación Mediterránea based on INDEC and COMTRADE.

The biggest increase corresponded to Other Transportation Equipment (its prices rose at a 16.32% annual growth rate between 1993-94 and 2003-04, whereas world prices rose 9,08%), which could signal a quality improvement. Other manufacturing sectors where the increase in prices could reflect quality improvements include Food and Beverages, Paper and Paper Products, Textiles Manufactures and all Primary Activities

Between 1993 and 2005 there has been a deepening in the revealed comparative advantage (positive net exports in Leamer's commodity clusters) pattern of Argentina. Mining and Agriculture Products, mainly Cereals, but also Animal Products and Tropical Agriculture, have improved their external position. In 2005 64.5% of overall exports were exports of products with RCA. Revealed comparative disadvantage has also deepened. RCD is observed in Machinery, whose trade deficit in 2005 reaches US\$ 9,611 millions, and in Chemical Goods, with a trade deficit of US\$ 2,220 millions. As a result, 49.8% of imports are Machinery Goods and 19% are Chemical Goods.

Table 4
Revealed comparative advantage
Argentina: net exports in Leamer's 10 Commodity Clusters

	1993	2005
Petroleum	833	5,157
Raw materials	-242	437
Forest products	-488	-130
Tropical agriculture	267	2,162
Animal products	1,003	2,874
Cereals, etc.	5,172	12,904
Labor intensive	-440	-250
Capital intensive	-8	343
Machinery	-7,549	-9,611
Chemical	-1,751	-2,220

in million of dollars

Source: IERAL from Fundación Mediterránea based on COMTRADE.

11.2. New exports

To identify new exports activities we first analyze trade data at the 6 digit level of the Harmonized System (HS), as provided by the National Institute of Statistics and Census (INDEC), for the period between 1993-94 and 2003-04. We found 4.198 products that at least exported some value in 2004. The choice of the period of reference obeys both to data availability and to the need to control for the possible effects that unilateral trade liberalization (occurred mostly between 1987 and 1991) may have had on the structure of exports.

For the selection of the new exports we used two different criteria. First, we impose the condition that exports should have grown at least 300% between 1993-94 and 2003-04. This rate was chosen so as to include sectors that have increase above average export growth (154.7%) and median export growth (263%). The selection thus includes all sectors in the first five deciles classified by export growth. There are 1,797 sectors (42.8% of all products) that accomplish this first condition.

In order to concentrate only on those activities that have sufficient economic significance, we next impose the requirement of a minimum value of exports of US\$ 10 millions in the average of 2003-04 and a maximum value of exports of US\$ 1 millions in the average of 1993-94 so as to choose sectors pertaining only to the first decile. This criterion leaves us with only 90 products (5%) out of 1,797 products already selected.

From these 90 products we further excluded codes 999801, 999802 and 999804.¹⁵⁵ As a result, we have 87 products that meet all our requirements.

Table 5 A)
New export's share (%) in Argentine total exports

	1994-1993	2004-2003	Change
New exports	0,10	20,90	20,80
New exports without fuel	0,09	13,35	13,25
Fuels	0,00	7,55	7,55

Note: There are 90 new products

Table 5 B)

	Number of products	Exported value	
		1993	2004
New exports	90	11.646.297	7.377.016.530
New exports without fuels	85	11.337.058	4.720.637.077
Fuels	5	309.239	2.656.379.453
Fuels / New exports (%)	11,11	2,66	36,01

While representing a relatively small number of products, the new exports rapidly increased their shares in total exports. The emergence of new exports since the early 1990s have generated a dramatic structural change in Argentine external sales, as these new exports represent 20.9% of the total value exported during 2003-04 vis-à-vis 0.1% in 1993-94. Nevertheless, a significant portion of these new exports are fuels, which in 2004 represented 7.5% of total exports. These new exports showed a more dynamic behaviour than overall exports (see Table 6), and contributed with more than one third of overall export growth, which allowed them to reach a share of 36% of the export value of new export products (see Table 5).

Table 6
New exports dynamics
2004 - 1993

	Annual growth rate	Contribution to total export's growth
Total	9,2	
New exports	79,76	34,4
New exports without fuels	73,04	22,0
Fuels	127,84	12,4

Source: IERAL from Fundación Mediterránea based on INDEC and COMTRADE

¹⁵⁵ They are exports reserved for the particular use of the contracting parts and have no significance in our analysis.

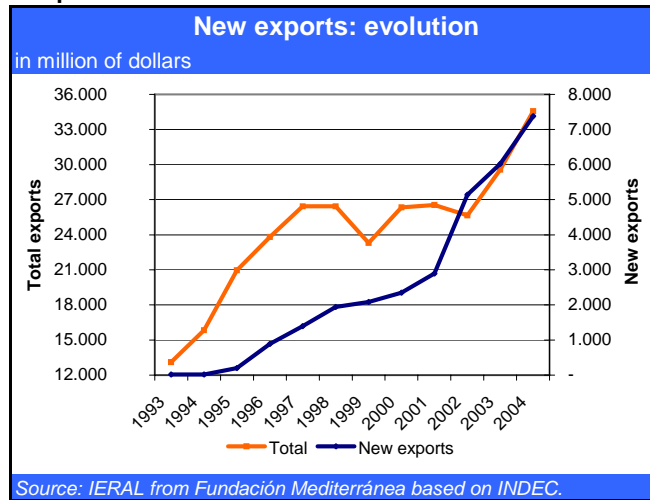
These new Argentine exports grew significantly faster than their world counterparts, allowing them to increase nine times their participation in world trade (see Table 7). Their current share of world exports (1.01%) compares very favorably to the participation of total Argentine exports in world trade (0.39%), which has remained stagnant since 1982.

Table 7

New export's share in world exports		
	1995	2004
Total	0,11	1,01

Graph 4 shows the evolution of total and new exports. Overall exports increased 163% between 1993 and 2004, while new exports showed a startling 63,242% increase.

Graph 4

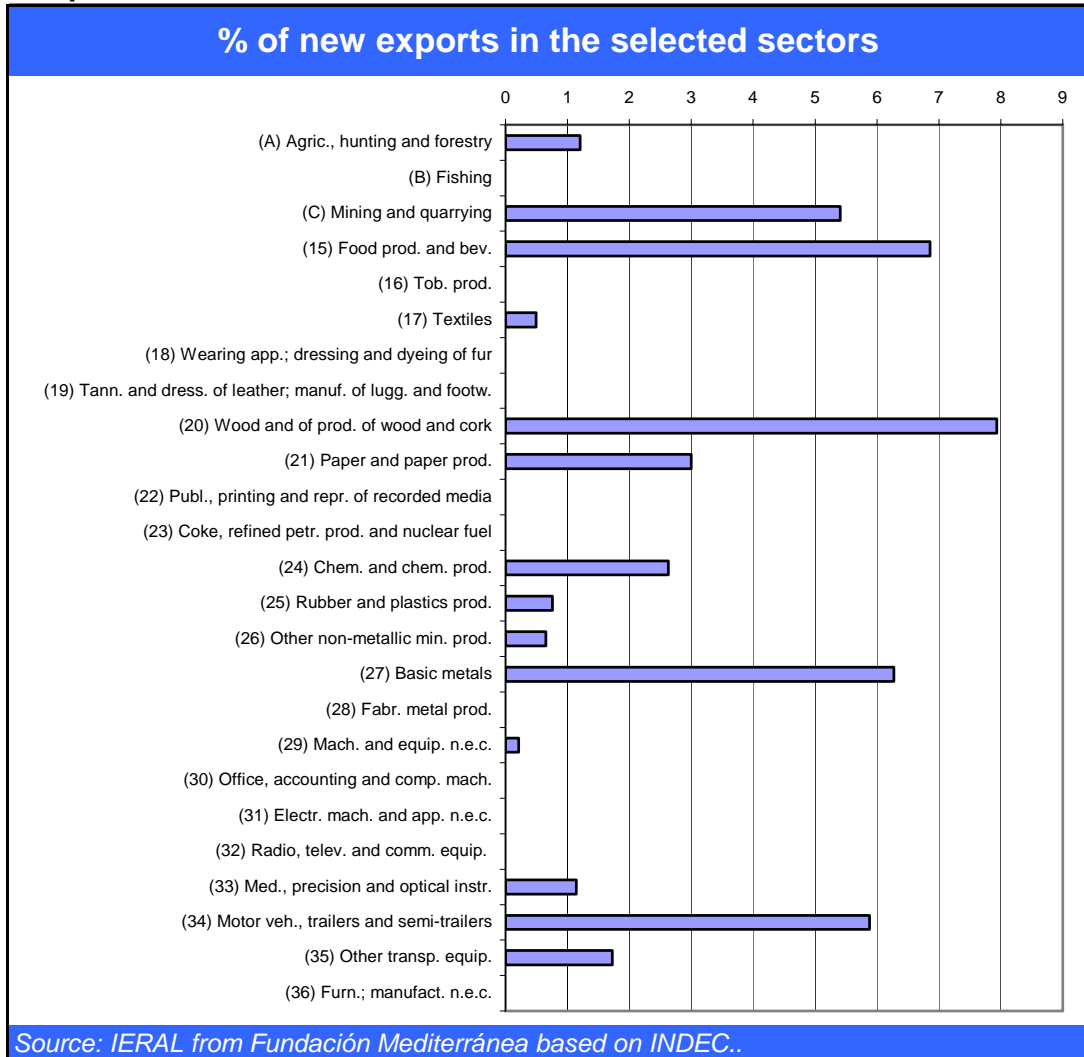


To gain further understanding of the characteristics of the new exports, products are grouped at a two digit industrial classification. We make the correspondences from the HS at 6 digit level to the International Standard Industrial classification (ISIC) at 4 digit level and aggregate it to a 2 digit level. Applying this transformation we can work with 25 sectors. Only 14 of these sectors include products which we consider new exports.

Then, a ‘new exports indicator’ by industry is constructed as the percentage of newly exported products relative to the total number of goods exported in each sector.¹⁵⁶ Graph 5 shows the number of new export products over the total number of exported products in each sector. The sectors with the largest presence of new exports (5% or more) include activities directly linked to the exploitation of mining resources (Mining and quarrying), industries that process agricultural resources (Food and Beverages), industrial manufactures that process natural resources (Wood and Wood Products, Basic Metals), and Motor Vehicles (a relatively labor intensive activity that got an initial boost from Mercosur. Other industries with a relatively large number of new exports (between 2 and 3%) include paper and paper products and chemicals.

¹⁵⁶ For example, in sector number 15 (Food and Beverages) there are 379 exported products included, out of which 26 are new exports. As a result, 6.7% of that sector’s products are considered new exports.

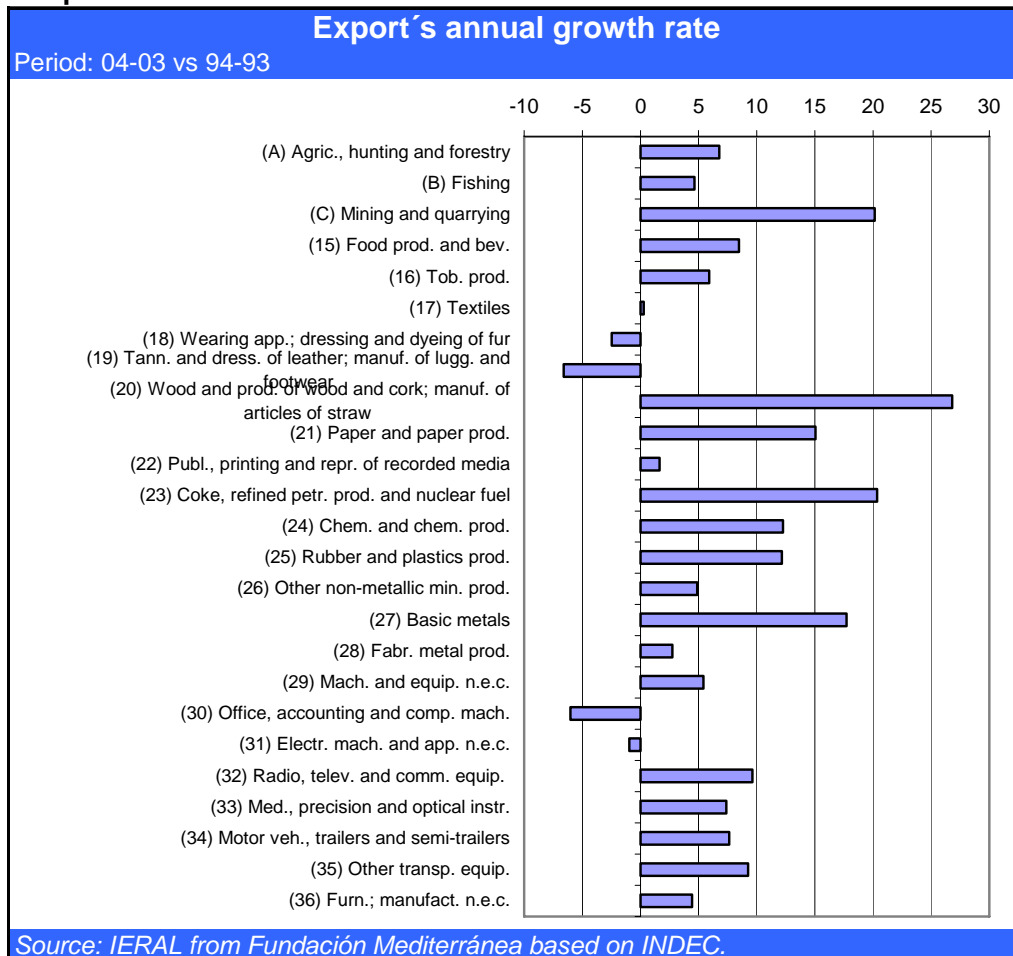
Graph 5



On the other hand, there were very few or none newly exported products in “modern” activities such as Medical, Precision and Optical Instruments, Electronics, Electrical Machinery, and Computing Equipment.

The concentration of new exports in activities linked to natural resources is consistent with the previously described gain in participation of these sectors in total Argentine exports. In the case of mining and metals, privatization and deregulation are the main suspects for the export boom. In the case of Wood and Wood Products, government involvement through subsidies, tax stability regimes, coordination facilitation and research activities was an important factor. In the case of foodstuff, trade liberalization, Mercosur and the exploitation of comparative advantage must have helped. The China effect may also have played a significant role in the expansion of most of these new activities.

Graph 6



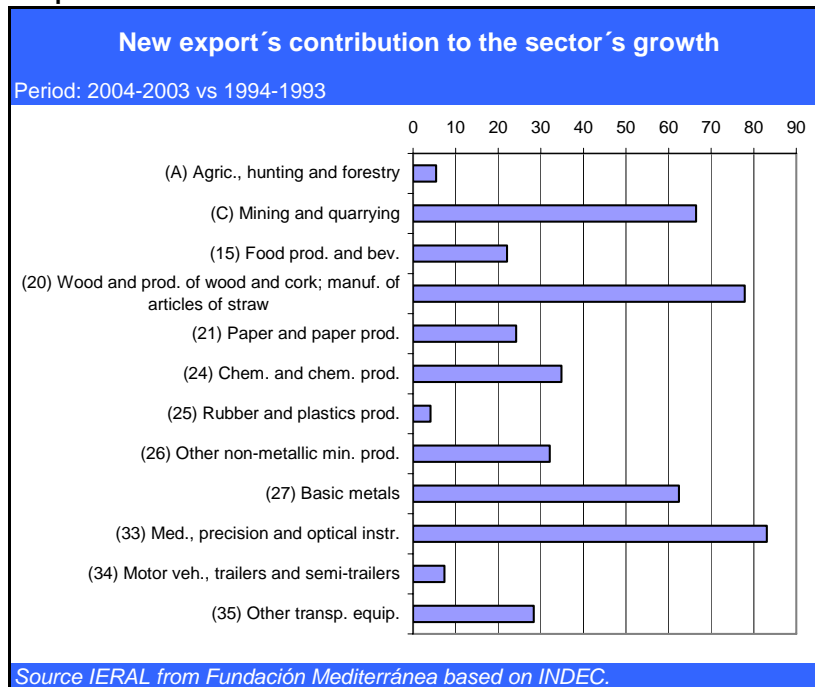
Graph 6 shows that the sectors with fastest growing exports were linked to natural resources (Wood and Wood Products, Coke and Oil Products, Mining and Quarrying, Paper and Paper Products, Manufactures of Basic Metals, Chemicals and Chemical Products and Rubber and Plastic Products). Most of these sectors also display a relatively large number of new export products.

Graph 7 displays the contribution of new exports to each sector's export growth.¹⁵⁷ It is interesting to highlight that new exports contribute to more than 50% of sectoral export growth in 5 out of 13 sectors: textiles (261%), wood and wood products (78%), mining and quarrying (67%), basic metals (62%) and medical and precision instruments (83%). In 10 of the 13 sectors new exports accounted for 20% or more of

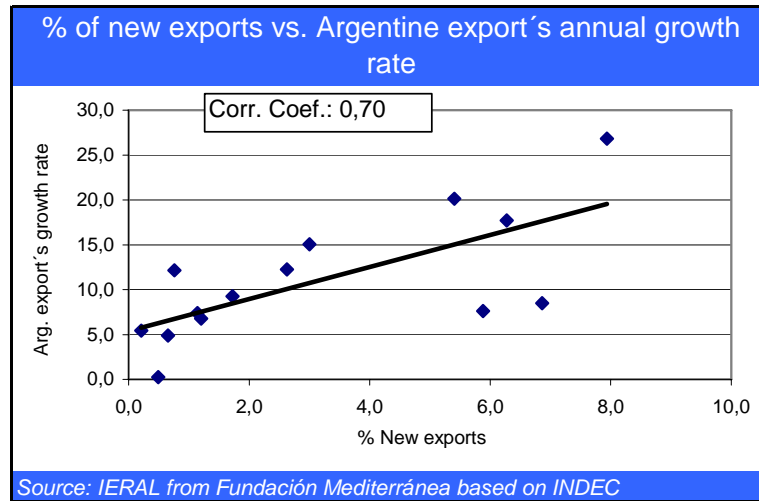
¹⁵⁷ We excluded sector 17 (Manufacture of Textiles) because it registers a contribution of 261% and goes out of scale (while the total sectoral exports grew just 3%, new sectoral exports rose from 0 in 1993-94 to 42 millions in 2003-04).

the sectoral export growth. This means that new exports have been a driving force in most industries, even in those where there were relatively few newly exported products. Put differently, most sectors experienced substantial intrasectoral changes in the composition of their exports. For instance, the relatively small number of new exports (1.1%) within the Medical, Precision and Optical Instruments sector (whose exports grew at an annual 7.5% rate) explained more than 80% of the sectoral export growth, and the very small number of new external sales (0.5%) in textiles contributed to 261% of the sectoral export growth. On the other hand, the motor vehicles industry shows a relatively large number of new exports (almost 6%), that explain a very small part (7%) of sectoral export growth.

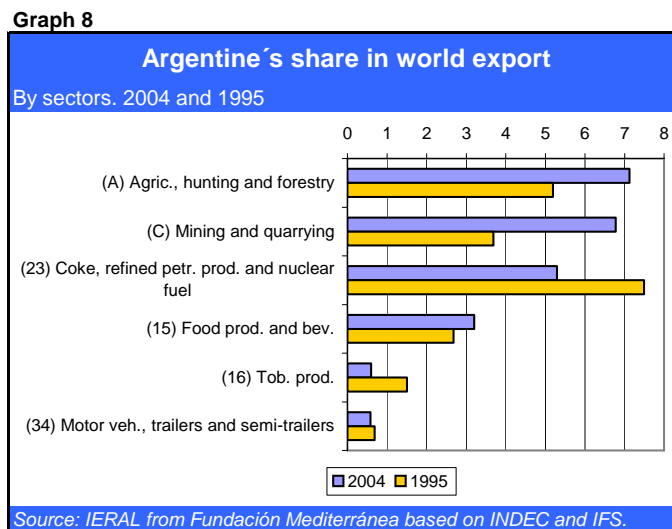
Graph 7



While the contribution of new exports to sectoral export growth was very significant in most industries, this contribution was usually bigger in those sectors with a larger number of new exports. As a result, there was a large and positive correlation between the percentage of new exports in each industry and the sectoral export growth.

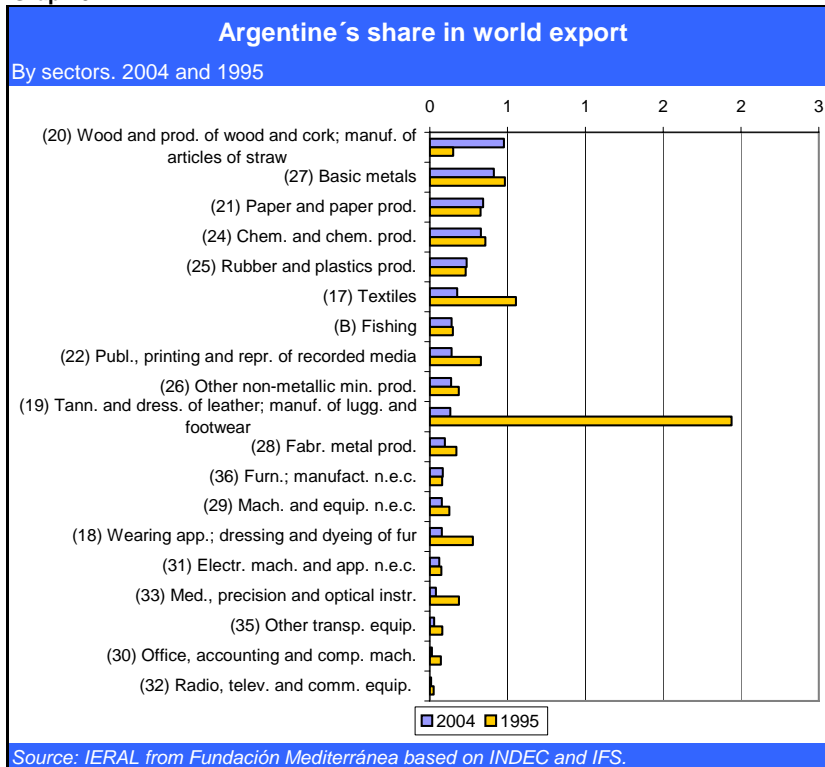


Graphs 8 and 9 show Argentina's shares in sectoral world trade. The sector with the largest world trade share, Agriculture, Hunting and Forestry, had very few newly exported products (1.2%), which contributed very little to the growth of total sectoral exports. Something similar happened to oil products and to tobacco products.

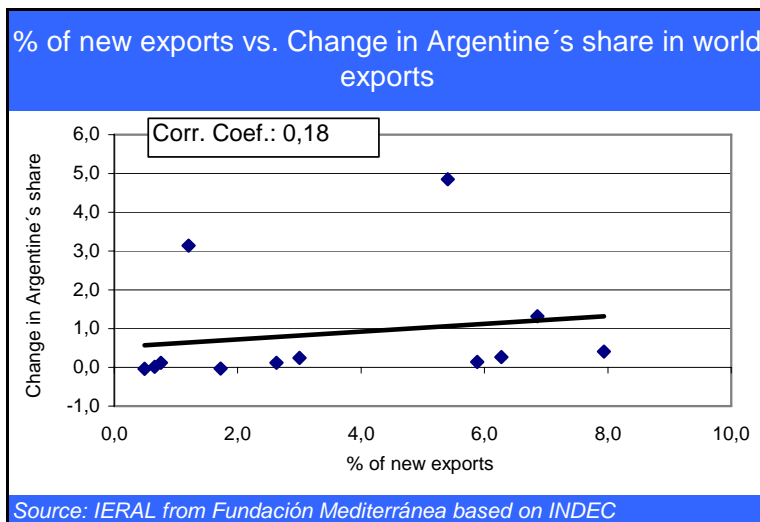


The other seven sectors in the top 10 list of activities with largest share in world trade display a combination of a significant number of newly exported products that contribute strongly to sectoral export growth.

Graph 9



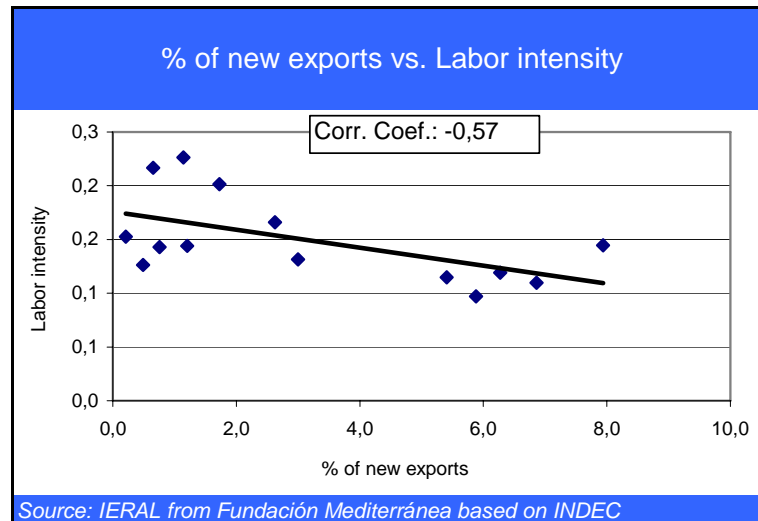
However, the contribution of new exports appears not to have been relatively important in the sectors that gained bigger shares in world trade.



The analysis of sectoral factor intensity reveals that the emergence of newly exported products has been more important in industries that are less labor-intensive.¹⁵⁸

¹⁵⁸ Labor intensity is measured as the labor/sectoral value added ratio, obtained from the 1997 Input-Output Tables.

This finding is consistent with the fact new exports were relatively more important in natural resource processing activities, which tend to be more capital intensive. It could also reflect the fact that capital was relatively cheap vis-à-vis labor during the 1990s, favoring the capital-intensive activities.



Finally, comparative advantage has not been a key driver in the surge of new exports, as only 28.9% of new exports were in sectors with revealed comparative advantage (RCA) in 1993, and the new exports in sectors with RCA tended to be of relatively low value (25.3% of the value of new exports was of products in sectors with RCA versus 28.9% in quantities). However, a closer link between comparative advantage and new exports was observed in 2004, as 60% of new exports were then in sectors with RCA, accounting for 77.3% of the value of all new exports in that year.

Table 8
% of New Exports in sectors with revealed comparative advantage

	1993	2004
Quantity	28,9	60,0
Value	25,3	77,3

This change is due to a modification in the pattern of revealed comparative advantage, where Capital Intensive Goods and Raw material Goods changed from RCD to RCA, with Capital Intensive Goods concentrating 25.9% of New Exports.

Table 9

Revealed comparative advantage

Argentina: net exports in Leamer's 10 Commodity Clusters and new exports

	1993	2005	% of New exports
Petroleum	833	5.157	5,6
Raw materials	-242	437	3,3
Forest products	-488	-130	8,9
Tropical agriculture	267	2.162	12,2
Animal products	1.003	2.874	5,6
Cereals, etc.	5.172	12.904	5,6
Labor intensive	-440	-250	5,6
Capital intensive	-8	343	27,8
Machinery	-7.549	-9.611	7,8
Chemical	-1.751	-2.220	17,8

in million of dollars

Source: IERAL from Fundación Mediterránea based on COMTRADE.

This means that most new exports started in sectors with revealed comparative disadvantage but their sizable growth led their sectors to acquire a comparative advantage at the end of the period. It is also very revealing that they represented a very large share of the value of the new exports at the end of the period, suggesting that newly acquired comparative advantages in new export activities were accompanied with an increasing quality upgrading.

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